

CARROTS, STICKS, AND SPACE PATENTS

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ABSTRACT

Patents are essential for promoting scientific progress and innovation. However, the current framework for patents in outer space unduly disincentivizes U.S. patentees from obtaining patents. Importantly, these disincentives may hinder innovation for vital technologies relating to space. This Note explains why international collaboration is necessary to solve this problem and how the United States can incentivize international support for a space patent regime. Specifically, this Note advocates a patent regime consisting of a single set of substantive and procedural patent laws governing the distinct territory of space. First, Part I provides a background on current patent laws in space. Next, Part II explains how current law disincentivizes patenting and how an international patent regime could ameliorate these problems. Finally, Part III uses rational choice theory to explain how the United States could balance the competing interests of other states to create a functioning patent system for U.S. patentees.

INTRODUCTION

The phrase “carrots and sticks” was initially used to describe how incentives and disincentives could elicit a desired behavior for driving a donkey.¹ In this example, carrots were incentives that motivated the donkey toward a desired result, and sticks were disincentives that discouraged an undesired result.² Although there are no actual donkeys or carrots in space,³ this metaphor is useful for analyzing the present patent system in space. For patents in space, the current system

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1. *Carrot-and-stick*, MERRIAM-WEBSTER, <https://www.merriam-webster.com/dictionary/carrot-and-stick> [<https://perma.cc/F6WV-75F4>].

2. *Id.*

3. *But see* SPACE JAM (Warner Bros. 1996) (depicting Bugs Bunny, a rabbit, in outer space consuming his favorite snack, carrots).

of carrots and sticks is inapt to encourage innovation by U.S. companies. This Note explains why resolving inadequacies for patents in space requires international collaboration and how the United States can use carrots and sticks to achieve international support for a space patent regime.

Two primary objectives of the patent system are to promote scientific progress and enhance the breadth of scientific knowledge in the world.⁴ To achieve this, patentees are granted an exclusive right to an invention in exchange for publicly disclosing information on how their invention works.⁵ Thus, the patent system assumes patentees are rational actors.⁶ Incentivized by the economic prospects of an exclusive right to an invention, a patentee will expend additional effort to innovate.⁷ Further, these economic incentives are great enough that a patentee is willing to disclose the invention rather than keep it secret.⁸ This disclosure can then buttress the innovation of future generations.⁹

In the context of international law, rational choice theory assumes that states are also rational actors.¹⁰ Much like private actors in the

4. See U.S. CONST. art. I, § 8, cl. 8 (“To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries[.]”); see also WORLD INTELL. PROP. ORG., INTELLECTUAL PROPERTY AND SPACE ACTIVITIES 2 (2004) [hereinafter WIPO, INTELLECTUAL PROPERTY], www.wipo.int/patent-law/en/developments/pdf/ip_space.pdf [<https://perma.cc/S9CF-PG9W>] (acknowledging patents “enrich the total body of technical knowledge in the world”).

5. WIPO, INTELLECTUAL PROPERTY, *supra* note 4; see also *Graham v. John Deere Co.* of Kan. City, 383 U.S. 1, 9 (1966) (describing a patent as “a reward, an inducement, to bring forth new knowledge”).

6. See, e.g., WILLIAM LANDES & RICHARD POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 294–333 (2003) (treating patentees as rational actors when evaluating patent incentives).

7. See *id.* at 300 (positing that patentees will increase spending on innovation so long as the economic returns from potentially broader patent protection are greater than the marginal increase in expenditures to innovate).

8. See Sean B. Seymore, *Symposium: The Disclosure Function of the Patent System*, 69 VAND. L. REV. 1455, 1455 (2016) (“[I]n exchange for the right to exclude, the inventor must fully disclose the technical details of the invention.”).

9. WIPO, INTELLECTUAL PROPERTY, *supra* note 4. Although the type of information that must be disclosed varies by country, most countries require some disclosure about how to make and use the invention. See generally WORLD INTELL. PROP. ORG., SUFFICIENCY OF DISCLOSURE (2021), https://www.wipo.int/export/sites/www/scp/en/national_laws/disclosure.pdf [<https://perma.cc/BE3M-RBPN>] (summarizing countries’ disclosure requirements).

10. See JACK L. GOLDSMITH & ERIC A. POSNER, *THE LIMITS OF INTERNATIONAL LAW* 3 (2005) (theorizing that “international law emerges from states acting rationally to maximize their interests”); see generally ANDREW T. GUZMAN, *HOW INTERNATIONAL LAW WORKS: A RATIONAL CHOICE THEORY* (2008) [hereinafter GUZMAN, *HOW INTERNATIONAL LAW WORKS*] (using rational choice theory to demonstrate how international law can influence state behavior).

patent system, states are assumed to have distinct interests and to act rationally to maximize those interests.¹¹ States' differing views on patents are an example of these distinct interests. Whereas developed nations tend to view strong patent protection as essential to the economy, developing nations seeking to gain access to new markets prefer to limit exclusive rights.¹² The strength of a state's space industry may also affect that state's views on the necessity of patent protection.¹³

For the most part, both the U.S. government and private U.S. patentees prefer strong patent protection in space.¹⁴ U.S. patentees value strong patent protection to ensure they can exclude potential infringers from profiting off their inventions.¹⁵ Likewise, policymakers in the United States want to ensure that this robust protection for U.S. patentees will continue to encourage innovation and investment in the country.¹⁶ However, patent law is territorial in nature, with each country having its own distinct set of patent laws.¹⁷ Space, by contrast,

11. GOLDSMITH & POSNER, *supra* note 10, at 7.

12. Robert C. Bird & Subhash C. Jain, *The Continuing Challenge of Global Intellectual Property Rights*, in THE GLOBAL CHALLENGE OF INTELLECTUAL PROPERTY RIGHTS 11 (Robert C. Bird & Subhash C. Jain eds., 2008). Consider, for instance, India, where weak pharmaceutical patent protections have led some commentators to refer to the generic drug market as a “copying industry” that allows companies to make money “copying stuff that is patented in the rest of the world.” Roger Collier, *Drug Patents: Innovation v. Accessibility*, 185 CANADIAN MED. ASS'N J. E379, E379 (2013), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3680575/pdf/185e379.pdf> [<https://perma.cc/5UJ6-7U7N>].

13. *See infra* Part III.

14. Although there is no exact definition of “strong” patent protection, it is generally characterized by a large scope of patentability, numerous enforcement mechanisms for patent owners, and a long duration of patent protection. *See* Suma Athreye, Lucia Piscitello & Kenneth C. Shadlen, *Twenty-Five Years Since TRIPS: Patent Policy and International Business*, 3 J. INT'L BUS. POL'Y 315, 318 (2020) (outlining the above criteria for strong patent protection).

15. *See* LANDES & POSNER, *supra* note 6, at 320 (claiming that broader protection is valuable to the patentee because the patentee can more readily prevent others from obtaining a similar patent).

16. *See supra* notes 4–9 and accompanying text. *See generally* U.S. CHAMBER OF COM., U.S. CHAMBER INTERNATIONAL IP INDEX (2021) [hereinafter U.S. CHAMBER IP INDEX 2021], https://www.valueingenuity.com/wp-content/uploads/2021/03/GIPC_IPIndex2021_FullReport.pdf [<https://perma.cc/T8ZJ-P6DL>] (advocating robust and predictable IP rights and analyzing methods to improve global IP protection).

17. *Frequently Asked Questions: Patents*, WORLD INTELL. PROP. ORG. [hereinafter *Frequently Asked Questions: Patents*], https://www.wipo.int/patents/en/faq_patents.html [<https://perma.cc/HQ7P-NGVB>]. Further, a country's patent laws can usually only be enforced in that country. *See Protecting Intellectual Property Rights (IPR) Overseas*, USPTO (Nov. 1, 2019, 1:40 PM) [hereinafter *Protecting Intellectual Property Rights (IPR) Overseas*], <https://www.uspto.gov/ip-policy/ipr-toolkits> [<https://perma.cc/9T3R-FVC3>] (“U.S. patent[s] extend only throughout the territory of the United States and have no effect in a foreign country . . .”).

is not subject to claims of sovereign ownership.¹⁸ This dichotomy has made it difficult for the United States to unilaterally protect U.S. patentees in outer space.¹⁹

For example, imagine a U.S. pharmaceutical company working to improve a cancer-fighting drug. The company finds that it can greatly increase the purity of the drug by producing it in a low-gravity environment.²⁰ The U.S. company subsequently obtains a patent in multiple countries for an innovative method of producing the drug in microgravity. Because microgravity environments are imperfect and difficult to sustain on Earth,²¹ the U.S. company invests to create a permanent manufacturing plant for the drug in space. However, a savvy competitor decides to use the disclosure from the patent to copy the U.S. company's process. Under current patent law, the competitor could likely evade infringement by registering its manufacturing lab in a country with weak patent protection before launching it into space.²² Even as the competitor exploited the U.S. company's invention, the United States would likely be unable to assert jurisdiction to enforce the patent.²³ Thus, the strength of the U.S. company's patent would diminish, disincentivizing future patentees from expending the effort to create and disclose innovative drugs.²⁴ This dilemma is known as the "flag of convenience" problem, and it is just one of many disincentives to patenting that U.S. space companies may face.²⁵

18. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies art. 2, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

19. See generally Marie Weisfeiler, *Patent Law in Space*, B.C. INTEL. PROP. & TECH. F. (2019) (advocating for an international organization to resolve current gaps in patents in space). But see William C. Pannell, *Pirate Battles in Outer Space: Preventing Patent Infringement on the 8th Sea*, 46 U. MEM. L. REV. 733, 757–59 (2016) (suggesting the United States could pass legislation that might limit some of the current problems in space).

20. See TOSAPORN LEEPUENGTHAM, *THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES* 72 (2017) (acknowledging that low-gravity environments could increase drug purity).

21. See Katarina Zimmer, *Pharma Looks to Outer Space To Boost Drug R&D*, SCIENTIST (Dec. 1, 2020), <https://www.the-scientist.com/bio-business/pharma-looks-to-outer-space-to-boost-drug-rd-68183> [<https://perma.cc/TVJ2-QG4M>] (explaining how pharmaceutical companies are already exploring the potential benefits of space on drug manufacturing).

22. See *infra* Part II.A.

23. See *infra* Part II.A.

24. Cf. LANDES & POSNER, *supra* note 6, at 320 (emphasizing how stronger protection creates greater incentives to patent).

25. See *infra* Part II.

Although patent infringement in space is not currently prevalent, the rapid commercialization of space will likely lead to patent disputes in the near future.²⁶ Because the United States values patent protection and has one of the strongest space industries,²⁷ the United States should pioneer a potential solution to problems plaguing patents in space. This Note explains why an international patent regime for space is necessary to solve these problems and how the United States can work to achieve this. Specifically, this Note advocates a patent regime consisting of a single set of substantive and procedural patent laws governing the distinct territory of space.

First, Part I provides a brief description of relevant laws currently governing patents in space. The relative lack of explicit laws regulating patents in space creates potential problems for U.S. patentees. Part II elaborates on the features of the current system that disincentivize U.S. patentees from obtaining patents and explains how an international patent regime could ameliorate these problems. Specifically, the flag of convenience problem disincentivizes patenting by requiring patentees to expend tremendous costs to obtain adequate patent protection in space. Procedural changes such as creating a single patent filing and examination system for space would resolve this problem. Moreover, current jurisdictional disputes in space make it difficult to determine which substantive rules apply, again disincentivizing patenting. Treating space as a distinct territory with a single set of substantive patent laws would fix this issue. Finally, Part III proffers ways the United States could balance the competing interests of other states to effectuate a functioning space patent system for U.S. patentees. Using rational choice theory, it is possible to group states together based on their likelihood to support an international patent regime for space. Drawing on other examples from international law, this Part attempts to demonstrate how the United States could incentivize support from

26. See Theodore U. Ro, Matthew J. Kleiman & Kurt G. Hammerle, *Patent Infringement in Outer Space in Light of 35 U.S.C. § 105: Following the White Rabbit down the Rabbit Loophole*, 17 B.U. J. SCI. & TECH. L. 202, 205 (2011) (claiming that there is currently a “commercial space race” that will likely require increasing application of intellectual property laws in space); see also Weisfeiler, *supra* note 19, at 1 n.1 (predicting that space travel will allow for more private business ventures).

27. See U.S. CHAMBER IP INDEX 2021, *supra* note 16, at 308–10 (ranking the United States as a leading country for IP protection and outlining ways the United States is continuing to strengthen patent protection); SPACETECH ANALYTICS, SPACETECH GOVERNMENT ACTIVITY 2021 / Q2 LANDSCAPE OVERVIEW 2 (2021), <https://analytics.dkv.global/spacetechnology/SpaceTech-Government-Activity-Overview-2021.pdf> [<https://perma.cc/5M8X-BP9R>] (noting that the United States continues to have the highest level of space activity among countries).

each group of states. After support is achieved, there are many potential enforcement mechanisms for the patent laws.²⁸ However, a detailed discussion of enforcement is beyond the scope of this Note.

I. CURRENT PATENT LAWS

This Part provides a cursory overview of current patent laws. The Agreement on Trade-Related Aspects of Intellectual Property Rights (“TRIPS”) is a multilateral agreement governing intellectual property. For space-specific patent laws, two relevant international agreements are the Convention on Registration of Objects Launched into Outer Space (“Registration Convention”) and the International Space Station Intergovernmental Agreement (“IGA”).²⁹ The United States enacted the Patents in Space Act in 1990,³⁰ but that act simply incorporates the preexisting international framework into domestic law.

A. *The TRIPS Agreement*

The TRIPS Agreement is a 1995 multilateral agreement aimed at creating certain minimum standards of patent protection in signatory countries.³¹ Specifically, TRIPS requires countries to make patents available in all fields of technology.³² Additionally, inventions must satisfy some form of novelty, inventiveness, and industrial utility

28. Compare, e.g., Weisfeiler, *supra* note 19, at 8–9 (advocating for the World Intellectual Property Organization (WIPO), a formal international organization, to enforce patents in space), with Graeme B. Dinwoodie, *The Development and Incorporation of International Norms in the Formation of Copyright Law*, 62 OHIO ST. L.J. 733, 742 (2001) (noting that in the past the United States has chosen to incorporate international intellectual property agreements into domestic law through legislation).

29. Convention on the Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, T.I.A.S. No. 8,480 [hereinafter Registration Convention]; Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station, Jan. 29, 1998, T.I.A.S. No. 12927 [hereinafter IGA].

30. Patents in Space Act, Pub. L. No. 101-580, 104 Stat. 2863 (1990) (codified at 35 U.S.C. § 105).

31. See *Overview: The TRIPS Agreement*, WTO [hereinafter *Overview: The TRIPS Agreement*], https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm [<https://perma.cc/U9EN-KVVE>] (noting that the TRIPS Agreement set out substantive standards, enforcement procedures, and a dispute settlement system for IP rights).

32. *Id.*

standards to qualify for a patent.³³ Thus far, over one hundred countries have accepted TRIPS.³⁴

However, each country retains latitude to craft its own domestic patent laws.³⁵ This presents three issues that must be addressed to truly harmonize substantive patent law. First, each country has different practices for complying with TRIPS conditions.³⁶ For instance, even if TRIPS sets conditions for compulsory licensing, each country determines for itself what behavior by patent owners would satisfy these conditions.³⁷ Second, TRIPS only sets out minimum standards of patent protection.³⁸ Accordingly, the strength of patent protection still varies substantially across countries.³⁹ Finally, each country maintains independent patent prosecution procedures, requiring a patentee to complete a full examination process in each country they seek a patent in.⁴⁰ Thus, the TRIPS Agreement still falls short of harmonizing international patent law.

B. The Registration Convention

The Registration Convention is a 1975 United Nations (“U.N.”) agreement designed to assign objects launched into space to a specific country. The effect of the Registration Convention when read with previous agreements is that the “launching state” retains jurisdiction over an object launched into space.⁴¹ Thus, the launching state can extend its patent laws to registered space objects.⁴²

A launching state is (1) a state that launches a space object, (2) a state that “procures the launching of a space object,” (3) a state that

33. *Id.*

34. See *Frequently Asked Questions About TRIPS [Trade-related Aspects of Intellectual Property Rights] in the WTO*, WTO [hereinafter *Frequently Asked Questions About TRIPS*], https://www.wto.org/english/tratop_e/trips_e/tripfq_e.htm [<https://perma.cc/YXB5-BWU7>] (emphasizing that TRIPS applies to all World Trade Organization members). Note that many developing countries were granted waivers and are thus not yet obligated to implement the full terms of the TRIPS Agreement. *Id.*

35. See Athreye et al., *supra* note 14, at 321 (“Although TRIPS established harmonization, it did not create a world of uniform patent policies and levels of patent protection.”).

36. *Id.*

37. *Id.*

38. *Overview: The TRIPS Agreement*, *supra* note 31.

39. Athreye et al., *supra* note 14, at 317, 321.

40. See Ro et al., *supra* note 26, at 207 (noting that patentees must file a domestic application in each jurisdiction in which they are seeking a patent).

41. *Id.* at 208.

42. *Id.*

has a space object launched from its territory, or (4) a state that has a space object launched from its facility.⁴³ Under this definition, there could be more than one potential launching state for a single space object.⁴⁴ For competing claims of jurisdiction, the Registration Convention instructs potential launching states to “jointly determine” a single launching state.⁴⁵

Although the Registration Convention only refers to the actions of states, rather than private companies, some commentators have suggested that a state can become a launching state through the actions of private companies incorporated in the state.⁴⁶ In other words, even if a private U.S. company procured a space object, the U.S. government would qualify as a launching state.⁴⁷ In practice, the United States has seemed to support this interpretation of the Registration Convention, as it has historically claimed to be a launching state based on the actions of private corporations.⁴⁸

C. *The International Space Station*

The IGA is a multilateral treaty designed to assign jurisdiction on the International Space Station (“ISS”).⁴⁹ The ISS is composed of multiple modules, each registered to a state.⁵⁰ Under the agreement, each country retains jurisdiction over its distinct module of the ISS.⁵¹ Specifically, Article 21 of the IGA states, “[F]or purposes of intellectual property law, an activity occurring in or on a Space Station flight element shall be deemed to have occurred only in the territory of

43. *Id.* at 215.

44. See Babak Shakouri Hassanabadi, *Complications of the Legal Definition of “Launching State,”* SPACE REV. (Sept. 2, 2014), <http://www.thespacereview.com/article/2588/1> [<https://perma.cc/TXP3-YKCS>] (outlining instances where more than one country could be a launching state for an object).

45. Registration Convention, *supra* note 29, at art. II(2).

46. Ro et al., *supra* note 26, at 215–16.

47. *Id.*

48. See *id.* at 217 (noting historical examples where the United States’ claim as a launching state was solely based on a private U.S. corporation procuring the space object).

49. IGA, *supra* note 29, at art. 5. Note that although the IGA was formally signed into U.S. law in 1998, the agreement was a culmination of negotiations that had taken place since at least 1984. See *id.* at 1.

50. Pannell, *supra* note 19, at 747.

51. IGA, *supra* note 29, at art. 5.

the Partner State of that element’s registry.”⁵² In other words, each state’s own domestic patent laws apply in its module.⁵³

D. The U.S. Patents in Space Act

The U.S. Patents in Space Act essentially embodies the Registration Convention, while allowing individual treaties like the IGA. Under the Patents in Space Act, (1) “[a]ny invention made, used or sold in outer space on a space object or component thereof” that is (2) “under the jurisdiction or control of the United States” is considered to be made, used, or sold in the United States.⁵⁴ The Act does not specify what is required for an object to be “under the jurisdiction or control” of the United States.⁵⁵

The Patents in Space Act provides two exceptions to this rule. First, U.S. patent law does not apply to any space object registered to another country in accordance with the Registration Convention.⁵⁶ As long as an object has been launched under the Registration Convention, the launching state retains jurisdiction.⁵⁷ Second, U.S. patent law does not apply to a space object specifically identified by an international agreement to which the United States is a party.⁵⁸ The IGA, where the United States and other countries reached a specific agreement to assign jurisdiction over each module, is an example.⁵⁹ Thus, the Patents in Space Act gives strong deference to the Registration Convention and other international agreements.

II. RESOLVING INADEQUACIES IN CURRENT PATENT LAW

Certain features of the patent law system in space disincentivize U.S. companies from obtaining patents. The following Sections will first briefly describe how the flag of convenience problem and jurisdictional uncertainty disincentivize innovation. Then, the Sections will highlight why unilateral action by the United States would not be effective in resolving these problems. Ultimately, this Part concludes

52. *Id.* at art. 21.

53. Elizabeth I. Winston, *Patent Boundaries*, 87 TEMP. L. REV. 501, 537 (2015).

54. 35 U.S.C. § 105.

55. *See id.*

56. *Id.*

57. *See supra* Part I.B.

58. 35 U.S.C. § 105.

59. *See IGA, supra* note 29, at art. 5.

that the appropriate solution likely requires a single set of international patent regulations to govern the distinct territory of space.

A. *The Flag of Convenience Problem: Why the United States Should Work To Raise Minimum Patent Standards and Create a Single Filing System*

The current application of national patent laws based on a space object's country of registration disincentivizes U.S. patentees from obtaining patents by requiring companies to balance the limited territorial scope of patent protection with the high transaction costs necessary to obtain a patent. Although many of these disincentives are also a part of patent law on Earth, they are heightened in the context of space. Moreover, unilateral extension of the U.S. patent laws cannot resolve this problem.

Applying patent law based on an object's country of registration presents an opportunity for companies to exploit U.S. companies' novel innovations. Recall that under the Registration Convention, the national laws of the "launching state" apply to space objects.⁶⁰ Further, a company only has patent protection in countries where the company holds a patent.⁶¹ Accordingly, it is possible for a competing company to strategically register an infringing invention in a launching state where a U.S. company has not obtained a patent.⁶² The previous hypothetical of a U.S. pharmaceutical company attempting to patent a microgravity process is one striking example of this flag of convenience problem.⁶³

Broadly, the flag of convenience loophole disincentivizes patenting by weakening the scope of patent protection. Without protection, a company might not have adequate economic incentives to obtain a patent, which would decrease innovation and disclosure.⁶⁴ For instance, in the microgravity pharmaceutical example, the infringing competitor would likely gain profits that the original

60. Matthew J. Kleiman, *Patent Rights and Flags of Convenience in Outer Space*, 23 AIR & SPACE LAW. 4, 4 (2011).

61. *Id.*

62. *See id.* at 5 (suggesting companies will be incentivized to register in particular countries to avoid infringement).

63. *See supra* notes 20–25 and accompanying text (introducing hypothetical example).

64. *See* J. Jonas Anderson, *Hiding Behind Nationality: The Temporary Presence Exception and Patent Infringement Avoidance*, 15 MICH. TELECOMM. & TECH. L. REV. 1, 43 (2008) (arguing that infringement resulting from inadequate patent protection reduces economic rewards for a patentee, thereby reducing incentives to innovate).

inventor would have earned with patent protection.⁶⁵ Research in the pharmaceutical and space industries is expensive and requires a large amount of capital.⁶⁶ Thus, without the economic security of a patent, the U.S. company might have been discouraged from creating the innovative drug altogether.⁶⁷ However, even if the company would have created the drug regardless of patent protection, weak patent protection could discourage an inventor from disclosing the technology to competitors in a patent.⁶⁸ As a result, the technology from the patent could not be used to advance further innovations once the patent term expired.⁶⁹

One apparent solution to the flag of convenience problem might be for a company to obtain a patent in every country. However, there are competing disincentives that deter a company from seeking to do this. To start, it is unlikely that every country would allow the company to obtain a patent. As countries have done with maritime law,⁷⁰ certain countries may elect to create low enforcement standards to incentivize infringing companies to register and invest in the country.⁷¹ Additionally, a patentee must also balance the desire for patent protection with the cost and efficiency of obtaining a patent in multiple countries. The numerous domestic patent law systems on Earth create

65. Cf. LANDES & POSNER, *supra* note 6, at 324–25 (noting broad patent protection increases profits because competitors are not able to make similar substitutes).

66. See Nick Skillicorn, *Top 1000 Companies That Spend the Most on Research & Development (Charts and Analysis)*, IDEA TO VALUE (Aug. 28, 2019), <https://www.ideatovalue.com/inno/nickskillicorn/2019/08/top-1000-companies-that-spend-the-most-on-research-development-charts-and-analysis> [<https://perma.cc/8MFM-HM93>] (listing pharmaceutical and aerospace as top ten industries in R&D spending as of 2018).

67. See *supra* note 64.

68. See, e.g., *Where Are SpaceX's Patents? Its Trade Secrets Strategy Is Fraught with Peril*, PAT. FORECAST (May 27, 2021), <https://www.patentforecast.com/2021/05/27/where-are-spacexs-patents-its-trade-secrets-strategy-is-fraught-with-peril> [<https://perma.cc/BEZ6-DAPG>] (emphasizing how Elon Musk, founder of SpaceX, has elected to forgo patenting rocket technology for fear of China using the disclosure as a “recipe book”).

69. Cf. WIPO, INTELLECTUAL PROPERTY, *supra* note 4 (arguing that patents benefit future innovation through the disclosure requirement).

70. See Pannell, *supra* note 19, at 741 (describing how in maritime law, companies often engage in “forum shopping” to seek out countries with the lowest costs, taxes, and liability); see also *supra* Part I.A (noting that TRIPS still leaves large gaps in substantive patent protection and enforcement).

71. See generally Yong Bum Lee, *Public Space, Private Patents: Updating International Space Law To Protect Patents in Outer Space*, 33 HARV. J.L. & TECH. 293 (2019) (discussing in detail the potential for a “race to the bottom” problem where countries are economically incentivized to serve as safe havens for patent infringement).

high transaction costs to obtain a patent.⁷² Consequently, patentees rarely expend the effort and money necessary to gain patent protection in every country⁷³ and instead target the few patent offices in which the need for enforcement is the greatest.⁷⁴ In this way, the flag of convenience problem presents disincentives for patenting that are indicative of patent law on Earth as well.⁷⁵

Still, the disincentives created by the flag of convenience problem are exacerbated in the context of space. Consider the microgravity pharmaceutical example.⁷⁶ The process for producing the drug was uniquely designed and patented to be used in space. As noted before, space was the only practical place to implement the process patent. The inventor undertook the costs of research, development, and ultimately manufacturing the drug in space. Nevertheless, the infringing competitor obtained the same economic benefit from the same exact resources without any of the costs the inventor undertook to create the process.⁷⁷ This would be unlikely to occur on Earth because a patentee could obtain patents wherever a product was most prevalently used.⁷⁸ Further, most patents on Earth are not required to be performed in a specific geographic location.⁷⁹ However, any country could potentially serve as a launching state for an infringing product in space. Therefore, protecting a patent used in space requires obtaining a patent in *every* country.

72. See Anthony de Andrade, *Twelve Ways To Manage Global Patent Costs*, WIPO MAG. (Aug. 2017), https://www.wipo.int/wipo_magazine/en/2017/04/article_0007.html [<https://perma.cc/L5XF-R93V>] (explaining the difficulty in managing a global patent portfolio with multiple filing fees, examination processes, and translation costs).

73. See Michael D. Bednarek, *Global Patent Strategy*, MANAGING INTELL. PROP., Nov. 1994, at 12, 12 (“[F]ew individuals or even large companies can afford to protect every invention in every country.”).

74. Anderson, *supra* note 64, at 35.

75. Note that even if innovation in expensive industries persists despite the flag of convenience problem, U.S. companies may nonetheless face disincentives to innovate. Creating a single filing system would limit these disincentives.

76. See *supra* notes 20–25 and accompanying text (introducing hypothetical example).

77. See Keith Reeves, *12 Steps from Product Concept to Manufacturing*, BUS. 2 CMTY. (Apr. 20, 2016), <https://www.business2community.com/product-management/12-steps-product-concept-manufacturing-01518713> [<https://perma.cc/VXH2-MNPC>] (listing the steps necessary to commercialize a product); see also Nihad A.M. Tamimi & Peter Ellis, *Drug Development: From Concept to Marketing!*, 113 NEPHRON CLIN. PRACT. 125, 125 (2009) (emphasizing the particularly high costs of commercializing a pharmaceutical drug).

78. See Kleiman, *supra* note 62, at 5 (pointing out that even in nonterritorial areas of Earth like the high seas, there is at least a “destination country” that can assert its patent laws).

79. One exception might be deep-sea mining, where patents are primarily used in the deep sea, where there is limited regulation. Pannell, *supra* note 19, at 742.

Unilateral action by the United States would not sufficiently resolve the flag of convenience problem for patents in space. Pointedly, the opportunity for a potential infringer to exploit the flag of convenience loophole exists so long as there is at least one country where a U.S. company is unable to obtain a patent.⁸⁰ Nevertheless, some commentators have suggested the United States could partially solve this dilemma unilaterally by banning any imports from an infringing company.⁸¹ For instance, in the microgravity pharmaceutical example, the United States could try to prevent the infringer from selling any of the drugs to U.S. customers. Because the United States accounts for a large share of global consumers, this would lessen the economic benefit an infringing company could obtain.⁸²

However, this does not adequately resolve the flag of convenience problem. To start, it is unclear if the United States has a legal basis for banning imports related to infringing space products.⁸³ Still, even if there is a legal basis, banning imports only covers the narrow case of an infringer who wants to sell products in the United States. A potential infringer may still obtain enough profit from other markets and thus choose to utilize the flag of convenience loophole.⁸⁴ Moreover, certain space industries, such as commercial tourism, do not require any imports into the United States.⁸⁵ Therefore, a ban on imports would not affect an infringing company's decision to use the

80. *See id.* (“Current patent law requires a company to apply for a patent in every country where its space object may potentially be infringed upon.” (citation omitted)).

81. *See id.* at 757–59 (claiming the United States could lessen the impact of the flag of convenience problem by banning imports from companies that utilize the loophole).

82. *Id.* at 759.

83. *See* Ro et al., *supra* note 26, at 225 (arguing that because 35 U.S.C. § 105 does not explicitly address the acts of “offering to sell” and “importing,” it is unlikely U.S. patent law can be used to prevent imports from companies using an infringing device).

84. *See* Homi Kharas & Wolfgang Fengler, *Which Will Be the Top 30 Consumer Markets of this Decade? 5 Asian Markets Below the Radar*, BROOKINGS (Aug. 31, 2021), <https://www.brookings.edu/blog/future-development/2021/08/31/which-will-be-the-top-30-consumer-markets-of-this-decade-5-asian-markets-below-the-radar> [<https://perma.cc/H4N2-MZBM>] (recognizing that other countries, such as China and India, have large consumer markets).

85. The commercial space tourism industry gives consumers an opportunity to experience space travel. The proprietary aspects of this industry primarily relate to taking a consumer from Earth to space and do not require any “imports.” For a discussion on the emergence of this industry and unanswered legal questions related to commercial space tourism, see generally Steven Freeland, *Up, Up, and . . . Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space*, 6 CHI. J. INT’L L. 1 (2005).

flag of convenience loophole, and U.S. companies would remain disincentivized from obtaining patents.⁸⁶

At the very least, the flag of convenience problem requires the United States to work to raise the minimum standards of patent protection in every country and create a single patent filing system. First, continuing to raise the standards of patent protection in every country would prevent countries from serving as safe havens for infringement. Current agreements, such as TRIPS, provide a framework for this.⁸⁷ Second, creating a single filing and examination system would decrease the transaction costs of obtaining a patent in every country. Although agreements such as the Patent Cooperation Treaty (“PCT”) have attempted to implement variations of this, a true single filing system does not yet exist.⁸⁸

Notably, the flag of convenience problem does not necessitate a single set of substantive patent laws for space. Even if each country applied domestic patent law through the Registration Convention, raising the standards and creating a true single filing system would decrease many disincentives to patenting for U.S. companies.⁸⁹ Nevertheless, the following Section outlines why a single set of patent laws is likely needed.

B. Defining Boundaries: Why the United States Should Treat Space as a Distinct Territory with a Single Set of Substantive Patent Laws

For current space launches, countries engage in both ex ante and ex post negotiations with one another to clarify which country has jurisdiction over a patented space object. When a country engages in ex post negotiations, U.S. companies must wait for a decision on what

86. See Pannell, *supra* note 19, at 759 (advocating a ban on imports but also acknowledging that in numerous space industries, a ban on imports would not affect infringing activities).

87. The TRIPS Agreement requires signatories to afford minimum standards of patent protection to patentees and represents a movement toward the global harmonization of patent law. However, each country still maintains its own distinct territorial patent laws. Athreye et al., *supra* note 14, at 321.

88. See Ro et al., *supra* note 26, at 207 (discussing the shortcomings of the PCT). Under the PCT, an applicant can file an application for a patent that “reserves” a single priority date if the applicant files a patent in other participating PCT countries. *Id.* However, the patent applicant must still complete a full examination process in each individual country. *Id.* Therefore, a patentee must still expend great effort to obtain a patent in each country. Like the TRIPS Agreement, the PCT has achieved widespread support, and now has 156 contracting states. *The PCT Now Has 156 Contracting States*, WORLD INTELL. PROP. ORG., https://www.wipo.int/pct/en/pct_contracting_states.html [<https://perma.cc/Z7UE-UP3A>].

89. See *supra* notes 87–88 and accompanying text.

the applicable patent laws are. This uncertainty regarding the law will disincentivize patenting, as has happened in similar domestic settings.⁹⁰ Nevertheless, the lack of clear territorial boundaries in space makes it difficult for countries to act *ex ante* to resolve potential jurisdictional disputes. Because jurisdictional concerns often require negotiations with other countries, unilateral action by the United States would not be appropriate. Defining space as a distinct territory with a single set of patent laws could alleviate current jurisdictional issues.

When possible, the United States has attempted to negotiate international treaties in advance to clarify the jurisdictional rules for private companies.⁹¹ One example of this is the IGA, which clarified that each country retains jurisdiction over its distinct module on the ISS.⁹² Accordingly, U.S. companies know which set of patent laws applies based on the module in which an activity takes place.⁹³ However, there are still many instances where a company may be uncertain about what legal rules apply and must wait for resolution after electing to launch a space object.

Consider, for instance, a scenario where multiple countries could potentially have jurisdiction over a launch.⁹⁴ Suppose a U.S. company built a satellite for use in the Netherlands. The U.S. company elects to launch the satellite from a Japanese facility located in French territory.⁹⁵ Moreover, assume the U.S. company does not have expertise in actual launch procedures and instead partners with a Chinese company that specializes in satellite launches. Recall that a

90. See *infra* notes 108–115 and accompanying text.

91. See, e.g., IGA, *supra* note 29 (defining the jurisdictional rules for the ISS).

92. See *supra* Part I.C.

93. See Juan Felipe Jimenez, *Patents in Outer Space: An Approach to the Legal Framework of Future Inventions*, 98 J. PAT. & TRADEMARK OFF. SOC'Y 447, 456 (2016) (noting that patent jurisdiction is based on a module's country of registration). *But see* Kurt G. Hammerle & Theodore U. Ro, *The Extra-Territorial Reach of U.S. Patent Law on Space-Related Activities: Does the "International Shoe" Fit as We Reach for the Stars?*, 34 J. SPACE L. 241, 265–73 (2008) (noting there are still some legal rules, such as the temporary presence doctrine, that might create legal uncertainties on the ISS).

94. See Jack Wright Nelson, *Lost in Space? Gaps in the International Space Object Registration Regime*, EJIL:TALK! (Nov. 19, 2018), <https://www.ejiltalk.org/lost-in-space-gaps-in-the-international-space-object-registration-regime> [<https://perma.cc/Q26M-Z64N>] (analyzing the NSS-6 and NSS-7 satellite launches, where the United States, the Netherlands, and France could each claim "launching state" status because a U.S. company built the satellites for use by a Dutch company and the satellites were launched from French territory).

95. See, e.g., *Overseas Offices*, JAXA, <https://global.jaxa.jp/about/centers/resident/index.html> [<https://perma.cc/3G6G-ZD68>] (listing international offices of the Japan Aerospace Exploration Agency (JAXA), including one in France).

launching state is (1) a state that launches a space object, (2) a state that “procures the launching of a space object,” (3) a state that has a space object launched from its territory, or (4) a state that has a space object launched from its facility.⁹⁶ Under current interpretations of the Registration Convention, China might have a claim as a launching state because a Chinese company performed the actual launch procedures.⁹⁷ Additionally, the United States could claim a U.S. company was bringing forth the satellite, while the Netherlands could claim the satellite’s intended use was to benefit the Netherlands. Consequently, both the United States and the Netherlands could likely claim to have “procured” the satellite and therefore qualify as launching states.⁹⁸ Moreover, France would likely be a launching state because the launch occurred in French territory.⁹⁹ Finally, Japan would likely be a launching state because the launch occurred in a Japanese facility.¹⁰⁰ Thus, in this hypothetical there are at least five countries that could qualify as launching states. Nevertheless, as the space economy grows increasingly privatized, it is possible to imagine that even more countries may have a claim as a launching state.¹⁰¹

If there are multiple potential launching states, they must negotiate to determine which state will register the object.¹⁰² Consequently, the hypothetical U.S. satellite company would not know which country’s patent laws would apply until the United States, the Netherlands, China, Japan, and France all agreed on which state would serve as the launching state.¹⁰³ To complicate matters further, launches

96. See Registration Convention, *supra* note 29, at art. I (defining the term “launching state”). Also recall that states can become launching states through the actions of their private corporations. See *supra* Part I.B.

97. See Registration Convention, *supra* note 29, at art. I (defining “launching state” to include a state that launches a space object).

98. See *id.* (defining “launching state” to include a state that procures the launching of a space object).

99. See *id.* (defining “launching state” to include a state from whose territory a space object is launched).

100. See *id.* (defining “launching state” to include a state from whose facility a space object is launched).

101. See Henry R. Hertzfeld, *Globalization, Commercial Space and Spacepower in the USA*, 23 SPACE POL’Y 210, 212 (acknowledging a current trend toward multinational firms and globalization in space).

102. See Registration Convention, *supra* note 29, at art. II(2) (“Where there are two or more launching States in respect of any such space object, they shall jointly determine which one of them shall register the object in accordance with paragraph 1 of this article” (emphasis added)).

103. See *id.*

may involve more than one space object.¹⁰⁴ For instance, imagine that the hypothetical U.S. company launched over one hundred satellites on a single rocket.¹⁰⁵ Each of those satellites could be a distinct patented space object.¹⁰⁶ Moreover, each space object could have numerous potential launching states.¹⁰⁷ Thus, a U.S. company could face an increasing number of jurisdictional disputes as the number of space objects and potential launching states increases. In each instance, the U.S. company would have to wait for the potential launching states to agree on which country will register the space object, creating uncertainty on which legal rules apply.

Lack of clarity regarding what legal rules apply likely disincentivizes patents.¹⁰⁸ For instance, in the U.S. pharmaceutical industry, some commentators attributed a decrease in innovative drug approvals to unpredictable patent rules.¹⁰⁹ Specifically, delayed clarification of recognized ambiguities in U.S. patent law discouraged drug companies from taking on “high-risk investments to create new medicines.”¹¹⁰ Much like the development of new drugs, the development of innovative space technology is a costly endeavor.¹¹¹ A U.S. space company may not be willing to invest in developing this innovative technology if it is not clear what rules will apply to a potential patent. As noted previously, in the space context a U.S.

104. See, e.g., Amy Thompson, *SpaceX Launches a Record 143 Satellites on One Rocket, Aces Landing*, SPACE.COM (Jan. 24, 2021), <https://www.space.com/spacex-launches-143-satellites-transporter-1-rocket-landing> [<https://perma.cc/K5H7-MVLG>] (detailing how one SpaceX launch involved 143 distinct satellites).

105. See *id.*

106. See Registration Convention, *supra* note 29, at art. I(b) (defining “space object” somewhat circularly to only include “component parts of a space object”). A unique satellite is unlikely to be a component part of another satellite.

107. See *supra* notes 94–101 and accompanying text.

108. See Daniel R. Cahoy, *Patently Uncertain*, 17 NW. J. TECH. & INTELL. PROP. 1, 32 (2019) (noting that uncertainty is pervasive in patent law and claiming that this uncertainty is “akin to buying a lottery ticket and not knowing how many numbers, or perhaps even letters, will be used to determine the winner”).

109. See generally Christopher M. Holman, *Unpredictability in Patent Law and Its Effect on Pharmaceutical Innovation*, 76 MO. L. REV. 645 (2011) (partially blaming a decline in drug innovation on distinct ambiguities in disclosure, utility, patent-eligible subject matter, and obviousness that were not addressed expediently by U.S. courts).

110. See *id.* at 648 (describing a video presentation by Robert Armitage, general counsel for pharmaceutical company Eli Lilly, that includes a PowerPoint slide labeled: “Uncertain, unpredictable patent enforceability will destroy the ability to make the high-risk investments to create new medicines.”).

111. See Skillicorn, *supra* note 66 (listing numerous aerospace companies among the highest R&D spenders).

company may have to wait for ex post negotiations by countries to clarify the relevant legal rules. Even with a single patent filing system and minimum standards, each country could still have unique substantive patent laws.¹¹² Consequently, a U.S. company may be subject to a variety of substantive patent laws until the jurisdictional disputes are resolved.¹¹³ This delay in the clarification of rules is akin to what the pharmaceutical industry experienced and would likely disincentivize a company from trying to obtain a patent.¹¹⁴ The United States could resolve this dilemma by taking steps ex ante to eliminate the current ambiguities with patent law in space. Because the disputes primarily involve jurisdictional claims with other countries, the United States would have to negotiate multilateral arrangements.¹¹⁵

Nevertheless, it is difficult for the United States to resolve jurisdictional disputes ex ante. This is primarily because much of space involves nonterritorial rights, while patent law is by nature territorial.¹¹⁶ One advantage of the IGA is that the ISS is a quasi-territory.¹¹⁷ Each country on the ISS has a discrete module that effectively acts as a quasi-territory of the representative country.¹¹⁸ Accordingly, countries could use these clearly delineated boundaries to assign jurisdiction ahead of time.¹¹⁹ Space, however, is not subject to claims of national

112. See, e.g., Weisfeiler, *supra* note 19, at 5 n.45 (highlighting substantive differences between domestic patent law systems, even between developed countries, by noting that Russia has a compulsory sublicensing requirement for patents while the United States does not); see also WIPO, INTELLECTUAL PROPERTY, *supra* note 4, at 22 (pointing out other differences between patent law systems in such areas as the entitlement to rights, the protection of confidential information, and the enforceability of court judgments).

113. See *supra* notes 102–108 and accompanying text.

114. Unlike the problem the U.S. pharmaceutical industry faced regarding what the applicable laws meant, the U.S. space industry primarily faces a jurisdictional question of which country's laws apply to begin with. However, it is not clear that this distinction affects the analysis in any meaningful way. In both instances, there is a clear ambiguity that would affect the predictability of a future patentee's patent rights if left unresolved.

115. See Jay A. Erstling, *A Framework for Patent Exhaustion from Foreign Sales*, 25 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 499, 508 (2015) (delineating the limits of the United States' ability to act unilaterally by noting that "[t]he presumption that United States law governs domestically but does not rule the world applies with particular force in patent law").

116. See Outer Space Treaty, *supra* note 18, at art. II ("Outer space . . . is not subject to national appropriation by claim of sovereignty . . ."); see also *Frequently Asked Questions: Patents*, *supra* note 17 (explaining that patents are only enforceable in the territory in which they are granted).

117. Weisfeiler, *supra* note 19, at 5.

118. See Winston, *Patent Boundaries*, *supra* note 53, at 536.

119. Jimenez, *supra* note 93, at 455.

appropriation.¹²⁰ There are no clearly demarcated territories or quasi-territories. Because of this, agreements such as the Registration Convention naturally result in jurisdictional disputes. However, these disputes are difficult to solve *ex ante* because a country would have to expend excessive transaction costs to account for possible contingencies.¹²¹ Consider the hypothetical where there are multiple potential launching states for a space object.¹²² How could the United States accurately craft a legal rule *ex ante* to handle this scenario without knowing the facts at hand? For example, the United States might be willing to sacrifice jurisdiction for a standard satellite launch but less willing if a competing launching state presented national security concerns.¹²³ Ultimately, the lack of clear boundaries makes it difficult to promulgate a bright-line legal rule. Defining space as its own territory with distinct patent laws would allow the United States to clarify many ambiguities ahead of time.¹²⁴

One alternative rule that might limit ambiguities would be to assign jurisdiction based on the state a company is incorporated in.¹²⁵ However, this solution is ultimately at odds with the normative framework of patent law. As emphasized previously, jurisdiction for patent law is determined based on the territory in which patented

120. Outer Space Treaty, *supra* note 18, at art. II.

121. Andrew T. Guzman, *A Compliance-Based Theory of International Law*, 90 CALIF. L. REV. 1823, 1855 (2002) [hereinafter Guzman, *A Compliance-Based Theory*] (“In practice, however, substantial transaction costs prevent international agreements from specifying every possible future contingency . . . [and] it is often impossible to predict all potential future states of the world, let alone to list them all in an agreement.”).

122. See *supra* notes 94–101 and accompanying text (providing example).

123. See, e.g., *The Department of Justice’s National Security Division Chief Addresses China’s Campaign To Steal U.S. Intellectual Property*, NAT’L L. REV. (Oct. 17, 2021), <https://www.natlawreview.com/article/departement-justice-s-national-security-division-chief-addresses-china-s-campaign-to> [https://perma.cc/FT8J-ZFHN] (U.S. Department of Justice official discussing the Chinese government’s “economic espionage” and theft of U.S. companies’ IP information). The United States could first try to prevent the initial grant and disclosure of a patent that presents extreme national security concerns by issuing a “secrecy order.” Kate S. Gaudry & James Golladay, *What Happens When the Feds Decide an Invention Is ‘Secret?’*, NAT’L DEF. (Jan. 1, 2016), <https://www.nationaldefensemagazine.org/articles/2015/12/31/2016january-what-happens-when-the-feds-decide-an-invention-is-secret> [https://perma.cc/5TV7-XSFX]. However, secrecy orders are rarely issued—less than 1 percent of all applications in the U.S. are subjected to a secrecy order. *Id.*

124. See, e.g., WIPO, INTELLECTUAL PROPERTY, *supra* note 4, at 22 (advocating the treatment of space as a distinct territory for patents).

125. See 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, 407–08 (2018) (suggesting an alternative to the current Registration Convention would be to assign jurisdiction based on place of incorporation).

activities take place,¹²⁶ not the nationality of an inventor.¹²⁷ Applying jurisdiction based on a company's place of incorporation would essentially create a nationality rule for patent jurisdiction in space. Consequently, patents in space would be unnecessarily incongruous with patent law on Earth.¹²⁸ Instead, space should act as a distinct territory with clear boundaries, much like the borders of countries.¹²⁹ Regardless of if a company has launched a satellite,¹³⁰ created an extraterrestrial pharmaceutical factory,¹³¹ or brought tourists to the moon,¹³² patent laws should apply based on where these activities occur—the territory of space. Treating space as a distinct territory is a straightforward application of the current patent law framework on Earth.

The United States should collaborate with other countries to treat space as a separate territory with distinct patent laws. This would allow the United States to reduce ambiguities *ex ante*, thereby incentivizing U.S. companies to obtain patents on innovative space technology.

III. ACHIEVING SUPPORT FOR AN INTERNATIONAL SPACE PATENT REGIME

For an international space patent regime to be effective, its backers must convince other countries to agree to follow the regulations. This task is difficult for two primary reasons. First, recognizing an international set of regulations for patents in space would require states to give up some of their sovereignty.¹³³

126. See Hammerle & Ro, *supra* note 93, at 251 (emphasizing that “[t]he core of the U.S. Patent Act’s provisions on infringement has historically been explicitly territorial in its jurisdictional scope of infringing subject matter”); see also Erstling, *supra* note 115, at 509 (underscoring the “strict territorial limitation of U.S. patent law”).

127. *Foreign Applicants for U.S. Patents*, BUS. PATS., <http://www.the-business-of-patents.com/foreign-applicants.html> [<https://perma.cc/662G-PBA7>]. But see WIPO, INTELLECTUAL PROPERTY, *supra* note 4, at 21 (“[M]any national laws require that an inventor should first apply for patent protection in the State of which the inventor is a resident or in the State in which the invention was made.”).

128. See *supra* note 126 and accompanying text.

129. See Eric Betz, *The Kármán Line: Where Does Space Begin?*, ASTRONOMY (Mar. 5, 2021), <https://astronomy.com/news/2021/03/the-krmn-line-where-does-space-begin> [<https://perma.cc/H4NH-T46Y>] (emphasizing that it is feasible to demarcate a boundary for where space begins).

130. See, e.g., *supra* notes 94–101 and accompanying text.

131. See, e.g., *supra* notes 20–25 and accompanying text.

132. See Freeland, *supra* note 85, at 13 (describing the potential emergence of space tourism).

133. Kleiman, *supra* note 60, at 6. Depending on the enforcement mechanism chosen for the regulations, states may also have to surrender sovereignty by recognizing a supranational body to

Sovereignty stands for the broad principle that each state has the independent authority to set legal rules within its territory,¹³⁴ and is traditionally considered one of the most fundamental principles in international law.¹³⁵ Accordingly, states are often reluctant to give up sovereignty. Recognizing a supranational patent law regime for space would require states to discontinue applying domestic patent law to their “territories” through the Registration Convention, thereby sacrificing sovereignty.¹³⁶ Second, different states hold conflicting views on patent protection.¹³⁷ Although many industrialized nations view strong patent protection as an essential component of the modern economy, developing nations often prefer weaker protection to allow for more widespread access to technology.¹³⁸ These two problems will complicate any effort to obtain global support for a space patent regime.¹³⁹

Previous works have failed to adequately justify how achieving global support is feasible in an international space patent regime. Some proposals have suggested that simply housing the international regime in an already existing international organization could resolve this issue.¹⁴⁰ According to these proposals, because an esteemed international organization has already obtained a level of international legitimacy, states would choose to respect space patent laws out of

enforce the regulations. *See* Weisfeiler, *supra* note 19, at 8–9 (advocating for WIPO to enforce patents in space).

134. *See generally* Brad R. Roth, *The Enduring Significance of State Sovereignty*, 56 FLA. L. REV. 1050 (2004) (discussing in detail the different interpretations of sovereignty in practice).

135. *See* Claudio Grossman & Daniel D. Bradlow, *Are We Being Propelled Towards a People-Centered Transnational Legal Order?*, 9 AM. U. J. INT’L L. & POL’Y 1, 1 (1993) (“Sovereignty is the fundamental concept around which international law presently is organized.”); *see also* EMER DE Vattel, *THE LAW OF NATIONS* 290 (Béla Kapossy & Richard Whatmore eds., Liberty Fund, Inc. 2008) (1797) (“Of all the rights that can belong to a nation, sovereignty is, doubtless, the most precious.”); Kofi Darko Asante, *Election Monitoring’s Impact on the Law: Can It Be Reconciled with Sovereignty and Nonintervention?*, 26 N.Y.U. J. INT’L L. & POL. 235, 235 (1994) (stating that sovereignty is the source “from which all specific political powers are derived” (quoting *Sovereignty*, BLACK’S LAW DICTIONARY (6th ed. 1990))).

136. *See supra* Part II.A.

137. Kleiman, *supra* note 60, at 6.

138. Bird & Jain, *supra* note 12.

139. *See* Kleiman, *supra* note 60, at 6 (admitting that garnering support for an international regime would be a “politically difficult task”).

140. *See* Jimenez, *supra* note 93, at 468 (advocating to house the international regime in the U.N.); Weisfeiler, *supra* note 19, at 9 (advocating to house the international regime in both the U.N. and WIPO).

deference to the organization.¹⁴¹ However, this represents a somewhat superficial analysis of what is necessary to achieve international recognition. Currently, there is not a standard international set of patent laws for the territory of space.¹⁴² Therefore, any proposed reforms would act as a new set of international standards and require positive support from states, regardless of which organization promulgated the standards.

This Part demonstrates how support for an international space patent regime is attainable under a rational choice theory of international law. Broadly, rational choice theory attempts to explain state behavior by assuming that states have distinct interests and that states will act rationally to maximize these interests.¹⁴³ For patents in space, there are many interests a state may attempt to balance. Nevertheless, this Part will assume a state has two dominant interests: the state's general preference for patent protection and the state's involvement in the space industry.

Using these assumptions, it is helpful to visualize a graph that organizes states based on their likelihood of support for an international set of patent regulations in space. The graph measures space ambitions on the horizontal axis and patent protection preference on the vertical axis, with states sorted into quadrants based on their interests. In the first quadrant are the states most interested in an international space patent regime. This includes states, such as the United States, that prefer patent protection and plan to participate heavily in the space industry.¹⁴⁴ In the second and third quadrants are states that are somewhat ambivalent to participating in an international space patent regime. This includes states that value patent protection but currently have no aspirations to participate in the space industry (quadrant II). Additionally, this includes states that are generally against patent protection but likewise are not involved in the space industry (quadrant III). Finally, the fourth quadrant contains the states that are most opposed to a potential international space patent regime. This consists of states that are generally against patent protection but

141. See Jimenez, *supra* note 93, at 465–66 (acknowledging that while it would be “very difficult” to get countries to support an international framework, this could be overcome simply by “designat[ing] the power to design space patent law to the most iconic entity in terms of international neutrality: The United Nations”).

142. See *supra* Parts I–II.

143. See *supra* note 10 (providing explanation).

144. See *infra* fig.1. The specific states in Figure 1 were chosen to represent the diverse spread of patent protection and space ambitions.

plan to participate in the space industry. The graph below approximates where real-world states would fall on these metrics.

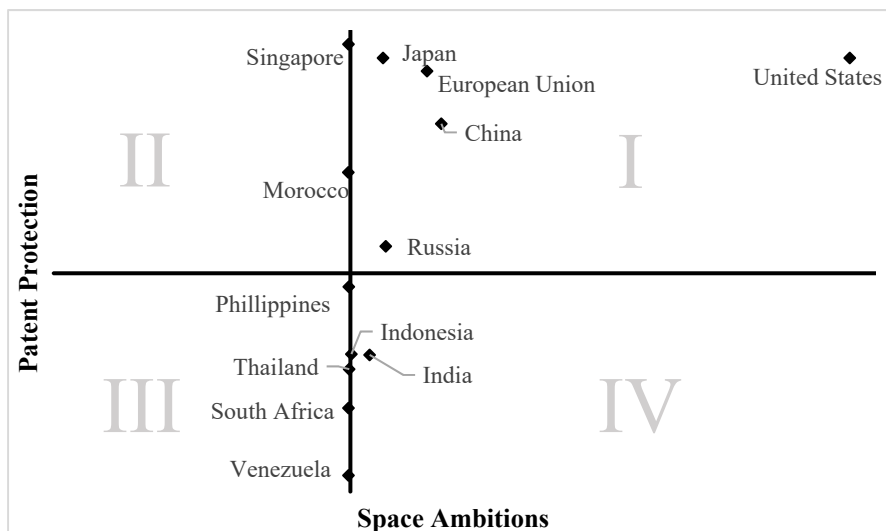


Figure 1: State Space Ambitions vs. State Patent Protection¹⁴⁵

The following Sections will individually analyze each group of similarly situated states. This first requires identifying the distinct incentives and disincentives each group of states may face when deciding whether to participate in an international patent regime for space. Then, the Section will identify what factors, if any, may ultimately motivate a state to support the regime.

145. Figure 1 was made by plotting a state's current government space budget with the state's IP Index Score. See *SpaceTech Government Activity 2021 / Q2 Landscape Overview*, *supra* note 27 (analyzing space activity in various countries); see generally U.S. CHAMBER IP INDEX 2021, *supra* note 16 (analyzing the strength of IP protection in various countries). Of course, there are numerous other factors besides government spending that measure a state's involvement in the space industry. Additionally, a state's current involvement in the space industry does not necessarily indicate the state's future ambitions to participate in the space industry. However, this graph is not an exact formula and is only meant to present a rough approximation to help visualize what a country's interests might be.

A. *States in Favor of an International Space Patent Regime: Why the United States Should Act First*

The states most likely to support an international set of patent regulations for space are states that prefer patent protection and plan to participate heavily in the space industry. Notable examples include the United States, European Union member states, Japan, China, and Russia.¹⁴⁶

Broadly, these states face a coordination problem often referred to in international law as the “battle-of-the-sexes.”¹⁴⁷ In this dilemma, states first face a particular problem. Although the states all have incentives to resolve the problem, the states may prefer different solutions.¹⁴⁸ Accordingly, states may struggle to reach a consensus on the appropriate solution.¹⁴⁹ After all, if a state’s own solution is not chosen as the consensus, it will be at a disadvantage relative to the state whose solution is chosen. Nevertheless, the negative impact of not reaching a consensus at all is greater than the negative consequences of not having a state’s own solution used.¹⁵⁰ For this reason, establishing a single set of regulations is in the best interest of each state.¹⁵¹

In the context of space, the aforementioned states all have an interest in having a standard set of patent laws. An international space patent regime would clarify jurisdictional rules and help eliminate the flag of convenience problem, encouraging private space companies to obtain patents.¹⁵² Although each state would prefer to have its own domestic patent law used as the substantive guidelines for the international regime, implementing a consensus solution produces a net benefit over not reaching a solution at all. Thus, these states would likely agree to an international set of patent laws once a focal point is established.¹⁵³

The United States should act first to create the focal point of an international set of patent laws. One apparent disincentive for the

146. *See supra* fig.1.

147. Andrew T. Guzman, *The Consent Problem in International Law* 50 (Berkeley Program in L. & Econ., Working Paper Series, 2011) [hereinafter Guzman, *The Consent Problem*].

148. *Id.*

149. *Id.*

150. *Id.*

151. *Id.*

152. *See supra* Part II.

153. *See* Guzman, *The Consent Problem*, *supra* note 147 (“It is well established that creation of a focal point is enough to solve the [battle-of-the-sexes] game.”). Here, “focal point” refers to the initial set of laws used as the set of regulations for all states.

United States to do so is that the private space industry, while growing, still has high barriers to entry.¹⁵⁴ Further, formalizing the focal point into a multilateral agreement involves substantial transaction costs, such as identifying the relevant states, understanding each state's preferences, and coordinating these preferences by negotiating over the substance and form of the agreement.¹⁵⁵ Consequently, the United States would initially have to expend a large amount of effort to establish a focal point for the regulations, even though patent infringement in space is not currently prevalent.¹⁵⁶ But even assuming the rapid commercialization of space will not pose an immediate problem for patentees,¹⁵⁷ the United States still has incentives to take the lead on setting the international space patent standards. Specifically, acting first would allow the United States to have a greater impact on what the substantive patent laws for space will be.

The benefit of acting first in battle-of-the-sexes games was demonstrated by the United States' proactive involvement in the internet. In the early stages of the internet, there was no formalized method for registering domain names for websites.¹⁵⁸ Coordination was necessary among states to ensure a standardized system where each domain name would correspond to a distinct IP address.¹⁵⁹ The United States was the first country to create a focal point for this coordination, by founding the Internet Corporation for Assigned Names and Numbers ("ICANN") to manage internet domain names globally.¹⁶⁰ As part of the founding, the United States stipulated that ICANN be

154. See Kleiman, *supra* note 60, at 5 (noting that the flag of convenience problem is not yet prevalent because the private space industry is still growing).

155. See R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 15 (1960) ("In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain . . ."); Guzman, *A Compliance-Based Theory*, *supra* note 121, at 1846 (proposing that international law operates in two stages, and "[i]n the first stage, states negotiate over the content of the law and the level of commitment").

156. Coase, *supra* note 155; Guzman, *A Compliance-Based Theory*, *supra* note 121.

157. See Kleiman, *supra* note 60, at 5.

158. Jon Bing, *Building Cyberspace: A Brief History of Internet*, in INTERNET GOVERNANCE: INFRASTRUCTURE AND INSTITUTIONS 8, 35 (Lee A. Bygrave & Jon Bing eds., 2009).

159. Lee A. Bygrave, Susan Schiavetta, Hilde Thunem, Annebeth B. Lange & Edward Phillips, *The Naming Game: Governance of the Domain Name System*, in INTERNET GOVERNANCE: INFRASTRUCTURE AND INSTITUTIONS, *supra* note 158, at 147, 149–50.

160. Lee A. Bygrave & Terje Michaelsen, *Governors of Internet*, in INTERNET GOVERNANCE: INFRASTRUCTURE AND INSTITUTIONS, *supra* note 158, at 92, 103.

based in U.S. territory and thereby subject to U.S. law.¹⁶¹ Moreover, the United States guided ICANN policy and retained oversight of many substantive tasks ICANN performed.¹⁶² Ultimately, ICANN received global recognition and standardized the domain name system of the internet.¹⁶³ Simply by being the first state to create a focal point for coordination, the United States was able to exert significant influence over the substantive laws of the internet.

Granted, it will be more difficult for the United States to exert influence in the context of patents for space than with domain names for the internet. During the creation of ICANN, there were no other domain name systems.¹⁶⁴ Other countries besides the United States likely did not have robust solutions of their own to serve as a focal point.¹⁶⁵ This would decrease incentives for a country to oppose the United States' solution of ICANN.¹⁶⁶ Conversely, other countries already have their own domestic patent systems.¹⁶⁷ Consequently, the United States may receive greater resistance from countries because each country would prefer its own domestic patent law serve as the focal point.¹⁶⁸ Still, there is currently no focal point for a standardized patent system in space. Therefore, although it might be more difficult for the United States to exert *total* control over the consensus solution, acting first would nonetheless give the United States much greater influence over the substantive patent laws for space.

Thus, while support for an international space patent regime is probable among highly incentivized states, the United States would benefit further by being the first state to create a focal point for

161. Emily M. Weitzenboeck, *Hybrid Net: The Regulatory Framework of ICANN and the DNS*, 22 INT'L J.L. & INFO. TECH. 49, 53 (2014).

162. *Id.*; see also Bygrave et al., *supra* note 159, at 152 (describing initial domain name management as a "collaborative project" between ICANN and the U.S. government).

163. See Lawrence B. Solum, *Models of Internet Governance*, in INTERNET GOVERNANCE: INFRASTRUCTURE AND INSTITUTIONS, *supra* note 158, at 48, 60 (detailing the broad acceptance of ICANN's domain name system).

164. See Bygrave & Michaelsen, *supra* note 160, at 104 (acknowledging that before the creation of ICANN, management of domain names was "ad hoc" and "relatively informal").

165. See *supra* notes 140–143 and accompanying text.

166. See *supra* notes 140–143 and accompanying text.

167. See *Protecting Intellectual Property Rights (IPR) Overseas*, *supra* note 17 ("Almost every country has its own patent law . . .").

168. Moreover, the disparities between these countries' patent laws are not always minor. See *supra* note 112. For instance, Russia's requirement of mandatory patent sublicensing differs appreciably from U.S. patent law. Weisfeiler, *supra* note 19, at 5 n.45. As the magnitude of the disparity grows, a country will be more likely to compete with the United States in establishing a focal point.

coordination. This would allow the United States to ensure that much of U.S. patent law is incorporated into the substantive patent laws of space.

B. States Currently Without Space Ambitions: Why Support of an International Space Patent Regime Is Still Relevant

The states that may be indifferent to supporting an international set of patent regulations for space are those that have no immediate plans to participate in the space industry. This includes states with varying levels of support for patent protection. Examples of states with no involvement in the space industry who prefer patent protection might include Morocco and Singapore.¹⁶⁹ On the other hand, non-spacefaring states that are generally against patent protection could include Venezuela and South Africa.¹⁷⁰

As a practical matter, analyzing a state's incentives for a standard set of space patent rules is only necessary to the extent that the state is actually able to violate the international regulations.¹⁷¹ For instance, if a state were never involved in space in any way, then there would be no opportunity for the state to violate patent laws for space. Accordingly, the state's preference for patent laws in space would be of little importance because it would not be able to exploit the flag of convenience loophole.¹⁷² However, as the space industry grows, states' preferences and attitudes toward space may change.¹⁷³ Thus, it is still relevant to examine non-spacefaring states' incentives, since these states might engage in the space industry in the future.

Even without space ambitions, non-spacefaring states may have some incentives to support an international space patent regime. Specifically, innovations in space may nonetheless provide benefits to countries on Earth.¹⁷⁴ For instance, nearly all countries benefit from the use of satellite technology, regardless of whether the country has

169. *See supra* fig.1.

170. *See supra* fig.1.

171. GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 22 ("It is necessary to determine if and when international law *changes* the behavior of states." (emphasis added)).

172. *See supra* Part II.A.

173. *See* GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 27 (noting the payoffs for states may change over time).

174. *See generally* WORLD ECON. F., SIX WAYS SPACE TECHNOLOGIES BENEFIT LIFE ON EARTH (2020), https://www3.weforum.org/docs/WEF_GFC_Six_ways_space_technologies_2020.pdf [<https://perma.cc/8RB6-XHCU>] (describing various benefits from space technology, such as improved disaster response, communication technology, and environmental regulation).

further space ambitions.¹⁷⁵ Satellites can increase connectivity, improve sustainability, and assist healthcare systems.¹⁷⁶ Supporting an international space patent regime may give non-spacefaring states a greater say in how the substantive patent regulations impact these resources.¹⁷⁷

Still, non-spacefaring states have competing disincentives to commit to an international set of regulations for patents in space. The high transaction costs and effort necessary to create these regulations may disincentivize states that prefer patent protection but are not involved in the space industry.¹⁷⁸ Because these states do not have any current plans to participate in the space industry actively, they might decide the transaction costs outweigh the benefits of providing input for substantive patent law.¹⁷⁹ Further, non-spacefaring states that are generally against patent protection would be especially unlikely to commit to a set of regulations that purports to strengthen patent protection.

Non-spacefaring states in favor of patent protection will likely join an international space patent regime if the space industry grows. As noted previously, the high initial transaction costs of creating regulations may disincentivize these states from helping create international standards.¹⁸⁰ However, there may be fewer transaction costs in adopting the patent regulations after the standards have

175. See Keith Gottschalk, *Here's How Satellites Have Changed the Modern World*, WORLD ECON. F. (Oct. 10, 2017), <https://www.weforum.org/agenda/2017/10/heres-how-satellites-have-changed-the-modern-world> [<https://perma.cc/VDS7-QUDV>] (noting that even non-spacefaring countries have benefited from satellite use and, in some cases, have paid spacefaring countries to launch satellites for them).

176. Deanna Wetmore, *How Satellite Technology Is Helping Developing Countries*, BORGEN PROJECT (Nov. 2, 2017), <https://borgenproject.org/satellite-technology-is-helping-developing-countries> [<https://perma.cc/9NZU-UDWP>].

177. See generally Martha Finnemore & Michelle Jurkovich, *Getting a Seat at the Table: The Origins of Universal Participation and Modern Multilateral Conferences*, 20 GLOB. GOVERNANCE 361 (2014) (attributing broad participation in multilateral agreements to increased voting rights and influence for smaller states).

178. See GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 121 (“Rationality implies that states will seek to maximize the joint surplus of any agreement, taking into account transaction costs.”). Admittedly, the transaction costs of joining the agreement would be lower after negotiations have taken place. Thus, it is possible some states may strategically forgo participating in negotiations and later join the agreement after transaction costs have decreased. However, a state runs the risk of the final agreement being in tension with its domestic patent laws. See *supra* note 112 (highlighting differences in domestic patent laws).

179. GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 121.

180. See *supra* note 178 and accompanying text.

already been created and negotiated.¹⁸¹ In addition to a reduction in disincentives, these states would also experience an increase in incentives to adhere to a set of patent regulations if they develop space ambitions as the industry grows. Consequently, their incentives to support an international set of regulations would be similar to the incentives of current spacefaring states in favor of patent protection.¹⁸²

Surprisingly, non-spacefaring states against patent protection may still adhere to an international set of patent regulations for space, even if the space industry grows. A state will comply with international law if the incentives to comply outweigh the disincentives.¹⁸³ If a state against patent protection suddenly gained space ambitions, there may be a disincentive to comply with an international set of patent laws for space.¹⁸⁴ Certainly, it is unlikely a state against patent protection would have immediate incentives to affirmatively support a regime that increases patent protection. However, a state may still have incentives to comply with an agreement even if it does not explicitly endorse the agreement.¹⁸⁵ For instance, a state may gain reputational benefits, such as the approval of the United States, by not violating the international space patent standards.¹⁸⁶ If these reputational benefits exceed the economic benefits of limiting patent protection in space, a state will choose to comply with the standards, regardless of whether there is an explicit agreement. As emphasized before, even if a state does not affirmatively support an international regime, mere compliance with the regime's standards could eliminate issues such as the flag of convenience problem.¹⁸⁷ Ultimately, this all depends on how much a state can benefit by violating patent protections in space. If a state can obtain a comparatively large benefit from violating patent protections,

181. See *supra* note 178.

182. See *supra* Part III.A.

183. See Guzman, *A Compliance-Based Theory*, *supra* note 121, at 1853 (“A country’s decision to follow international law reflects a judgment that the costs of a violation outweigh the benefits.”).

184. See *supra* notes 178–179 and accompanying text (noting that the ultimate standards may conflict with a state’s domestic patent laws and preferences).

185. GUZMAN, *HOW INTERNATIONAL LAW WORKS*, *supra* note 10, at 133 (emphasizing that even without legal obligations, “forces of reputation, retaliation, and reciprocity give states an incentive to comply”).

186. See *id.* at 73 (pointing out that honoring commitments is one way a state can gain reputational benefits).

187. See *supra* Part II.A.

then it will likely affirmatively oppose an international regime for space.¹⁸⁸

C. *States Opposed to an International Space Patent Regime: How the United States Can Still Achieve Support*

The states most likely to oppose an international set of patent regulations for space are those that generally oppose patent protection and have current plans to participate in the space industry. Notable examples include India and Indonesia.¹⁸⁹ For these states, the potential benefit of violating patent protections in space outweighs any incentives to abide by a set of regulations.¹⁹⁰ Consequently, the United States would have to create additional incentives to elicit compliance and support for an international space patent regime from these states. The United States could utilize both substantive and formal concessions to create these additional incentives while still ensuring a strong international space patent framework.¹⁹¹

One strategy the United States could pursue is to broaden the scope of the negotiations and make substantive concessions unrelated to patent laws in space.¹⁹² This technique was used previously in the context of intellectual property rights during the negotiation of the TRIPS Agreement.¹⁹³ TRIPS is the most comprehensive multilateral agreement on intellectual property to date¹⁹⁴ and required signatories to establish a minimum standard of intellectual property protection.¹⁹⁵ During negotiations, developed states remained steadfast in requiring robust intellectual property protections.¹⁹⁶ Accordingly, there was very little room for bargaining over the substantive intellectual property rights provisions of the agreement.¹⁹⁷ To overcome this, developed countries widened the scope of negotiations and made concessions on

188. See *infra* Part III.C.

189. See *supra* fig.1.

190. See *supra* notes 168–173 and accompanying text.

191. This Section assumes that the United States would attempt to avoid making substantive concessions related to patent law. See, e.g., *supra* note 112. However, as noted before, at least some substantive concessions related to patent law might be necessary even among incentivized states. See *supra* notes 147–153 and accompanying text.

192. See GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 165 (noting that broadening the scope of a negotiation can help garner support for an agreement).

193. *Id.* at 167.

194. Overview: *The TRIPS Agreement*, *supra* note 31.

195. *Id.*

196. GUZMAN, HOW INTERNATIONAL LAW WORKS, *supra* note 10, at 166.

197. *Id.*

market access, agricultural subsidies, and protection from unilateral sanctions by the United States.¹⁹⁸ These concessions increased developing countries' incentives to support the TRIPS Agreement. Similarly, the United States could attempt to make concessions unrelated to patent laws in space to obtain support for an international space patent regime. This would ensure that the United States would not have to lower substantive patent protections in space for U.S. patentees.

Additionally, the United States could attempt to change the form of the agreement itself. The form includes the parts of the agreement that determine the degree to which a state pledges to be bound by an obligation.¹⁹⁹ As with substantive provisions, states weigh the costs imposed by formal provisions of an agreement when deciding whether to join.²⁰⁰ Moreover, if a particular form requires a lower level of commitment, joining the agreement imposes fewer costs on a state.²⁰¹ Decreasing the costs to join the agreement means more states are likely to join.²⁰² Because global support is necessary for an international space patent regime to be effective,²⁰³ it might be beneficial for the United States to accept a less binding agreement to increase overall support for the agreement.

Transition periods are a specific formal design element the United States could use to lower the level of commitment. By providing a state with additional time before the substantive provisions of an agreement begin to bind it, transition periods allow a state to avoid the immediate costs of compliance.²⁰⁴ For instance, the agreement for patents in space could be structured to give developing countries more time to adopt the standard substantive patent laws. This would address economic and administrative constraints that many developing countries currently

198. *Id.* at 166–67.

199. *Id.* at 131.

200. *See id.* at 134, 137 (noting that “formal design elements can affect the seriousness of commitment” and that states will change these elements to “maximize the value of the agreement”).

201. *Id.* at 136.

202. *See id.* at 173 (emphasizing that membership can be increased by weakening the commitments required to join an agreement).

203. *See supra* Part II.

204. *See Frequently Asked Questions About TRIPS*, *supra* note 34 (explaining that transition periods allow countries to delay applying provisions of an agreement); *see also* GUZMAN, *HOW INTERNATIONAL LAW WORKS*, *supra* note 10, at 156 (arguing that the form of an agreement affects future behavior and impacts the cost of joining an agreement).

face in implementing patent protection²⁰⁵ and thereby lessen the disincentives a state may have to support an international space patent regime. A similar strategy was used to elicit support for the TRIPS Agreement, where developing countries were given a transition period of four years.²⁰⁶ A transition period would likely be even more effective in the context of patent protection in space. Because patent infringement in space is currently less common than infringement on Earth,²⁰⁷ a longer transition period could be granted until the private space industry has fully developed.²⁰⁸ The longer transition period would provide even greater incentives for states to support patent regulations in space than with the TRIPS Agreement.

However, the United States must be cautious not to allow formal concessions that render the substantive portions of the agreement ineffective. The ability of formal concessions to diminish an agreement's effectiveness is demonstrated by the failure of the Kyoto Protocol on climate change.²⁰⁹ Climate change represented a similar collective action problem to patents in space and required global support.²¹⁰ To achieve widespread support, developing nations were initially subjected to less rigid emissions requirements than developed nations.²¹¹ Yet, developing nations represented some of the largest polluters.²¹² Consequently, the weaker obligations allowed developing nations to continue to pollute at high levels, reducing the effectiveness of restrictions developed countries faced.²¹³ For patents in space, it is

205. Bird & Jain, *supra* note 12.

206. See *Frequently Asked Questions About TRIPS*, *supra* note 34 (listing countries that were granted a transition period for TRIPS). Note that many of the countries that would be most opposed to an international space patent regime, such as India and Indonesia, were also developing countries given transition periods under the TRIPS Agreement.

207. See Ro et al., *supra* note 26, at 205–06 (noting that as commercial space industries grow, patent litigation in space will become more prevalent).

208. This transition period could work on a country-specific basis, giving countries with smaller space activities more time to accept the agreement.

209. See Mary J. Bortscheller, *Equitable but Ineffective: How the Principle of Common but Differentiated Responsibilities Hobbles the Global Fight Against Climate Change*, 2 CLIMATE L. REP. 49, 51 (2010) (claiming exceptions in the Kyoto Protocol rendered the agreement ineffective).

210. See *id.* at 49 (emphasizing that climate change requires an international response).

211. Kayla Clark, *The Paris Agreement: Its Role in International Law and American Jurisprudence*, 8 NOTRE DAME J. INT'L & COMP. L. 107, 110 (2018) (noting that developing nations were considered less capable of immediately implementing emissions standards because of economic factors, similar to arguments made in the intellectual property context).

212. *Id.* at 110–11.

213. See *id.* at 111 (arguing that ineffective use of transition periods rendered the Kyoto Protocol “unambitious in both spirit and execution”).

imperative the United States avoid formal concessions that would render an international agreement ineffective. If patent protections in space are too weak,²¹⁴ then the agreement will be ineffective in incentivizing patentees, regardless of how many states support the agreement. In this way, the potential effectiveness of the agreement serves as a limiting factor on the formal concessions the United States should make.

Overall, support for an international space patent regime is readily achievable even from spacefaring states that generally oppose patent protection. Although gaining their support would require additional incentives, other examples in international law demonstrate concessions are effective so long as they do not undermine the substantive thrust of an agreement.

CONCLUSION

The current framework for patents in outer space unduly disincentivizes U.S. patentees from obtaining patents. The United States should realign the current system of carrots and sticks in order to increase global innovation and technical knowledge. Specifically, the United States should collaborate with other countries to create a single set of substantive and procedural patent laws to govern the distinct territory of space. Although countries may have varying interests, the United States can achieve support for this regime using insights from the intersection of rational choice theory and international law.

214. *See supra* Part II.