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Christopher Michael Hearsey

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THE EVOLUTION OF OUTER SPACE LAW: AN ECONOMIC ANALYSIS OF
RULE FORMATION

by

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A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

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2015

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This thesis, submitted by Christopher M. Hearsey in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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Christopher M. Hearsey

December 10, 2015

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“But still try, for who knows what is possible?”¹

- Michael Faraday

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¹ THE LIFE AND LETTERS OF FARADAY VOL. II 483 (Henry Bence Jones ed., Longmans, Green & Co. 1870).

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The Author dedicates this work to the women in his life that have helped him become the person he is today: Gail, Tiffany, Monica, and Suzanne.

ABSTRACT

This thesis comprises a study of those socio-economic dynamics that establish and influence the existence, distribution, and evolution of rules for the outer space environment. In particular, this thesis analyzes how the initial State practice of launching objects into outer space led to the genesis of rules for the outer space environment. The presentation of this thesis includes an introduction, a methodology section, three studies, and a conclusion. The first study considers the formation of initial rules for the outer space environment as a consequence of State practice using historical analysis and game theory. The second study considers how States utilized their ability to practice foreign relations to produce and conclude the Outer Space Treaty and how the adoption of the Outer Space Treaty led to the subsequent adoption of specialized treaties regarding objects launched into outer space using economic analysis of public international law. The third study comprises a case study of the term “space object” and its adoption and subsequent evolution into State national laws that originated from the initial State practice of launching objects into outer space using comparative and economic analyses of public international law. Collectively, each study seeks to demonstrate how the rules for the outer space environment have evolved and converged in content (i.e., definition, meaning, and scope of a rule) as a result of the consumption (i.e., acceptance of the obligation of a supplied rule) of legal rules on which States depend to ultimately manage the risks and costs associated with activities to and in the outer space environment.

CHAPTER I

INTRODUCTION

“Facts are not autonomous. They gain meaning from the frameworks within which human beings interpret them.”²

a. Thesis Statement

The thesis presented here comprises a study of those socio-economic dynamics that establish and influence the existence, distribution, and evolution of rules for the outer space environment. In particular, this thesis analyzes how the initial State practice of launching objects into outer space led to the genesis of rules for the outer space environment. In studying this issue, an economic analysis of international law is applied to three sources of rules of public international law: international custom, international agreements, and general principles of law. Rules of international custom, international agreements, and general principles of law arise from the supranational market of international relations. States develop rules for the outer space environment as a function of the exchanges (occurrences and transactions) of self-regarding units, i.e., States, in the

² Thomas Levenson, *Science Doesn't Work the Way You Might Think*, THE ATLANTIC, Nov. 10, 2015, available at <http://www.theatlantic.com/science/archive/2015/11/science-doesnt-work-the-way-you-think-it-does/414744/>.

supranational market of international relations. In order to purchase rules on the supranational market of international relations, States must give something of value to other States in the form of some element of their State sovereignty.³ Because States value their sovereignty so highly, exchanges result in the formation, proliferation, and consumption of rules of jurisdiction, which are considered a component of State power because it is the basis for which a State may legitimately assert its authority outside its territory.⁴

When States enter the supranational market of international relations, they attempt to maximize their valued preferences (economic and national security, foreign policy preferences) by exchanging in the buying (i.e., accepting the obligation of a rule) and selling (i.e., supplying (or offering) rules that States may consume) of rules of jurisdiction supplied to the supranational market through a variety of respective State practices in relation to some source of rules.⁵ The supply of rules of jurisdiction is based on the demand of States as a product of their valued preferences in relation to the environments beyond a State's sovereign territory.⁶ The sale of rules of jurisdiction in relation to some valued preference may occur when States supply rules to the supranational market of international relations through negotiation and/or conclusion of an international

³ See discussion *infra* and Figure 1.

⁴ See JOEL P. TRACHTMAN, *THE ECONOMIC STRUCTURE OF INTERNATIONAL LAW* (Harvard Univ. Press 2008) [hereinafter *ECONOMIC STRUCTURE*]; Jeffrey L. Dunoff & Joel P. Trachtman, *Economic Analysis of International Law*, 24 *YALE J. INT'L L.* 1 (1999) [hereinafter *Dunoff & Trachtman*]; and Joel P. Trachtman, *Economic Analysis of Prescriptive Jurisdiction*, 42 *VA. J. INT'L L.* 1 (2001) [hereinafter *Prescriptive Jurisdiction*]. *C.f.* ERIC A. POSNER & ALAN O. SYKES, *ECONOMIC FOUNDATIONS OF INTERNATIONAL LAW* (Belknap Press 2013) [hereinafter *POSNER & SYKES*]. See also JAMES CRAWFORD, *BROWNIE'S PRINCIPLES OF PUBLIC INTERNATIONAL LAW* (8th ed., Oxford Univ. Press 2012) [hereinafter *BROWNIE*].

⁵ See Appendix for Glossary of Terms and Figure 2.

⁶ Every environment outside a State's territory has its own unique benefits, costs, and risks and therefore rules States supply and consume are taken in relation to those economic factors and priced into an obligation.

agreement, promulgation of national laws, regulations, and policies, or State practice itself. The buying of rules of jurisdiction in relation to some valued preference may occur when States consume (i.e., the act of giving notice to the acceptance of the obligation of a rule(s) of jurisdiction) a rule(s) supplied on the supranational market of international relations.⁷ Consequently, States may choose from a variety of possible rules of jurisdiction in relation to some valued preference depending on the type of market from which rules may arise because the type of market where an exchange could take place can also affect the types of rules that are supplied as the result of barriers to market entry.⁸

The concept of rules is developed as a sufficient component of State practice because not all rules tend to become the product of public international law. Since rules comprise some social value to its subjects, i.e., States, the highest expression of social value for rules is the establishment of rules of law because such rules confer on the international community of States ordered authority outside of a State's territorial boundaries.⁹ In order to measure how rules come into existence and evolve, game theory, economic analysis of international law, and comparative analysis are utilized. Since States make decisions under imperfect information, convergence on at least one common basis for the definition, meaning, and scope of a legal rule for space activities should lead to an efficient outcome within a particular interval of time. However, when valued

⁷ This may take the form of accepting obligations that arise from the signature or ratification of international agreements, expressed directly or indirectly from State practice, or through the publication within the State in the form of national laws, regulations, and policies. See discussion *infra*.

⁸ See discussion *infra*.

⁹ See DAVID A. LAKE, HIERARCHY IN INTERNATIONAL RELATIONS (Cornell Univ. Press 2009) [hereinafter LAKE], and BROWNLIE *supra* note 4. See also ROBERT C. ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES (Harvard Univ. Press 1991) [hereinafter ELLICKSON], and ECONOMIC STRUCTURE *supra* note 4.

preferences change, rules and supranational markets related to those valued preferences will tend to evolve as well. Changes over time to the definition, meaning, and scope of a legal rule for the outer space environment demonstrates evolution, which may or may not tend to efficient rule supply. Consequently, evolution may engender potential and quantifiable ripple effects to social actors who rely on such rules in terms of social expectations, the legality of acts or omissions, the valuation of the types of permissible activities conducted in the outer space environment, and the management of risks and costs in the conduct of outer space activities.

b. Outline of Thesis

The general question this thesis seeks to answer is: how did the (unilateral) occurrences and (bilateral/multilateral) transactions of self-regarding units, i.e., States, create supranational markets of international relations that give rise to the development of rules of jurisdiction over activities regarding the outer space environment from the initial State practice of launching objects into the outer space environment? In other words, what economic processes describe how the State practice of launching objects over the territories of sovereign States toward and into the outer space environment gave rise to the entire corpus of space law?

Supranational markets of international relations arise whenever States seek to act beyond their sovereign territories. States act beyond their territories to maximize the utility of their valued preferences, which tend to manifest through their foreign policy, national and economic security needs. When States seek to maximize the utility of their

valued preferences, States necessarily engage in State practice, the act of which supplies rules of jurisdiction to the supranational market of international relations.

States supply rules to the supranational market of international relations through their State practice. Rules manifest through State practice in the form of rules of jurisdiction.¹⁰ Rules of jurisdiction are a function of a State's sovereignty because it is the basis for the allocation of a State's authority over objects and subjects to its jurisdiction.¹¹ Because the international system of States operates on the basis of sovereign legal equality and consent, a State's authority is at its zenith within the borders of the State, while a State's authority is at its nadir when it is acting beyond its territory.¹² Thus, in order to minimize costs and maximize benefits in the pursuit of maximizing their valued preferences, States supply and consume rules of jurisdiction on the supranational market of international relations.

This thesis explores how rules of jurisdiction in regard to the outer space environment have been valued by States over time. The value of rules is defined by four criteria: the nature of the activity, the environment in which the activity may take place, the minimization of uncertainty of State practice in the environment, and the rule source, i.e., international custom (State practice and *opinio iuris*), international agreements (treaties), and general principles of law (common rules of national law). Moreover, the sources of rules of public international law for which States may seek to supply, negotiate, and/or consume, vary in value.¹³ This happens because when States seek to

¹⁰ See ECONOMIC STRUCTURE *supra* note 4, and *Prescriptive Jurisdiction* *supra* note 4.

¹¹ See ECONOMIC STRUCTURE *supra* note 4, and *Prescriptive Jurisdiction* *supra* note 4. See also BROWNLIE *supra* note 4, and George Manner, *The Object Theory of the Individual in International Law*, 46 AM. J. INT'L L. 428 (1952) [hereinafter Manner].

¹² See BROWNLIE *supra* note 4.

¹³ This is because the obligation purchased varies depending on the source of the rule as a product of the prohibition on nonconsensual rule-making in the international system.

supply or consume rules for the outer space environment, it is implicit that those States value the ability to launch objects, the outer space environment, and the need to maximize their valued preferences through State practice in different ways. Some States will seek to supply and consume rules from all possible sources, while other States may not participate in rule supply or consumption at all. Furthermore, some States may only supply or consume some rules, but not all.¹⁴

The number of States that engage in the supranational market of international relations for activities in the outer space environment has grown significantly since October 1957.¹⁵ Participant States that have consumed rules of jurisdiction on the supranational market regarding activities in the outer space environment buy these rules because they are willing to sell an element of their sovereignty to gain some authority over activities in the outer space environment in relation to other States. The cost of a rule of jurisdiction is in incurring obligations, the breach of which will generally impose some sanction, in order to extend a State's authority over persons, things, and events outside its territory, e.g., in the outer space environment, to satisfy some valued preference in relation to the authority of other States.

The supply of rules of jurisdiction only comes from those States that are interested in activities in the outer space environment.¹⁶ The initial supply and

¹⁴ See discussion in Chapter V *infra*.

¹⁵ See Graph 2.

¹⁶ Compare John Cobb Cooper, *The Russian Satellite – Legal and Political Problems*, 24 J. AIR L. & COMM. 379 (1957) [hereinafter *Russian Satellite*] with U.N. Comm. on the Peaceful Uses of Outer Space [UNCOPUOS], Legal Sub-Comm., *Annotated Provisional Agenda*, U.N. Doc. A/AC.105/C.2/L.295 (Jan. 13, 2015), available at http://www.unoosa.org/pdf/limited/c2/AC105_C2_L295E.pdf. See U.N. Comm. on the Peaceful Uses of Outer Space [UNCOPUOS], Legal Sub-Comm., *Report of the Chair of the Working Group on the Definition and Delimitation of Outer Space*, U.N. Doc. A/AC.105/C.2/2015/DEF/L.1 (Apr. 17, 2015), available at http://www.unoosa.org/pdf/limited/c2/AC105_C2_2015_DEF_L01E.pdf. See also GBENGA ODUNTAN, *SOVEREIGNTY AND JURISDICTION IN AIRSPACE AND OUTER SPACE* (Routledge 2011),

consumption of rules for the outer space environment resulted from the launch of the Sputnik and Explorer objects between October 1957 and January 1958.¹⁷ Since January 1958, the United States, the Soviet Union, and eleven other States continue to engage in the same State practice of launching objects over the territories of sovereign States into and through the outer space environment.¹⁸

The rules of jurisdiction that arose from the State practice of launching objects over the territories of sovereign States and into the outer space environment grew at the greatest rate over the first twenty years following the launch of Sputnik.¹⁹ Moreover, the rapidity of the acceptance of the State practice to launch objects over the territories of sovereign States indicates significant consumption of rules from all three sources of rules of public international law, i.e., international custom, international agreements, and general principles of law – each source of rules represents an individual supranational market of international relations. Since October 1957, the State practice of launching objects over the sovereign territories of other States has solidified into international custom because there is sufficient evidence to indicate that States have purchased the obligation to ensure they can continue the State practice.²⁰ Moreover, some States have accepted the obligations associated with the State practice of launching objects over the sovereign territories of other States as a matter of national law and international

and Dean N. Reinhardt, *The Vertical Limit of State Sovereignty* (Jun. 2005) (unpublished Master's thesis, McGill University) (on file with the Institute of Air & Space Law, McGill University), *available at* http://digitool.library.mcgill.ca/R/?func=dbin-jump-full&object_id=83956&local_base=GEN01-MCG02.

¹⁷ See WALTER A. MCDUGALL, . . . THE HEAVENS AND THE EARTH: A POLITICAL HISTORY OF THE SPACE AGE (Johns Hopkins Univ. Press 1985).

¹⁸ See *Timeline of first orbital launches by country*, WIKIPEDIA.ORG, https://en.wikipedia.org/wiki/Timeline_of_first_orbital_launches_by_country accessed Dec. 10, 2015.

¹⁹ See Graph 10 *infra*.

²⁰ See MICHAEL P. SCHARF, *CUSTOMARY INTERNATIONAL LAW IN TIMES OF FUNDAMENTAL CHANGE* 123-137 (Cambridge Univ. Press 2013).

agreement.²¹ To a large degree, the obligation has at least converged on the content for the first rule of space law that may be defined as consisting of the following elements: (1) an object, (2) intended to be launched, or (3) launched, that includes a (4) launch vehicle, (5) payload, or (6) satellite – which also includes (a) remote sensing, (b) scientific, (c) telecommunication satellites, as well as (7) including the component parts and parts thereof of a launch vehicle, payload, or satellite. However, this definition is relative to States that exist on Earth because the limiting requirement of the State practice is that the object intended to be launched or launched is a function of the overflight of a sovereign's territory. States only enjoy the benefits of sovereign territory relative to the Earth and there is a general prohibition on a State's ability to extend unilaterally its sovereignty to the outer space environment without the consent of other States.²²

The proliferation of the State practice of launching objects into the outer space environment demonstrates the extent to which the international community of States values an interest in rules of jurisdiction over space activities. However, not all States participate in the supranational market of international relations for rules regarding activities in the outer space environment. Some States may only participate in one, some, or all supranational markets that arise, i.e., those supranational markets in relation to rules of each source of public international law. For example, one hundred and four (104) out

²¹ See Chapter V *infra*. See also Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty]; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* Apr. 22, 1968, 672 U.N.T.S. 119 [hereinafter Rescue and Return Agreement]; Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29, 1972, 961 U.N.T.S. 187 [hereinafter Liability Convention]; and Convention on the Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

²² See Outer Space Treaty *supra* note 21, at art. II. See also John H. Knox, *A Presumption Against Extraterritoriality*, 104 AM. J. INT'L L. 351 (2010) [hereinafter Knox].

of one hundred and ninety three (193) United Nations Member States have ratified the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (Outer Space Treaty).²³ Moreover, the Outer Space Treaty was negotiated and concluded in the United Nations (UN) Committee on the Peaceful Uses of Outer Space (COPUOS), which began with eighteen (18) and has grown, as of October 2015, to eighty three (83) member States.²⁴ Of all the one hundred and ninety three (193) United Nations Member States today, approximately twenty nine (29) States have enacted rules of national (space) law the subject of which at least concerns the launching and use of space objects.²⁵

The rapidity of rule development across each supranational market that facilitates exchanges in rules of public international law for the outer space environment has varied since October 1957. Although consumption of rules of jurisdiction increased sharply when first supplied by international agreements, space treaty rule consumption has trended relatively flat since around 1980, except in a few supranational markets where the trend is clearly positive.²⁶ However, supranational market participation has continued to increase somewhat sharply in some markets even as rule consumption remains flat.²⁷ Moreover, the number of States that consume rules of jurisdiction is at best one hundred and four (104) relative to treaty obligations and at least twenty-nine (29) relative to the number of States that have directly promulgated national (space) laws regarding space objects. Nonetheless, as changes to the supply of rules, in the number of market

²³ See Outer Space Treaty *supra* note 21.

²⁴ See United Nations Office of Outer Space Affairs, *Members of the Committee on the Peaceful Uses of Outer Space*, UNOOSA.ORG, available at <http://www.unoosa.org/oosa/en/members/index.html> accessed Dec. 10, 2015.

²⁵ See Chapter V *infra*.

²⁶ See Graph 10 *infra*.

²⁷ *Id.*

participants, and in rule consumption rates continue to arise with varied velocity, there is much fragmentation in the types of obligations States have purchased with respect to supranational markets of international relations for the outer space environment.

Recent trends indicate that the rate of rule consumption and evolving valued preferences of States have shifted market participation and rule supply back to unilateral State practice with the deepening maturity of the commercial, civil, and military space sectors within States.²⁸ This may be the product of inertial forces endemic to some States in determining the scope of their valued preferences to launch objects over the territories of other States because the rapid growth of technology makes it hard for States to consistently value the benefits and costs associated with the particular types of activities a space object could perform in the outer space environment. On the other hand, there is limited consensus on the scope of the types of obligations that a State could purchase in the form of rules of jurisdiction on the supranational market for the outer space environment.²⁹ Consequently, despite attempts at coordination or cooperation among States, the supply of some types of rules has not settled in terms of the content, i.e., definition, meaning, and scope, because there is little incentive to supply or consume

²⁸ This is observed in the recent growth in the number of States that have promulgated national space laws with respect to rules governing space objects and correlated growth in the acceptance of the set of rules that comprise the Registration Convention since it obligates States to institute rules regarding the registration of space objects launched by the State Party. See Registration Convention *supra* note 21, and United Nations Office of Outer Space Affairs [UNOOSA], *National Registry Notifications*, UNOOSA.ORG, available at <http://www.unoosa.org/oosa/en/spaceobjectregister/national-registries/index.html> accessed Dec. 10, 2015. See also Louis Friedman, Op-Ed, *The new space race: It's not just the U.S. and Russia anymore*, L.A. TIMES, Dec. 9, 2013, available at <http://articles.latimes.com/2013/dec/09/opinion/la-oe-friedman-new-space-race-20131209> accessed Dec. 10, 2015, and Mark Magnier, Bruce Wallace & Shankhadeep Choudhury, *A great leap skyward*, L.A. TIMES, Nov. 18, 2007, available at <http://articles.latimes.com/2007/nov/18/world/fg-spacerace18> accessed Dec. 10, 2015.

²⁹ See, e.g., Michael Krepon, *Space Code of Conduct Mugged in New York*, ARMSCONTROLWONK.COM, Aug. 4, 2015, available at <http://www.armscontrolwonk.com/archive/404712/space-code-of-conduct-mugged-in-new-york/> accessed Dec. 10, 2015.

rules that may not help maximize some States' valued preferences for utilizing space objects in the outer space environment.³⁰

There will most likely be some types of change to State practice that will force an evolutionary response in the generation of rules of jurisdiction for the outer space environment regarding space objects. If so, then State practice will necessitate the reevaluation of those valued preferences associated with space activities. In so doing, a re-supply of rules in response to changes in State practice will occur and, depending on the value of a new State practice, States will price the new supply of rules in accordance with the need to consume new rules of jurisdiction over persons, things, and events that could occur in the outer space environment. *Ceteris paribus*, this process should repeat every time there is a shift in a State's valued preferences as a product of State practice; thus, further perpetuating the evolution of rules and rules of law for the outer space environment.

c. The Theoretical Foundations of an Economic Analysis of Rule Formation

i. Epistemological Approach

Generally, the subject of law and economics can be defined as “the application of economic methods to legal analysis.”³¹ Thus, the law and economic literature can be broken down into two basic analytical parts: 1) economic analysis *of law* and 2) economic analysis *in law*. (Emphasis added). The former analytical part reflects the study

³⁰ *Id.*

³¹ See ECONOMIC STRUCTURE *supra* note 4, at 1.

of two basic questions: a) what are the effects of legal rules on the behavior of relevant actors, and b) how are the effects of rules socially desirable?³² However, these questions can also be reformulated to inquire about how economic methods of analysis are applied to the study of legal institutions and doctrines through comparative analysis focusing on the consequences of legal rules through cross-jurisdictional, historical, or hypothetical processes.³³ The latter analytical part concerns the study of the underlying economics of a legal rule, i.e., “economic analysis supplies inputs to a legal rule.”³⁴ For example, in the cases of antitrust or anti-dumping issues under international trade law, “whether two products are “like,” with the result that discrimination between them is prohibited, by reference to cross-elasticities of demand.”³⁵ Or by way of another example, in US national law, a Herfindahl index for a particular industry may be used to determine whether the merger of companies would create market concentrations greater than the level of market share permitted by law.³⁶ Hence, this latter analytical part considers the underlying economic forces and processes that govern how rules function in a system of

³² See, e.g., ECONOMIC ANALYSIS OF LAW IN HANDBOOK OF PUBLIC ECONOMICS 1661 (A.J Auerbach, et al. eds., North Holland 2002); AVERY WIENER KATZ, FOUNDATIONS OF THE ECONOMIC APPROACH TO LAW (Lexis Nexis 2006) [hereinafter KATZ]; ROBERT COOTER & THOMAS ULEN, LAW & ECONOMICS (Addison-Wesley 2012) (2000); and RICHARD POSNER, ECONOMIC ANALYSIS OF LAW (Wolters Kluwer 2014) [hereinafter POSNER].

³³ See Dunoff & Trachtman *supra* note 4, at 7, and ECONOMIC STRUCTURE *supra* note 4, at 3.

³⁴ See Dunoff & Trachtman *supra* note 4, at 7.

³⁵ See Dunoff & Trachtman *supra* note 4, at 6. Cross-elasticities of demand is generally defined as the percentage change in demand for one good that occurs in response to a percentage change in the price of another good. The degree of elasticity or “responsiveness to change” in a good is measured in relative percentage. A relative negative change between two goods indicate that if the demand for one good decreases then a corresponding increase in the demand for the other good should arise. This signifies that the good are “complimentary goods.” If, on the other hand, an increase in the demand for one good corresponds with an increase in the demand for a second good, this signifies that the two goods are “substitute goods.” See also George Stigler, *Law or Economics*, 35 J. L. & ECON. 455, 467 (1992).

³⁶ See Nicole Palan, *Measurement of Specialization – The Choice of Indices* (Forschungsschwerpunkt Internationale Wirtschaft (“FIW”) Working Paper No. 62, 2010), available at http://www.fiw.ac.at/fileadmin/Documents/Publikationen/Working_Paper/N_062-Palan.pdf, and Eric Nauenberg, Kusalaya Basu & Harish Chand, *Hirschman-Herfindahl index determination under incomplete information*, 4 APPLIED ECON. LETTERS 639 (1997).

law and the extent to which State practice may determine the existence of a legal obligation as a product of a particular outcome in a supranational market.

Fundamentally, the approach taken in this thesis is a hybrid of both types of economic analysis as applied to public international law. With respect to the economic analysis *of* public international law, the issue of how economic methods are applied to doctrines of international law and international institutions provide a means by which to measure how rules of public international law arise and evolve over time. With respect to economic analysis *in* public international law, the secondary objective of this thesis is to design a means by which an observer can compare the content (i.e., definition, meaning, and scope) of rules over time. Furthermore, several economic methods are used in an attempt to model how rules are adopted and proliferate over time. When States seek to negotiate for or decide to follow some rule or rule of law, it is assumed that they seek to manage risks to State practice and maximize consistent definition and meaning for a rule of jurisdiction to minimize the cost of the obligation over time. However, as State preferences change, so may a rule or rule of law or a necessary element of a rule of law over time may also change.

The application of economic methods to public international law and rule-making is the primary concern of this thesis. The power of this approach is that the various methodologies that comprise economic analysis can be applied to a variety of subjects related to public international law providing a foundation for measuring the distinction of belief from opinion in a justifiable and falsifiable manner. As Trachtman points out,

economics itself is not so much a methodology as an epistemology. Economics encompasses a broad range of methods. In this regard, economics is simply another word for rational social scientific analysis – properly applied, it rejects no method that is rational. . . . Economics is a strong social science because it is an open system. The only conditions for inclusion in the system are rational analysis (but not necessarily the assumptions that people are rational) and methodological individualism.³⁷

From this starting point, the basic assumptions that underlie the economic analyses utilized in this thesis are “(i) methodologically, that individuals [i.e., States] seek to maximize the achievement of their [valued] preferences; and (ii) normatively, that the only valid source of preferences – of values – is individuals [i.e., States].”³⁸

This thesis attempts to take a positivist view of rule formation and makes no assumptions or claims regarding how best rules should arise, which represents a normative view of rule formation.³⁹ The major point of this thesis, therefore, is to analyze what may be termed “preference revelation” and its consequences for rule formation.⁴⁰ In other words, this thesis assumes that States will seek to minimize costs and manage risks associated with extending State authority outside their sovereign territories in the form of a supply of rules of jurisdiction. Consumption of the same rules of jurisdiction permits States to assert their authority extraterritorially while accepting the obligations from such rules imposes liabilities on States. A breach of an agreed upon rule of jurisdiction may

³⁷ See ECONOMIC STRUCTURE *supra* note 4, at 1.

³⁸ *Id.*

³⁹ See Roberto Ago, *Positive Law and International Law*, 51 AM. J. INT’L L. 691 (1957).

⁴⁰ See Dunoff & Trachtman *supra* note 4, at 9.

lead to sanctions in the form of tangible and intangible costs, e.g., shaming, warfare, monetary damages, declaration of responsibility, or collective denial of a State's authority in the international system.⁴¹

Preference revelation is observed when States enter the supranational market of international relations and seek preference satisfaction through the use of stratagems in relation to other market participants. States have wide latitudes of freedoms in determining their economic (i.e., health of the State), foreign policies (i.e., application of sovereign authority), and national security (i.e., internal and external security) needs in relation to other States.⁴² Underlying the analysis of preference revelation, as will be discussed below, are supranational market forces that drive States to develop rules under imperfect information in the course of conducting their international relations to achieve preference satisfaction. Any change in information regarding a State's valued preferences or any element of a rule over time tends to drive the evolution of rules. Therefore, in this thesis, application of economic analysis does not seek to answer the question of how States should value their preferences, but how States seek to maximize their valued preferences and its consequences for rule formation and evolution.

Moreover, the economic theories underlying the study of rule formation can be differentiated.⁴³ First, the *Coase theorem* assumes that a market mode of allocation is superior to bureaucratic allocation because bargaining will lead to an efficient outcome

⁴¹ See BROWNIE *supra* note 4. See also CARL VON CLAUSEWITZ, ON WAR 84 (Michael Howard ed., Peter Paret trans., Princeton Univ. Press 1989) ("War is not merely an act of policy but a true political instrument, a continuation of political intercourse carried on with other means.").

⁴² See LAKE *supra* note 9.

⁴³ I do not apply these theories below because the following analysis consists only of explaining the basic framework for rule-formation and evolution. I only mention these theories for completeness and address issues for future study.

regardless of the initial allocation of property if transaction costs are low.⁴⁴ Second, the *Fundamental Theorem of Welfare Economics* “posits that under perfection competition the market allocates resources efficiently,” but “recogniz[ing] that in a world without perfect competition we cannot say that a move toward the free market will enhance efficiency.”⁴⁵

Economic analysis of public international law as applied to the international system of States follows three basic questions. First, how many State participants are there in a given supranational market? Second, how does market participation via State practice lead to the supply, buying, and selling of rules in the form of rules of jurisdiction? Third, what are the consequences to the international system when the supply and types of rules evolve as a result of a change in the valued preferences of States?

Chapters III-V attempt to outline an answer to these questions in relation to rules of jurisdiction that arose from the initial rule of launching objects over the sovereign territories of other States. In the context of the supranational market of international relations, both market participation and rule development may or may not lead to an efficient outcome in the supply and purchasing of rules of jurisdiction in accordance with State(s) preferences.⁴⁶ In either case, how States enter the supranational market of international relations will depend on a variety of facts that must be observed to

⁴⁴ See RONALD COASE, *THE FIRM, THE MARKET, AND THE LAW* 95-156 (Univ. Chicago Press 1990).

⁴⁵ See *ECONOMIC STRUCTURE supra* note 4, at 2.

⁴⁶ See discussion *infra*. The construction of Herfindahl indexes were utilized to determine market share concentration for different supranational markets to determine what types of markets exist. See *supra* note 36.

determine whether a model of rule formation reflects an efficient means by which rules may arise based on the spectrum of market participation.

Market participation will vary in the supranational markets of international relations because each market with respect to each source of rules will have different barriers to entry. On the basis of sovereign legal equality, each State in the international system will generally have an equal market share only in terms of rules supplied by State practice. However, when States purchase the set of rules that comprise a treaty, the act of signature or ratification will establish the level of obligation purchased. The consumption of the set of rules that comprise a treaty gives each State Party an equal share of the obligation that arises from the treaty's rules. Non-States Parties do not purchase the obligation on the supranational market because they have not paid the price of accepting the treaty's legal obligations. Therefore a non-State Party cannot extend its authority relative to other States Parties to the treaty with respect to the set of rules the treaty comprises.

Since States are assumed to be rational, individualistic actors in the course of their international relations with other States, rules of jurisdiction may come about in a variety of ways open to States, either through cooperative or non-cooperative means.⁴⁷ Although rule formation may not always be efficient, the fact that States seek to maximize their utility through rule development provides direct and indirect evidence of their valued preferences. When a State does find it in its interest to seek to develop rules for itself and wish to see such rules proliferate, it tends to find ways to enter the supranational market of international relations to at least attempt to achieve rules for itself and to manage risks

⁴⁷ See BROWNIE *supra* note 4, and *Prescriptive Jurisdiction supra* note 4.

and minimize costs to States individually or collectively as a function of information about the subject activity for which rules are sought. How States go about achieving rule supply manifests through a variety of ways including through specific markets or via institutional means – where States have access to such venues.

ii. The International System of States Defined as a Private Legal System

Throughout human history, social order has played an important role in minimizing relative costs to existence.⁴⁸ Social order has and does come in a variety of forms, individually or collectively, e.g., warfare, religious or moral imposition, sovereign imposition, and familial imposition.⁴⁹ Historically, the disorder among and between States has resulted in significant costs in terms of human life, physical resources, developing advantageous capabilities, time, and effort.⁵⁰ Sometimes governments are too weak to perform the functions of protecting the lives of its people and their property.⁵¹ When local governments fail to enforce social order, significant third-parties have been known to intervene in disputes to minimize social and real costs through the enforcement of general rules of conduct and self-restraint.⁵² For example, religious institutions have historically enabled dialogue and negotiation between disputing parties, proceeding on the rules of good faith and fairness, by swearing an oath to abide by the rules agreed

⁴⁸ ADAM WATSON, *THE EVOLUTION OF INTERNATIONAL SOCIETY* (Routledge 2005) (1992).

⁴⁹ Amitai Aviram, *The Paradox of Spontaneous Formation of Private Legal Systems* (L. & Econ. Working Paper No. 192, Olin Program, Univ. Chicago L. Sch., 2003), available at http://www.law.uchicago.edu/files/files/192.aa_spontaneous.pdf?origin=publication_detail.

⁵⁰ See *supra* note 48.

⁵¹ See *supra* notes 48 & 49. See also THOMAS HOBBS, *LEVIATHAN OR THE MATTER, FORME AND POWER OF A COMMON WEALTH ECCLESIASTICALL AND CIVIL* (Thoemmes 2006) (1651).

⁵² See *supra* note 49.

upon.⁵³ This alternative to resorting to warfare tended to significantly minimize the costs to each disputant, even if for a short period of time.

One *apropos* example of a third-party imposing external rules by consent of the disputants is found in the “Pax Dei” movement of the tenth century in Western Europe.⁵⁴ The decline and fall of the Carolingian Empire caused a political vacuum in Western Europe resulting in the consolidation of power by rival lords through warfare.⁵⁵ Without a central, independent government to assert authority over Western Europe, rival lords resorted to the mutual destruction of their respective lands, in particular, farms and the peasants that worked the farms.⁵⁶ Without a central government to put an end to the warfare and impose peace, an opportunity arose for a third party to take a role in easing tensions and minimizing further destruction. Because a majority of the people of Western Europe in the tenth century worshipped under the faith of the Church of Saint Peter in Rome, local Christian Priests introduced the concept of “Pax Dei” – the first known decentralized, popular peace movement, as a solution to the high and constant social costs of existence.⁵⁷

One of the primary functions of the Pax Dei movement was the design of rules for the regulation of warfare.⁵⁸ The brutality that preceded the Pax Dei movement was so atrocious and unsustainable that all parties to such warfare desired for a way to end the suffering.⁵⁹ The rival lords adopted the Pax Dei rules by oath, which the rival lords

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ *Id.*

⁵⁹ *Id.*

voluntarily accepted.⁶⁰ The network of religious members of society took oaths seriously because they represented a covenant with the Christian God – a major aspect of social life in Europe at the time.⁶¹ Once the rival lords adopted the Pax Dei rules, which included rules regulating warfare, e.g., the rules of prohibition against harming non-combatants and suspending warfare during harvest season and times of religious significance, social order was imposed through the enforcement of the original oaths.⁶² If a party violated or derogated from the sworn oath that bound a party to a particular rule, then punishments would include social and religious ostracism – an imposition of significant real (i.e., tangible) and spiritual (i.e., intangible) costs to the violator.⁶³

The rules that members of the Pax Dei movement created and imposed on its subjects by consent provide an example of the formation of a private legal system.⁶⁴ A private legal system consists of private ordering among subjects to third-party rules, which do not arise from a centralized government.⁶⁵ Fundamentally, then, a private legal system can arise from “a non-governmental institution intended to regulate the behavior of its members.”⁶⁶ Thus, in the absence of a supranational State to impose authority on the disputing rival lords, the lords consumed and supplied third-party rules to increase social order.⁶⁷

While the use and enforcement of Pax Dei rules of warfare waxed and waned over time, States – such as they were between the tenth and seventeenth centuries – were not

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.*

⁶⁴ *Id.*

⁶⁵ *Id.*

⁶⁶ *Id.* at 3.

⁶⁷ *Id.*

immune from the degrading forces of social and real costs in their international relations. Through the middle of the seventeenth century, European monarchs still engaged in devastating international warfare leading to a significant shift in the international political and legal landscapes. Nevertheless, oaths were still an important part of social life and oath breaking tended to be severely punished.⁶⁸

The modern system of international relations of States began in 1648 with the conclusion of the Treaty of Westphalia, which ended the Thirty Years' War and the Eighty Years' War.⁶⁹ From the "Peace of Westphalia" arose new rules of international law that redefined State sovereignty, namely respect for sovereign boundaries, non-interference in domestic affairs, political independence and self-determination, and sovereign legal equality in relation to other State sovereigns.⁷⁰ Thus, two basic rules of the international system arose: 1) a State's application of its authority extraterritorially must arise from the consent of States and 2) State sovereignty is confined within the territory of a State.⁷¹

Both rules seek to enable a presumption against nonconsensual rule-making. Nonconsensual rule-making means the involuntary application of third party rules to State practice the breach of which imposes a sanction on a State although the State did not purchase the obligation of the rule⁷² If the rules supplied to the supranational market of international relations develop from nonconsensual rule-making, then consumption of

⁶⁸ *Id.*

⁶⁹ See Treaty of Westphalia (1648), and BROWNIE *supra* note 4.

⁷⁰ See BROWNIE *supra* note 4.

⁷¹ See BROWNIE *supra* note 4, and STEPHEN D. KRASNER, SOVEREIGNTY: ORGANIZED HYPOCRISY (Princeton Univ. Press 1999) [hereinafter KRASNER]. See also Knox *supra* note 22.

⁷² The act of nonconsensual does not impute liability on a State that has not purchased the obligation of the rule after subsequent breach of the rule.

such rules would violate the basic rule of the consent of States and impose obligations on States external to the State. The existence of such a supranational market of international relations would collapse the private legal system of States and create a supranational government above States.⁷³

As the new rules of international (or Westphalian) sovereignty permeated across Europe – and eventually all States on Earth, the circumstances leading up to and beyond the Peace of Westphalia produced a surge in scholarship directed at rival sovereigns on the scope of a State's powers vis-à-vis other State sovereigns and peoples collectively.⁷⁴ Many of these scholars put forth theories of international relations, as well as on the scope of a State's sovereign and international powers.⁷⁵ Consequently, States consumed many of the rules that international legal scholars put forth, which States utilized these new preferred powers to exercise their authority extraterritorially, giving rise to a worldwide expansion of State activities with all the attendant risks, costs, and benefits such activities engender upon the international system of States.⁷⁶

Although rules of international law have permeated across the Earth, not all States have adopted every rule of international law. Over time, rules change; States abandon, repeal, or replace rules with disutility in favor of different rules with greater utility.⁷⁷ This independence enables rule-making based on the exchanges (interactions and transactions)

⁷³ If observed, the act of supplying and consuming nonconsensual rules from the supranational market is *prima facie* evidence that the private legal system among States has broken down because order no longer arises from the collective actions of States but from the will of some supranational entity acting on the international system of States.

⁷⁴ See BROWNIE *supra* note 4.

⁷⁵ *Id.*

⁷⁶ *Id.*

⁷⁷ Some examples include the transition from the League of Nations to the United Nations Charter from 1920 to 1945; or the transition from the General Agreement on Tariffs and Trade (GATT) to the World Trade Organization (WTO) from 1947 to 1994.

between and among States as a function of State practice. Moreover, this independence would not have been possible but for the rules that States adopted as a result of the Peace of Westphalia. The Peace of Westphalia and the principles that States adopted from the treaty comprise the sovereign foundation of the State.⁷⁸

The concept of the State has evolved significantly over human history.⁷⁹ Nevertheless, the definition of “the State” adopted in this thesis derives from relatively modern sources of public international law. First, the treaty definition is found in the *Convention on the Rights and Duties of States* (Montevideo Convention), which entered into force on December 26, 1934.⁸⁰ The Montevideo Convention is the codification of international custom of those elements that define a State. As Article I of the Montevideo Convention affirms, a State is “a person of international law [that] should possess the following qualifications: (a) a permanent population; (b) a defined territory; (c) government; and (d) capacity to enter into relations with the other states.”⁸¹ Second, a codification of State practice for the definition of a State is found in the *Restatement (3rd) on the Foreign Relations Law of the United States* (Restatements).⁸² Section 201 of the Restatements defines a State as being “an entity that has a defined territory and a permanent population, under the control of its own government, and that engages in, or

⁷⁸ See BROWNLIE *supra* note 4.

⁷⁹ See *supra* note 48. Although this thesis does not consider the rules that have given rise to the formation of a State over time, it is worth noting, briefly, how States have evolved to be in a position to supply, negotiate, and consume rules of jurisdiction as a matter of binding obligations, i.e., what we today call rules of law.

⁸⁰ See Convention on the Rights and Duties of States (Montevideo Convention), Dec. 26, 1933, 165 L.N.T.S. 19, 28 AM. J. INT'L L. (Supp.) 75 (1934) (hereinafter Montevideo Convention), available at <http://www.ilsa.org/jessup/jessup15/Montevideo%20Convention.pdf>. See also Thomas D. Grant, *Defining Statehood: The Montevideo Convention and its Discontents*, 37 COLUM. J. TRANSNAT'L L. 403 (1999).

⁸¹ *Id.* at art. 1.

⁸² RESTATEMENT (THIRD) ON THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 201 (1987).

has the capacity to engage in, formal relations with other such entities.”⁸³ Figure 1 below provides an illustration of each element that comprises State sovereignty.

The Restatements definition is slightly augmented from the definition of the State provided by the Montevideo Convention. For example, the Restatements qualifies government with the aspect of “control”⁸⁴ – a normative element – meant to distinguish whether a State’s government has the ability to govern,⁸⁵ as well as augments the element of engaging in relations with other States by qualifying relations as “formal” and generalizing the subject of international relations to entities with which a State may “engage” in a variety of relationships.⁸⁶ While these qualifications further illustrate the common core of the rules by which States are defined, they also illustrate the departure from the general rule that a State is defined by four basic elements. Such differences in the rules, even if minor, signify the way State practice has evolved over time from the supply of rules that define a State.

Figure 1: Elements of State Sovereignty

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ See BROWNLIE *supra* note 4.

⁸⁶ Nevertheless, missing from both definitions is the concept of recognition. Recognition is an inherently political act and therefore a product of State practice that is subjective. Because the act of recognizing a State is inherently political, the degree to which States permit unrecognized States depends on factors the expression of which depends on the valued preference internal to States. See BROWNLIE *supra* note 4.

As discussed later in this chapter, States trade in components of power on the supranational market of international relations to satisfy some valued preference internal to the State.⁸⁷ In particular, States trade in rules of jurisdiction because such rules represent a function of a State's authority.⁸⁸ Moreover, the act of trading in components of power, like rules of jurisdiction, arises from State practice because it is the manifestation of the physical will of the State in seeking to maximize its *raison d'état* by extending its authority extraterritorially.⁸⁹ Since a State's authority derives from its sovereignty, trading in rules of jurisdiction necessitates the trading in a State's sovereignty as a means to extend State authority outside its territory.⁹⁰

The State is inherently bounded by its territory.⁹¹ Conterminous, moreover, a State's sovereignty is also bounded, but its authority may extend beyond its territory.⁹² When States assert some authority beyond their respective territory, they may act without the protection of their sovereignty.⁹³ Consequently, to manage the risks and minimize the costs of a State's international relations, States seek to trade in rules of authority that take the form of rules of jurisdiction.⁹⁴ These rules are generated by States through their State practice and form the basis of rule-making and supply in the international system of States.

When States engage in the maximization of their valued preferences through State practice, their actions necessarily affect the social order established by the international

⁸⁷ See *supra* note 4.

⁸⁸ *Id.*

⁸⁹ *Id.*

⁹⁰ *Id.*

⁹¹ See BROWNIE *supra* note 4.

⁹² *Id.*

⁹³ See *The S.S. Lotus (Fra. v. Tur.)*, 1923 P.C.I.J. (ser. A) No. 10. See also BROWNIE *supra* note 4.

⁹⁴ See *supra* note 4.

community of States. Because no supranational State exists with the authority to impose rules on all States, States will tend to order themselves in relation to those States that share the same or similar interests, the results of which create social ordering.⁹⁵ A consequence of social ordering is the generation of rules of jurisdiction for which States may bargain to maximize their valued preferences.⁹⁶ In order to maximize their valued preferences, States may independently or co-dependently develop rules as a function of their respective State practices and cooperate to bargain for rules of jurisdiction over some activity in some location beyond their territories.⁹⁷ States tend to use any means necessary to accomplish this task, including the use of international fora and tribunals – both of which represent third party institutions.⁹⁸

Equating the international legal system with a private legal system creates two issues. First, must all rules of jurisdiction developed by States to govern their extraterritorial activities have binding legal effect (i.e., bargained for obligation the basis of which enables State authority extraterritorially)? If not, what good is the supply of rules that do not have binding legal effect? Second, how does an observer distinguish between rules of jurisdiction that are non-binding and binding? What is the process of transition?

In regard to the first issue, not all rules that could be supplied for consumption by States must have binding legal effect because not every State practice or supplied rule

⁹⁵ See *supra* note 9.

⁹⁶ See ELLICKSON *supra* note 9.

⁹⁷ Two good examples of these practices in work is the political integration of the European Union between 1958 and 2007, and the political integration of “the several States” of the United States in 1789. See European Union, *The History of the European Union*, EUROPA.EU, available at http://europa.eu/about-eu/eu-history/index_en.htm accessed Dec. 10, 2015. See also DAVID C. HENDRICKSON, *PEACE PACT: THE LOST WORLD OF THE AMERICAN FOUNDING* (Univ. Press of Kansas 2003).

⁹⁸ See *supra* note 49.

may be considered obligatory as a matter of law.⁹⁹ The benefit of the supply of such rules is dependent on a variety of factors. These include, *inter alia*, transaction costs, externalities, discounted enforcement costs, and the overall benefit assumed in the supply of such rules to enhance social order through cooperation or coordination.¹⁰⁰

For example, when members of COPUOS negotiated the Outer Space Treaty they relied on rules of jurisdiction expressed in the *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space* (Declaration of Legal Principles).¹⁰¹ COPUOS members developed the Declaration of Legal Principles initially as a set of non-binding rules and supplied these rules to the supranational market of international relations.¹⁰² Consequently, the UN General Assembly (UNGA) consumed the Declaration of Legal Principles when it voted to adopt the rules as a UNGA resolution in 1963.¹⁰³ By 1966, using the Declaration of Legal Principles as the basis for the negotiations, COPUOS concluded the Outer Space Treaty and supplied a set of rules of law as a multilateral international agreement.¹⁰⁴ Once the Outer Space Treaty was opened for signature, interested States started to consume the rules of jurisdiction of the Outer Space Treaty by accepting the costs associated with the obligations the treaty establishes relative to the price paid, i.e., cost of signature, ratification, accession, or succession.¹⁰⁵

⁹⁹ See BROWNLIE *supra* note 4.

¹⁰⁰ See *supra* note 4.

¹⁰¹ Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 18/1962, U.N. Doc. A/RES/18/1962 (Dec. 13, 1963).

¹⁰² See BROWNLIE *supra* note 4.

¹⁰³ See BROWNLIE *supra* note 4.

¹⁰⁴ See MANUAL ON SPACE LAW VOL. I (Nadasiri Jasentuliyana ed., Oceana Publ'ns 1979) [hereinafter MANUAL]. See also Paul Dembling & Daniel M. Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR L. & COMM. 419 (1967).

¹⁰⁵ See ANTHONY AUST, MODERN TREATY LAW AND PRACTICE (2nd ed., Cambridge Univ. Press 2007).

With respect to the second issue, the process that governs how a rule transitions to a rule of law varies based on how the rule was initially supplied to the supranational market of international relations. A rule will have a particular content, i.e., definition, meaning, and scope, and that content may serve to maximize a State's valued preference. The transition from rule to rule of law occurs when a State gives notice that it has purchased an obligation in relation to other States in the international system in order to enjoy the right of extending authority extraterritorially. When a State purchases the obligation of a rule of jurisdiction on the supranational market of international relations it gives notice to other States in the form of some affirmative act or omission as a product of State practice. Generally, an affirmation permits or signals that the State will or intends to exert its authority beyond its territory bounded by the content of the rule of jurisdiction.

Moreover, each source of rules of public international law has its own associated costs and benefits. Because the international system of States functions as a product of the rule of the consent of States, some rules may not be desirable to some States. With respect to international custom, State practice itself is not clearly indicative of being performed out of a sense of legal obligation. If a State is a consistent objector to the obligatory nature of the rule as a function of its State practice, this is sufficient to signal to the international market that the rule has no binding legal effect because the State has not consumed the rule of law by accepting the cost of the legal obligation of the rule.¹⁰⁶ Instead, the State has supplied rule(s) associated with its State practice only. However, a State could take affirmative acts in the course of its State practice that would represent a

¹⁰⁶ See BROWNIE *supra* note 4.

market signal of buying the legal obligation of the rule in the form of its sovereign authority.¹⁰⁷ When this situation arises, a rule of international custom may form evidenced by a State's practice conducted out of a sense of legal obligation.¹⁰⁸

With respect to international agreements, when States seek to negotiate and conclude an international agreement, the fact that States would participate in the development of rules of jurisdiction is indicative of the costs States are willing to accept based on the supply of the set of rules that comprises the international agreement. Since an international agreement manifests as a supply of choice of law rules of jurisdiction based on the intent of the negotiating States Parties, those States that participate in the supply of rules of jurisdiction will incur transactional costs whether or not those States sign or ratify the international agreement.¹⁰⁹ Conversely, some States may never take part in the original negotiations and therefore will never expend any resources in the development of rules of jurisdiction underlying the international agreement, but may nevertheless later consume the rules of jurisdiction as a product of the international agreement. Subsequent consumption via signature or ratification generally implies the level of value the State has for the international agreement.¹¹⁰ Furthermore, when a State leaves an international agreement, the State will sell back its legal obligation and abandon

¹⁰⁷ See BROWNIE *supra* note 4.

¹⁰⁸ See North Sea Continental Shelf Cases (F.R.G. v. Den; F.R.G. v. Neth.), 1969 I.C.J. Reports 44 (Feb. 20) ("in order to achieve this result, two conditions must be fulfilled. Not only must the acts concerned amount to a settled practice, but they must also be such, or be carried out in such a way, as to be evidence of a belief that this practice is rendered obligatory by the existence of a rule of law requiring it. The need for such a belief, i.e., the existence of a subjective element, is implicit in the very notion of *opinio [i]uris sive necessitatis*. The States concerned must therefore feel that they are conforming to what amounts to a legal obligation. The frequency, or even habitual character of the acts is not in itself enough. There are many international acts, e.g., in the field of ceremonial and protocol, which are performed almost invariably, but which are motivated only by considerations of courtesy, convenience or tradition, and not by any sense of legal duty.").

¹⁰⁹ See POSNER and KATZ *supra* note 32.

¹¹⁰ See *supra* note 105.

any benefits that derive from the agreement under conditions set forth by the international agreement.¹¹¹ Because States commoditize their sovereignty in the form of rules of jurisdiction that are not fungible with other elements of their sovereignty, a State's sovereign authority may be revoked and the rule's obligation discharged once a State takes an affirmative act to do so because of the prohibition on nonconsensual rule-making, i.e., compelled purchase of an obligation.¹¹²

With respect to general principles of law, each State has its own internal processes by which it discharges its sovereign authority to promulgate or publish rules of jurisdiction within its territory. This ability is a defining element of a State. However, when rules of jurisdiction internal to the State apply extraterritorially, such rules manifest as State practice based on how the State values certain preferences of its foreign policy, economic and security needs. Without evidence of consistent objection, any act by which a State discharges its authority extraterritorially can manifest as a supply of rules of jurisdiction with respect to the State itself because the legal obligation, i.e., *opinio iuris*, is based on the sovereign act of promulgating or publishing rules of jurisdiction within its territory.¹¹³ When States collectively or independently promulgate or publish the same rules of jurisdiction with respect to congruent activities and extraterritorial environments, they express the same State practice.¹¹⁴ Since States develop their national laws independent of other States, common rules of jurisdiction among States are considered general principles of law and are indicative of a common basis with regard to some application of a State's authority extraterritorially. In other words, there is a presumption

¹¹¹ See Laurence R. Helfer, *Exiting Treaties*, 91 VIR. L. REV. 1579 (2005).

¹¹² See *supra* note 105.

¹¹³ See BROWNIE *supra* note 4.

¹¹⁴ *Id.*

that the commonly used rules of jurisdiction developed by States is evidence of purchased rules of jurisdiction because there is consensus among States about the content of the rule.¹¹⁵

The international system of States operates much like a private legal system.¹¹⁶ The rules of jurisdiction that make up the basis of the international legal system are created by States through their State practice.¹¹⁷ When States have disputes among or between each other, they may violate the rules they accept from the sale of their sovereignty and accept the risks of breaching their obligations to other States. However, sometimes the costs of breach are sufficiently high that States resort to third parties to assist in resolving a dispute.¹¹⁸ Such third party entities can take the form of an international forum or tribunal, e.g., the United Nations Security Council, the International Court of Justice (ICJ), permanent and *ad hoc* international criminal or civil tribunals.¹¹⁹ Moreover, since participation in international tribunals and fora arise from the consent of the States Parties, generally no alternative imposition by an external authority exists.¹²⁰ However, States may collectively act together to enforce or punish violations of international law, which develops fundamentally from State practice.¹²¹

When international tribunals intervene to resolve disputes, they act pursuant to the vested authority granted by the consent of the States Parties to declare what the rule of law to be applied is and determine which State(s) Party breached an obligation it owed to

¹¹⁵ *Id.*

¹¹⁶ *See supra* note 49.

¹¹⁷ *See supra* note 49. *See also* BROWNLIE *supra* note 4.

¹¹⁸ *See supra* note 49.

¹¹⁹ *See* BROWNLIE *supra* note 4.

¹²⁰ *Id.*

¹²¹ *Id.*

the other State(s) Party.¹²² The act of declaring what rules of international law are and how they apply to the disputant States is only binding between the disputants, but the declaration itself is a valued preference of the States Parties because they consented to the tribunal's authority.¹²³ Furthermore, the publication of a tribunal's declaration represents another example of an exchange in the supranational market of international relations. Moreover, as a published document, the declaration issued by the tribunal will necessarily state the rule(s) of international law used in the decision regarding the dispute. Consequently, relative to non-States Parties, the publication of the declaration of the rule of law used in the decision is fundamentally a (re-)supply of rules to the supranational market of international relations.

To summarize, first States develop their internal valued preferences generally based on foreign policy, economic and national security needs. Next, States will physically manifest the maximization of their valued preferences in the form of State practice. State practice may necessitate the need to enter a supranational market of international relations. By entering a supranational market, a State may supply rules unilaterally or bilaterally relative to other States. Once rules of jurisdiction are supplied to a supranational market, States may individually or collectively set an associated price on accepting the obligation of a supplied rule. If a State accepts the obligation of a supplied rule and gives notice of this fact in the form of published evidence, e.g., through the promulgation or publication of a national law, regulation, or policy, or via a signature or ratification of an international agreement, a State is said to have consumed the rule. The

¹²² *Id.*

¹²³ See Statute of the International Court of Justice at art. 36. See also ANTHONY AUST, HANDBOOK OF INTERNATIONAL LAW 403-404 (Cambridge Univ. Press 2010) [hereinafter HANDBOOK].

cost of consuming a rule is the acceptance of an obligation to other States to ensure the extension of a State's authority beyond its territory.

Public international law may be described as a set of rules and processes that describe which and how rights, duties, and obligations apply to States via the supply and consumption of rules that arise from the exchanges of States in the supranational market of international relations.¹²⁴ The benefit of such rules enables cooperation in the form of bounds of consent to the extension of a State's authority beyond its sovereign territory.¹²⁵ The cost incurred results from giving notice that the State has purchased the obligation of the rule and may be held liable for its breach.¹²⁶ Nonetheless, a sovereign State has the exclusive authority to make its own rules and rules of law, including the authority to change rules and rules of law. In doing so, it creates a process of orderly change in how rules and rules of law are created over time as manifested from rule- and law-making internal to a State.¹²⁷ So long as States continue to supply and consume rules of jurisdiction and create obligations among and between States, the international legal system will remain stable until the valued preferences of States change potentially giving rise to a resupply of rules, via a change(s) in State practice, to the supranational market of international relations for possible consumption. Such an event would close the loop on

¹²⁴ See H.L.A. HART, *THE CONCEPT OF LAW* (Oxford Univ. Press 1997) (1961).

¹²⁵ See generally, Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972); Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement to Facilitate Coasean Trade*, 104 YALE L. J. 1027 (1995); Ian Ayres & Eric Talley, *Distinguishing Between Consensual and Nonconsensual Advantages of Liability Rules*, 105 YALE L. J. 235 (1995) [hereinafter Ayres & Talley]; Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996). C.f. James E. Krier & Stewart J. Schwab, *Property Rules and Liability Rules: The Cathedral in Another Light*, 70 N.Y.U. L. REV. 440 (1995), and Richard A. Epstein, *A Clear View of The Cathedral: The Dominance of Property Rules*, 106 YALE L. J. 2091 (1997).

¹²⁶ *Id.*

¹²⁷ See BROWNLIE *supra* note 4.

the processes of rule formation, development, and evolution.¹²⁸ Figure 2 below illustrates this process.

¹²⁸ The stability of preference revelation, rule supply, and rule consumption enables stability in the international legal system of States. Consequently, instability of the international system of States may be defined as the maximization of sequences of cascading events that cause fundamental reevaluations valued preferences that may manifest through changes in State practice that cause States to shift the content of rules to enable the supply of new rules to supranational markets of international relations for consumption to ensure the new valued preference is maximized.

Figure 2: The Processes of Rule Formation, Development, and Evolution

iii. Supranational Markets of International Relations

The general market under study here is the supranational market of international relations. Markets are generally defined as “a place of commercial activity in which goods or services are bought and sold.”¹²⁹ In the context of the international relations of States, the place where such actions or activities may arise is anywhere States have interests in maximizing their valued preferences (i.e., individual utility).¹³⁰ This occurs through the application of foreign relations, whether in specific fora or as a consequence of State actions or activities (i.e., State practice). The actions and activities in which States engage manifest broadly through components of power, developed and used generally to satisfy valued preferences regarding rules of jurisdiction, which are a function of the fundamental basis of legal obligations.¹³¹ When States engage themselves in centralized or decentralized supranational markets of international relations, the end result may lead to the buying and selling of goods or services which includes rules of jurisdiction. Whether rules of jurisdiction have binding effect as law depends on how such rules are developed or purchased by States.

Through unilateral State practice or by negotiation in the supranational market of international relations, States seek to “sell” their valued preferences as rules or rules of law of jurisdiction by construction (e.g., international custom or national law) or in codified form (e.g., treaty law).¹³² When States engage in activities in the supranational market of international relations, the end result of the occurrences and transactions of

¹²⁹ BLACK’S LAW DICTIONARY 988 (8th ed. 2007).

¹³⁰ See ECONOMIC STRUCTURE *supra* note 4.

¹³¹ *Id.*

¹³² *Id.*

States can be the development of rules or rules of law that States seek to “buy” to maximize their individual preferences, but also to manage risk and increase certainty related to the activities subject to such rules or rules of law.¹³³ Below I attempt to deconstruct what this means as a function of rule development.

In terms of market participation, the entire international system of States is bounded only by the number of participant States, which an observer can measure relative to the interactions of self-regarding units, i.e., States.¹³⁴ Rule formation under public international law is the product of, at least, those States that are recognized as members of the United Nations, i.e., potential entities that can and may supply and/or purchase rules of jurisdiction on the supranational market of international relations. Moreover, the international system of States is treated as an open system whereby States are generally free to maximize their preferences in relation to other States bounded only by the hierarchies of international relationships.¹³⁵ Furthermore, there is no predetermined bound on market participation because the international system of States is open and therefore subject to evolution.¹³⁶ In other words, the supranational market of international relations is what States make of it.¹³⁷

The supranational market of international relations arises because States have preferences which it values relative to its *raison d'état*. In particular, States tend to rank economic health, authority, and security high on their list of preferences and must seek to maximize each through a variety of means (i.e., strategies), including international

¹³³ *Id.*

¹³⁴ See Dunoff & Trachtman *supra* note 4, at 13.

¹³⁵ See *supra* note 95. See also ECONOMIC STRUCTURE *supra* note 4.

¹³⁶ See ECONOMIC STRUCTURE *supra* note 4.

¹³⁷ See, e.g., Alexander Wendt, *Anarchy is what States Make of it: The Social Construction of Power Politics*, 46 INT'L ORG. 391 (1992).

cooperation. When international cooperation arises, States can exchange in preference identification through negotiation to form a rule(s) or rule(s) of law to govern themselves within a private legal system of international rules and laws. Rules and rules of law of jurisdiction manifest as components of State power that, in theory, should minimize transaction costs relative to other States engaged in the same types of exchanges.¹³⁸ In other words, States engage in negotiations in the supra-national market of international relations to trade in components of power, e.g., rules of jurisdiction, by seeking to maximize their set of valued preferences.¹³⁹ In doing so, States must relinquish some level of autonomy in order to obtain benefits from various forms of international relations exchanges (i.e., occurrences or transactions).¹⁴⁰

The supranational market is postulated to arise from the activities of States that may be defined as the exchanges among and between States engaged in international relations. First, occurrences are defined as those positive acts that States independently take in the course of their international relations to satisfy a valued preference. When a State, due to changes in competence, capabilities, or resources, begins a State practice dependent or independent of other States, the State's valued preference(s) may begin as a nonbinding rule relative to other States engaged in such practice. Over time, such rules may become a binding rule of public international law when codified or when such rules are observed as international custom if the State practice is general, consistent, and there is evidence of a purchase of a legal obligation.¹⁴¹ For example, as discussed in more

¹³⁸ See ECONOMIC STRUCTURE *supra* note 4.

¹³⁹ *Id.*

¹⁴⁰ See *supra* note 95. See also KRASNER *supra* note 71, and ECONOMIC STRUCTURE *supra* note 4.

¹⁴¹ See Office of the President, National Security Council, Draft Statement of Policy on U.S. Scientific Satellite Program, NSC 5520 (May 20, 1955).

detail below, when the Soviet Union and US began a State practice of launching objects into orbit around the Earth, a preference highly valued by both States (but for different reasons), this initiated rule formation regarding the “freedom of space”¹⁴² or more precisely the creation of an informal rule that permits a State the right to launch and orbit an object over the sovereign territories of other States into the medium of the outer space environment. Thus, State practice initiated by the US and the Soviet Union catalyzed rules of jurisdiction applicable to both States necessarily created a supranational market because each State had a valued preference in the ability to launch objects into the outer space environment.¹⁴³

Second, States individually “encounter one another and sometimes have occasion to cooperate, to engage in what may broadly be termed “transaction[s].””¹⁴⁴ Such transactions can manifest in the form of bi- or multi-lateral treaties, either conditioned for signature and ratification or open to all States. Regardless of how, if, or when States seek to transact and conclude an international agreement, States, through their preference valuations, must figure out for themselves the need to include some or all States in particular supranational markets as well as the need to close off some markets to some States. Nevertheless, the international system of States enables and permits these types of

¹⁴² *Id.*

¹⁴³ While I hesitate to proffer that such activities were predetermined, the fact that the requisite technology existed included the possibility that States would need rules to govern their activities to simultaneously achieve some individual utility as well as the need to minimize costs arising from such activities. The form of rules specially, and how such rules developed generally, are in no sense predetermined. Only the possibility of the need for rules through the existence of a possible market could, at most, have been predetermined. *See, e.g., infra* note 163.

¹⁴⁴ *See* Dunoff & Trachtman *supra* note 4, at 12.

transactions to occur even if the various supra-national markets that develop discriminate against or place barriers of entry on State participation.¹⁴⁵

There are many examples of conditioned participation to international agreements. For one, the Antarctica Treaty regulates international relations on the continent of Antarctica and those States Parties with initial claims have rights greater than other States that desire or have disputed claims to the continent.¹⁴⁶ As Article IV of the treaty states “No new claim, or enlargement of an existing claim to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force.”¹⁴⁷ On the other hand, the Outer Space Treaty is a multilateral treaty open to all States without precondition on capability of spaceflight or prior claims.¹⁴⁸ Hence, States can and do limit entrance into particular markets for the purposes of rule development and consumption.

The buying and selling of rules and/or rules of law of jurisdiction manifest and can be measured in a variety of ways. In the absence of a specific rule of international law, State practice, if objectively definite and distinguishable from other observed rules, may form nonbinding rules. A nonbinding rule, i.e., a rule that is not followed out of a measure of legal obligation, is distinguishable from a binding rule of law, i.e., a rule that establishes duties and obligations for which a breach could be measured and sanctions imposed, because the degree of the cost of enforcement significantly varies between each type of rule.

¹⁴⁵ See ECONOMIC STRUCTURE *supra* note 4.

¹⁴⁶ See The Antarctic Treaty System, <http://www.ats.aq/e/ats.htm>.

¹⁴⁷ See Antarctic Treaty, *opened for signature* Dec. 1, 1959, [1961] 12 U.S.T. 794, T.I.A.S. No. 4780, 402 U.N.T.S. 71 [hereinafter Antarctic Treaty]. See also BROWNIE *supra* note 4.

¹⁴⁸ See BROWNIE *supra* note 4.

For example, the cost to enforce a treaty obligation may be less than the cost to enforce a national law or an international custom because being a State Party to a treaty provides *prima facie* evidence that a State Party has purchased the obligations of the rules that comprise the treaty.¹⁴⁹ The enforcement of rules of national law or international custom may have a higher cost to enforce relative to international agreements because of the rule of consent to an obligation a breach of which would impose liability on the State, i.e., the presumption against nonconsensual rule-making.¹⁵⁰ This is a foundational rule of a private legal system.¹⁵¹

In order to mitigate or resolve international conflict(s), States may choose to resort to addressing disputes among and between States bi-or multi-laterally or through adjudication using third party rules.¹⁵² How States go about mitigating or resolving disputes will provide a supply of rules from State practice. Each type of rule may be priced by States on the supranational market of international relations and the purchase of the obligation of the rule may be evidenced by some affirmative act or omission.¹⁵³ When

¹⁴⁹ See, e.g., Gary L. Scott & Craig L. Carr, *Multilateral Treaties and the Formation of Customary International Law*, 25 DENV. J. INT'L L. & Pol'y 71 (1996), and Douglas Johnston, *Theory, Consent, and the Law of Treaties A Cross-Disciplinary Perspective*, 6 AUSTL. Y.B. INT'L L. 109 (1988), available at <http://www.austlii.edu.au/au/journals/AUYrBkIntLaw/1988/6.pdf>.

¹⁴⁹ See *supra* note 49. C.f. Vincy Fon & Francesco Parisi, *The Economics of Treaty Ratification*, 5 J. L. ECON. & POL'Y 209 (2009).

¹⁵⁰ C.f. Ayres & Talley *supra* note 125.

¹⁵¹ See *supra* note 49.

¹⁵² See BROWNLIE *supra* note 4.

¹⁵³ In the case of treaties, the act of signature, ratification, accession, or succession provides sufficient evidence of rule consumption. See *supra* note 105. In the case of national law and international custom, acts of State practice alone do not enable the nonconsensual purchase of rules on the supranational market. The purchase of the obligation arises when notice of the legal obligation is published in some form. In the case of national law, consensus in the purchase of a rule provides sufficient consent of States because the obligation is shared among States. In the case of international custom, some expression of legal obligation must arise to give notice of the purchase of the obligation. However, consistently objecting to the potential purchase of a supplied rule of international custom provides sufficient evidence that the obligation of the rule is not purchased no matter how the State practice related to the rule is expressed by States. See BROWNLIE *supra* note 4.

States seek to have their disputes adjudicated by third party rules, i.e., rules of public international law, States consent to the authority of the international tribunal for which the dispute may be resolved.¹⁵⁴ The rules of the adjudication include the requirement that the facts of the dispute must be agreed to by all States Parties to the dispute.¹⁵⁵ The publication of the documents that consist of the resolution of the tribunal to render a verdict in the dispute apply only to the States Parties to the dispute, but the rules utilized to render a verdict are re-supplied to the supranational market of international relations.

Rule formation and the buying of rules can be measured by looking at how valued preferences manifest as State practice and from deviations observed between State practice and in the types of obligations purchased by a State, respectively. First, how rules arise in and are supplied to the supranational market of international relations from the international relations of States may be measured as the consequence of stratagems of State practice: whether State preference(s) or action(s) lead to (a) cooperation or (b) defection (Strategy Testing) in the supply of rules.¹⁵⁶ This test enables the use of game theory to model how the stratagems, and associated payoffs, of States in exchanges over rules that direct the scope of a State's authority outside its sovereign territory may lead to an optimal outcome in the supply of rules. Consequently, the supply of rules that arise from the need to maximize valued preferences creates spontaneous order within the international system of States.¹⁵⁷ Once the rules are supplied, States are free to consume as many or as few rules that maximize their valued preferences. Deviations in how many

¹⁵⁴ See Statute of the International Court of Justice art. 36. See also HANDBOOK *supra* note 123.

¹⁵⁵ *Id.*

¹⁵⁶ See *supra* note 4.

¹⁵⁷ See ELLICKSON *supra* note 9.

or which rules are consumed impose benefits and costs and risks that States will seek to manage over time, which may or may not include rule supply or consumption.

Second, a comparative analysis of rules may be used to identify the core rules and their content, i.e., a rule's definition, meaning, and scope, in order to measure the extent to which a State purchased what types of obligations (Proof of Purchase). When States supply rules to the supranational market, States are not obliged to purchase rules.¹⁵⁸ However, when States buy a rule of jurisdiction the content of the supplied rule(s) may vary depending on the source. This creates different types of obligations with respect to each source of rules. Moreover, States may purchase rules with respect to the same type of person, thing, or event outside their territories and thus accept the obligations of all the rules consumed. Other States may not purchase the obligation of all rules associated with the same type of person, thing, or event outside their territories. Such differences indicate variability in valued preferences and a stratification of obligations among States with respect to the same types of rules. Consequently, rules of jurisdiction will vary and the extent of a State's authority beyond its sovereign territory will also vary.

Strategy and Proof of Purchase Testing are a measure of the observable outcomes of States engaged in the supranational market of international relations. However, these tests must be taken in relation to the number of States that participate in supranational markets because market share and participation provides a separate measure of the degree to which States value the supply and consumption of rules with respect to the same types of persons, things, or events outside the territories of States. From these measures,

¹⁵⁸ See BROWNIE *supra* note 4.

relationships among interested States governed by the same rules may be analyzed and compared to observed historical outcomes.

Supranational markets of international relations come in a variety of forms.

However, each supranational market may be analyzed with respect to other supranational markets because of the many ways rules are supplied by States over time. Since the adoption of the UN Charter, States Parties have grown from the original fifty-one (51) members to one hundred and ninety-three (193).¹⁵⁹ The expansion in the number of States in the international system necessarily affects how supranational markets function.

Moreover, the development of subsequent supranational markets under the UN Charter directly and its auspices allowed for an expansion of a variety of supranational markets to deal with a variety of international problems across a variety of Earthly and space environments. For example, the UN Charter explicitly permits a very important supranational market under the UN Security Council (UNSC) whereby its five permanent members sell their valued preferences to other members to buy.¹⁶⁰ The outcome of these exchanges leads directly to binding and non-binding rules of international law.¹⁶¹ In addition, States may cooperate and form specific supranational markets to coordinate or protect certain State practices.¹⁶² Thus, the type of obligations a State purchases on the supranational market will vary relative to how the market from where the rule originates operates and potentially imposes costs, benefits, and risks.

¹⁵⁹ See United Nations Charter arts. 23-32. See also BROWNIE *supra* note 4.

¹⁶⁰ *Id.*

¹⁶¹ *Id.*

¹⁶² This behavior is observed in a variety of different contexts. For example, States that value whaling, land mines, or oil cartels each seek to ensure their respective State practice continues.

iv. Rules of Jurisdiction as the Allocation of Authority

While axiomatic, fundamentally, a rule can arise in three ways. First, a rule can arise informally, i.e., through no formal means by which a State develops the rule institutionally. When a State practice arises from an occurrence in the course of international relations and that occurrence produces a State practice, other States may independently adopt the same rule. For example, when the Soviet Union launched its Sputnik objects into orbit around the Earth, only the Soviet Union had first engaged in a State practice of launching objects into orbit and over the territories of other States.¹⁶³ Within three months of the first Sputnik launch, the US launched its Explorer object into orbit independent of, i.e., not in cooperation with, the Soviet Union.¹⁶⁴ Although the US followed suit, it could have also objected to such a State practice or other States could have objected to such a State practice; although there is no evidence of objection by States to the State practice of launching objects into orbit over the territories of other States. Thus, State practice itself can be evidence of rule formation independent of some formal means of exchange.

Second, a rule can arise formally, i.e., through some formal means by which a State uses an international institution or forms a temporary institutional framework to conclude the supply of a rule(s). In either case, formal rules are negotiated through some agreed upon procedures, i.e., rules that govern the cooperation among negotiating States Parties, within a particular institution or institutional framework.¹⁶⁵ The outcome of the

¹⁶³ See John Cobb Cooper, *Legal Problems of Upper Space*, 50 PROCEEDINGS AM. SOC'Y INT'L LAW 85 (1956), and *Russian Satellite* *supra* note 16.

¹⁶⁴ See *supra* note 17.

¹⁶⁵ See BROWNIE *supra* note 4.

process to negotiate a formal rule(s) provides evidence of the existence of the formal rule(s). For example, when the US sought to bring States together to negotiate a Charter for a United Nations, delegates operated within a temporary institutional framework that utilized rules of procedure to enable negotiations of formal rules.¹⁶⁶ The outcome of the negotiations resulted in the adoption of a codified set of formal rules of law, namely the Charter of the United Nations.¹⁶⁷ Where the institutional rules laid out the process for ratification, upon the satisfaction of those rules, i.e., satisfaction of the requirement(s) for which the treaty comes into force activating the treaty's obligations to States Parties, the Charter of the United Nations transitioned to a set of rules of law.¹⁶⁸ Subsequently, when States use the UN to formalize the negotiation of treaties, i.e., a set of rules of law, or the adoption of declarations and other documents that generate rules, these rules come about by formal means inherent to UN administration.¹⁶⁹

Third, a rule can arise as a rule(s) of law, i.e., a codified rule or set(s) of rules from at least one objectively cognizable source of authority that directs a subject's act or omission to prevent a breach of a rule of law. The negotiation of formal rules may give rise to a rule(s) of law when codified into at least one objectively cognizable source of authority, e.g., treaties and national law. Because codification provides evidence of the existence of a rule(s) of law, they can be considered an objective source of authority. However, the codification of rule(s) of law must also be cognizable, i.e., rules of law

¹⁶⁶ See BROWNLIE *supra* note 4. See also MARY ELLEN O'CONNELL, INTERNATIONAL LAW AND THE USE OF FORCE (Found. Press 2009).

¹⁶⁷ See BROWNLIE *supra* note 4.

¹⁶⁸ See *supra* note 4.

¹⁶⁹ See discussion in Chapter IV *infra* on the formal processes of rule adoption within the institutional framework of the UN.

must be clearly identifiable relative to the subject of the rule(s) of law and within the scope of the negotiated transaction(s), i.e., intent of the Parties, for a rule(s) of law.

While States can virtually engage in any exchange (i.e., occurrence or transaction) related to their valued preferences in the course of their international relations, this thesis however only considers rules as the consequence of negotiating and trading in components of power.¹⁷⁰ Within the system of international relations of States, the economic character of rules can take the form of public and toll goods. First, public goods are defined as goods that are non-excludable and non-rivalrous. A rule is non-excludable when States cannot prevent the consumption or use of a rule just because a State breached a rule. A rule is non-rivalrous when the consumption and/or use of the rule by one State does not reduce the availability of the rule to another State. In other words, a rule(s) apply to all States that have accepted or are under an obligation to accept a rule(s).

For example, in the case of international custom, States cannot exclude other States from the rule or its obligation as a function of State practice; where consumption of a rule by a State does not reduce availability to other States (e.g., in the acceptance of rules that represent rights, duties, and obligations under the international custom). States that supply and/or consume rules of jurisdiction cannot reduce the consumption of rules by other States in the absence of such a rule that limits consumption (e.g., the obligation that international agreements must be kept). In other words, if a State chooses or is compelled to consume a rule (by way of some other rule), consumption does not

¹⁷⁰ See *supra* note 4.

necessarily affect the supply of such a rule(s) to other States.¹⁷¹ In the absence of an overriding rule, a State cannot claim that a rule applicable to all is excluded to itself.¹⁷²

Second, toll goods are goods that are excludable, but non-rivalrous. A rule is excludable when a State can be prevented from accessing the rule when it does not pay the associated price of the rule. As with public goods, a rule is non-rivalrous when the consumption and/or use of the rule by one State does not reduce the availability or utility of the rule to another State. In other words, a rule(s) applies to all States that have accepted a rule(s), but only when a rule(s) is/are paid for through the acceptance of some cost – an affirmation of a voluntary acceptance of the rule, e.g., signature or ratification cost.¹⁷³

For example, in the case of international agreements, States Parties first negotiate language that will comprise the set of rules of the agreement.¹⁷⁴ The negotiation and conclusion of an international agreement each represent a type of transaction cost; however, these transaction costs do not necessarily represent the acceptance of the rules.¹⁷⁵ Acceptance or intent to accept such rules of jurisdiction arises from the price paid by a State in ratifying or signing the agreement, respectively.

The utility in the development and exchange of rules and rules of law is that both can engender greater certainty about the costs and risks involved in engaging in international relations.¹⁷⁶ States must balance the need for predictability and flexibility in

¹⁷¹ However, there might be a question of whether the rule in question is of a type considered a rule(s) of law. In addition, this does not mean that States cannot effectively dissuade other States from becoming a State Party to an international agreement.

¹⁷² See *supra* note 105, and BROWNLIE *supra* note 4.

¹⁷³ *Id.*

¹⁷⁴ See *supra* note 105.

¹⁷⁵ See ECONOMIC STRUCTURE *supra* note 4.

¹⁷⁶ See Barbara Koremenos, *Contracting around International Uncertainty*, 99 AM. POL. SCI. REV. 549 (2005).

how rules and rules of law of jurisdiction are defined and scoped in a way that maximizes valued preferences but minimizes risks of international relations. When in the course of international relations, various unintended or unexpected costs and benefits might arise from the adoption, proliferation, and evolution of rules and rules of law, States will engage in exchanges (occurrences and transactions) to amend or resign from a rule(s) that no longer meet(s) the valued preferences of some or all States.

While rule formation and consumption form the bases of the underlying analyses, the glue that binds States to rules is the concept of jurisdiction.¹⁷⁷ Jurisdiction plays an important role in the international legal system because it forms the basis of State authority over persons, things, and events outside a State's sovereign territory and represents what may be termed a "property right" of State sovereignty.¹⁷⁸ The fundamental question here is how is authority allocated within the international system of States?¹⁷⁹ Generally, jurisdiction allocates State authority in the international system on the basis of sovereign legal equality (i.e., each State in the international system possesses the same legal rights as any other sovereign State).¹⁸⁰ Rules of jurisdiction take the form of a pre-transactional right because, unlike in municipal law, there is no requirement that States give consideration in the supply or purchase of rules of public international law.¹⁸¹ While no supranational State exists that can compel States to accept rights, duties, or obligations under public international law, States by their sovereign nature are required and expected to adhere to established rules of public international law.¹⁸² Accordingly, a

¹⁷⁷ See *supra* note 4.

¹⁷⁸ *Id.*

¹⁷⁹ See *supra* note 95.

¹⁸⁰ See *supra* note 4.

¹⁸¹ *Id.*

¹⁸² See BROWNIE *supra* note 4.

State's ability to conduct foreign relations and engage in international relations (i.e., politics) provides benefits and costs that are inherently scoped by jurisdiction because the distribution of authority over persons or things or events subject to State authority must be necessarily analyzed against the authority of other States in the international system, including, but not limited to, authority over rule-formation.

When States engage in the supranational market of international relations, the outcome can be the formation of a rule(s) or a rule(s) of law of jurisdiction, depending on the circumstances of formation. A rule is defined as one or more instruction(s) of a policy. Policy is defined as a valued preference that guides a course of action from a subjectively legitimate source of authority that directs a subject's act or omission to prevent a breach of the rule(s). For example, when a group of States enter into negotiations for the development of a rule that commits each State to take a voluntary course of action within a certain period of time, the rule that arises is a common rule to all participant States, i.e., States mutually agree to perform the rule that defines a course of action.¹⁸³ The fact that the rule may be nonbinding or binding as a matter of law or that States voluntarily commit to follow the rule is sufficient evidence that a rule has formed, but not necessarily that the rule will be followed or imputes an obligatory effect on participant States absent certain facts.¹⁸⁴ Although the rule in question may be voluntarily adopted by each State, the cost of breach will tend to limit rule-breaking because the more a State is seen to breach an agreed-upon rule, the more likely the breaching State could be subject to reputation costs or some other sanction in the future.¹⁸⁵ Thus the cost

¹⁸³ See, e.g., ELLICKSON *supra* note 9.

¹⁸⁴ *Id.*

¹⁸⁵ See ECONOMIC STRUCTURE *supra* note 4.

of breach may compel a State to honor its commitments, even if not followed out of a sense of a legal obligation.¹⁸⁶ However, when a State devalues following the rule it may stop following the rule if the cost of breach is relatively low, the risk of breach is potentially small, or the State can negotiate with other potential defectors to undermine the effectiveness of the rule and minimize potential costs of breach to all defectors.¹⁸⁷

For example, the Allies of the Second World War sought to replace the League of Nations Charter with a United Nations Charter before the war had even ended.¹⁸⁸ Since doing so required the abandonment of the set of rules that had been agreed upon under the League of Nations Charter since January 1920, the circumstances at the time, i.e., the prospect that the Allies could win the war, gave the United States a market to develop new post-war rules. The act of unilaterally replacing the old set of rules with ones set by the Allies could have only occurred if the costs of doing so were less than the benefit of establishing a new set of international rules under the vehicle of a United Nations Charter without participation of the Axis States.¹⁸⁹

When States engage in activities outside their sovereign territories – including participation in international fora, the exchanges in the supranational market that arise from State practice are inherently an exchange in the assignment of State authority.¹⁹⁰ The only general requirement is that a State has the capacity to engage in foreign relations. However, this ability does not necessarily lead to zero transaction costs or

¹⁸⁶ *Id.*

¹⁸⁷ Devaluation will occur when a State's valued preferences change. *See* Figure 2.

¹⁸⁸ *See* BROWNIE *supra* note 4.

¹⁸⁹ This is evidenced by the fact that the United Nations Charter explicitly states why the States Parties sought to supply new rules to the international system. *See* United Nations Charter at Preamble & art. 1.

¹⁹⁰ *See* ECONOMIC STRUCTURE *supra* note 4.

efficient rule-development outcomes, but the capacity to engage in foreign relations may increase or reduce transaction costs and/or externalities in particular instances.¹⁹¹ For example, States created after the adoption of the UN Charter had no ability to negotiate the set of rules that comprise the Charter, but nonetheless purchased the rules of the Charter and general public international law because the principle of sovereign legal equality provides a necessary benefit.¹⁹² While some cost is paid by the State in the ratification of the Charter and rules of public international law, the assumption is that acceptance implies that the benefit is greater than the cost of not accepting how authority is allocated in the international system by way of jurisdiction over particular persons and things or events.¹⁹³ Thus, when States engage in activities that give rise to the development of rules, States are inherently entering a supranational market of international relations to buy and sell their authority in the form of rules of jurisdiction.¹⁹⁴

Rules of jurisdiction represent the allocation of State authority in the international system and can take two basic forms: choice of law and prescriptive jurisdiction.¹⁹⁵ Choice of law rules represent the specific power of a State to assert authority over particular persons or things or events to which States will consensually agree. Without a proper basis of jurisdiction in international disputes, a State's or a private party's case may lead to a dismissal of claims before a tribunal.¹⁹⁶ To deal with this potential situation, States may negotiate amongst themselves the allocation of authority to

¹⁹¹ *Id.*

¹⁹² *Id.*

¹⁹³ *Id.*

¹⁹⁴ *See supra* note 4.

¹⁹⁵ *See* ECONOMIC STRUCTURE *supra* note 4.

¹⁹⁶ *See* BROWNLIE *supra* note 4.

determine which and in what instances a particular State will have jurisdiction over a particular dispute.¹⁹⁷ For example, following the political integration of European States, members of the European Council negotiated and concluded an international agreement with regard to jurisdiction over civil and commercial disputes that may arise within the territories of member States.¹⁹⁸ States may provide by international agreement such rules of jurisdiction over persons, things, or events and define elements of the rules of jurisdiction to manage risk, provide benefits, or reduce costs to the State and its subjects.

Prescriptive jurisdiction, on the other hand, represents the general power of a State to assert authority over all persons, things, or events that stem from the principles of sovereignty, sovereign equality, and independence from interference in the internal affairs of a State (i.e., Westphalian concepts of State sovereignty).¹⁹⁹ There are five recognized bases of prescriptive jurisdiction under public international law.²⁰⁰ First, territorial jurisdiction is the most used allocation of authority in that a State has jurisdiction over all persons and things or events within its territory.²⁰¹ Second, nationality jurisdiction represents the allocation of authority over nationals of the State anywhere.²⁰² Third, passive personality jurisdiction represents the allocation of authority over events connected to a State's national, usually where the national might be a victim of some harm arising from conduct not within the territory of the national's State.²⁰³

¹⁹⁷ *Id.*

¹⁹⁸ See Council Regulation (EC) 44/2001 of 22 Dec. 2000, available at http://ec.europa.eu/justice/civil/files/practical_handbook_eu_international_law_en.pdf. See also TREVOR C. HARTLEY, INTERNATIONAL COMMERCIAL LITIGATION (Cambridge Univ. Press 2010).

¹⁹⁹ See BROWNLIE *supra* note 4, and KRASNER *supra* note 71.

²⁰⁰ See BROWNLIE *supra* note 4. See also S HOUSTON LAY & HOWARD J. TAUBENFELD, THE LAW RELATING TO ACTIVITIES OF MAN IN SPACE (Univ. Chicago Press 1970).

²⁰¹ *Id.*

²⁰² *Id.*

²⁰³ *Id.*

Fourth, protective jurisdiction represents the allocation of authority over threats to the security, integrity, or economic interests of a State outside its territory.²⁰⁴ Fifth, universal jurisdiction represents the allocation of authority over specific acts deemed contrary to the interests of the international community of States as a whole.²⁰⁵ As can be observed in relation to each definition, prescriptive jurisdiction is not necessarily consensual in nature and provides the scope (narrow or broad application) of authority within and outside of a State's territory.²⁰⁶

Why is jurisdiction important to rule-formation? Fundamental to all legal analysis is the application of rules of jurisdiction.²⁰⁷ Jurisdiction helps identify the structure and scope of the allocation of authority that States utilize to formalize their exercises in power over subjects (e.g., natural and juridical persons) and objects (e.g., things) of the law.²⁰⁸ When States seek to engage in the supranational market of international relations, they are effectively exercising their sovereignty in relation to other States because sovereignty is the highest valued part of a State that it can offer to the market.²⁰⁹ When States engage in practices related to its foreign relations, national security, or economic interests, they are guided by valued preferences, e.g., some utility assessment developed by their governments.²¹⁰ States may or may not choose to cooperate in the international system; however, regardless of the choice, the benefits and costs of engaging in international relations may give rise to the need to minimize and manage risks associated with State practice.

²⁰⁴ *Id.*

²⁰⁵ *Id.*

²⁰⁶ *Id.*

²⁰⁷ *See supra* note 4.

²⁰⁸ *Id.*

²⁰⁹ *Id.*

²¹⁰ *See POSNER & SYKES supra* note 4.

Although international cooperation is not a predetermined result of State practice, when States do engage in activities outside their territories they tend to negotiate for rules of jurisdiction in relation to certain persons, things, or events that serve the interests of the State.²¹¹ In the case of choice of law rules, States bargain for rules and may be required to trade in some component of power to get agreement among other potential States Parties to conclude and eventually execute an international agreement. However, with respect to prescriptive jurisdiction, States create supranational markets more akin to an auction where States can bid up or down the price of the rule of jurisdiction based on State practice and the scope of the legal obligation as a function of that State practice.²¹²

The important distinction between the law and economics literatures on national and international law arises from how and which types of goods are allocated within society.²¹³ While goods and services are bought and sold among buyers and sellers at the national level, the things bought and sold by States are their valued preferences that are negotiated and priced as a rule of jurisdiction that may lead to a reallocation of State authority relative to other States. On one hand, choice of law rules enable States to determine which rules of law might apply in disputes between them as well as the consensual acceptance of rights, duties, and obligations regarding some type of act or omission in the course of a State's international relations or the execution and administration of international agreements.²¹⁴ On the other hand, prescriptive jurisdiction provides rules scoped to limit the authority of a State in relation to the authority of other

²¹¹ See *supra* note 4.

²¹² See Marie Obidzinski & Bruno Deffains, *Real Options Theory for Law Makers*, 75 RECHERCHES ECONOMIQUES DE LOUVAIN, DE BOECK UNIVERSITÉ 93 (2009), available at <https://halshs.archives-ouvertes.fr/hal-00447170/document>.

²¹³ See ECONOMIC STRUCTURE *supra* note 4.

²¹⁴ See ECONOMIC STRUCTURE *supra* note 4.

States. In other words, by virtue of the principles of sovereignty and sovereign equality and a State's ability to engage in foreign relations, States may trade in components of power, like rules of jurisdiction, to achieve some individual utility. Whether or not the allocation or reallocation of authority is good or bad, efficient or inefficient is a separate issue.

To summarize, a State's valued preferences inform how a State will seek to apply its authority extraterritorially. In doing so, a State enters the supranational market in relation to some valued preference. Market participation will lead to a supply of rules of jurisdiction. Once rules of jurisdiction are supplied, States may or may not seek to price out rules of jurisdiction in relation to facts that define a State's valued preferences. Once States begin to price out supplied rules of jurisdiction, States may or may not buy or sell rules of jurisdiction that result from market participation. If a State does not buy a rule of jurisdiction in relation to some valued preference, then it may be no better off than other State that also does not consume the rule of jurisdiction. If, on the other hand, a State does buy and consume a rule of jurisdiction, it has bargained for that rule by some affirmative act.²¹⁵ However, over time State practice may change because a State's valued preferences may change. Hence, changes in State practice may instigate market participation again and necessitate a re-supply of rules of jurisdiction restarting the cycle of rule development.²¹⁶

²¹⁵ See *supra* note 105.

²¹⁶ See Figure 2.

A. Sources of Rules of Public International Law

Rules supplied to the supranational market have many sources. One codified source usually relied upon as a list of acceptable sources of public international law is found in article 38 of the Statute of the International Court of Justice (ICJ). Article 38 states that

The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:

- a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
- b. international custom, as evidence of a general practice accepted as law;
- c. the general principles of law recognized by civilized nations;
- d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.²¹⁷

²¹⁷ Statute of the International Court of Justice, art. 38(1) (a)-(d). Article 59 states that “The decision of the Court has no binding force except between the parties and in respect of that particular case.” Every dispute under public international law adjudicated by an international tribunal tends, in most cases, to use past case law as persuasive rather than controlling law. Hence, this is a limiting principle of international tribunals because international law does not permit precedent to control future cases automatically like in common law courts. While unexplained in this thesis, it would be interesting to analyze if the temporal aspects of international adjudication affects rule development and whether the lack of binding precedent plays a role.

This thesis analyzes each recognized source of public international law to demonstrate the evolution of those rules for which States have bargained in the supra-national market of international relations relating to the outer space environment. The sources listed in article 38 above are formally recognized as sources of public international law.²¹⁸ However, much of the modern literature on public international law argues that certain rules of international custom actually form the basis of formal sources of law.²¹⁹ As Fitzmaurice argues, a treaty only contains the codification of material sources of law like contracts.²²⁰ In other words, treaties form sources of obligations for the States Parties. The formal source of the law of treaties comes from the rule of international custom defined by the phrase *pacta sunt servanda* (“agreements must be kept”).²²¹ Because international custom applies to all States that follow the same practice and have given notice of the purchase of the obligation of the practice, the authority to recognize and seek recognition of another State’s authority must necessarily derive from the shared valued preferences of States.

This thesis treats any source of rules as potential sources of public international law without making formal or material distinctions. However, the foregoing analysis is limited directly to the application of international custom, treaties, and general principles of law in relation to the outer space environment. All subsidiary sources, such as “judicial decisions and the teachings of most highly qualified publicists,”²²² provide only additional means of evidence of the definition, meaning, and scope of rules of public

²¹⁸ See BROWNLIE *supra* note 4.

²¹⁹ See EIRIK BJORGE, THE EVOLUTIONARY INTERPRETATION OF TREATIES 14 (Oxford Univ. Press 2014).

²²⁰ See G. FITZMAURICE, SYMBOLAE VERZIJL: PRESENTEES AU PROFESSEUR JHW VERZIJL A L’OCCASION DE SON LXX-IEME ANNIVERSAIRE 157-60 (Mattijs Nijhoff 1958), *in supra* note 219.

²²¹ See *supra* note 219.

²²² Statute of the International Court of Justice art. 38.

international law. Thus, all subsidiary sources used in this thesis are not treated as formal sources of public international law, but provide a means to determine the scope of the definition and meaning of rules that may be supplied to the supranational market.

1. International Custom

The rule of international custom may be defined as a general and consistent State practice performed out of a sense of legal obligation.²²³ Rules of international custom can be confined to a region, among States who use international custom in the course of a particular State practice, or broadened to all States who use the basis of State practice out of a sense of legal obligation.²²⁴ Because State practice is a product of the valued preferences of States, rules of international custom necessarily affect how States value the generation of such rules.

The formation and development of rules of international custom ultimately derive from State practice. However, the formalization of rules of international custom arise from the consensual nature of the international system of States. Moreover, changes in a State's valued preferences will necessarily produce changes in State practice. Changes in State practice will lead to changes in how State's supply rules to the supranational market of international relations. In doing so, these processes reflect how States value the need for such rules as a function of their perceived payoffs in relation to the strategies of other States engaged in the same State practice, rule supply, and/or rule consumption. However, the temporal measure of preference revelation can have significant effects on

²²³ See *supra* note 108. See also BROWNLIE *supra* note 4.

²²⁴ *Id.*

the rate of rule formation and development due to inherently inertial forces within the State itself.²²⁵

Nonetheless, sometimes changes in State practice will result in the valued preference of objecting to rule generation because the developing practice does not manifest as a valued preference of other States.²²⁶ Applying the framework that the international system operates like a private legal system, the act of persistently objecting to a rule of international custom derives from the express consent of States in the international system.²²⁷ In order to provide sufficient notice to other States of their objection to a rule of international custom, States must manifest their objections through some express action.²²⁸ This express act signals an alternative value for the supplied rule to the supranational market and represents an express denial to any attempt at nonconsensual rule-making.²²⁹

The act of persistently objecting has evolutionary effects on rule supply because States that consistently object to some types of rules that may be supplied or consumed puts those States in a different relationship with States who perform the same State practice and that have formalized the consumption of the rule in question.²³⁰ On one hand, the presumption against nonconsensual rule making sets forth the scope of which a State cannot be obliged to follow the rule, the breach of which may impose a liability on

²²⁵ See *supra* note 176.

²²⁶ See BROWNLIE *supra* note 4.

²²⁷ See Vincy Fon & Francesco Parisi, *Stability and Change in International Customary Law*, 17 SUP. CT. ECON. REV. 279 (2009).

²²⁸ *Id.* (“An exemption from the binding custom is obtained by subsequent objector states only to the extent to which the prospective beneficiaries of the rule acquiesce to the departure.”)

²²⁹ See *supra* note 111. *C.f.* Ayres & Talley *supra* note 125.

²³⁰ It is assumed that these processes are cyclic as a product of shifting valued preferences because States have the right to decide how best to manifest their own preferences.

the State that may be enforced by other States without its consent. On the other hand, a State may want to limit the content of a rule and therefore declare reservations or objections to certain interpretations of the rule in question.²³¹

However, because the two basic elements of international custom derive its meaning from the expression of State practice, evidence of rule consumption could manifest as a result of the outcome of exchanges in other supranational markets of international relations. For example, if a State enacts a national law that provides the basis for the State practice in question, then that act provides evidence of rule as a product of in the legal obligation defined by the State's legislation.²³² Alternatively, the codification and consumption of rules derived from international agreements, when concluded and in force, may also express State practice and will reflect the degree to which a State has purchased a particular legal obligation relative to other sources of rules.²³³

However, the consumption of a rule in one supranational market does not necessarily mean consumption of a rule in another supranational market. In other words, the fact that the source of the rule (i.e., custom, treaty, national law) can arise in three particular supranational markets has at least one common element, i.e., State practice. Since State practice is the physical manifestation of the State in the international system, the process by which a State could consume a rule relative to the source(s) of the rule varies because States have the freedom to determine and choose how rules form and develop that express that valued preference in the form of State practice. This can be

²³¹ See *supra* note 149.

²³² See Diane Howard, *Distilling General Principles of International Space Law*, 64 COLLOQ. L. OUTER SPACE (2013).

²³³ See BROWNIE *supra* note 4.

modeled using game theory to determine which stratagems are the most optimal or sub-optimal in attempting to maximize a valued preference. Consequently, rules of international custom are the product of the outcomes of State's trying to supply specific rules to ensure the formation and continuation of the underlying State practice.

2. Treaties

Article 38(1)(a) defines treaties as “international conventions, whether general or particular, establishing rules expressly recognized by the contesting states.”²³⁴ Treaties represent a codification of a set of rules supplied by States as a result of cooperative behavior in rule development. Once concluded, the set of rules that comprises a treaty are supplied to the supranational market of international relations and the ability to consume a treaty's rules may have barriers to entry depending on the valued preference of States that negotiated the treaty to supply rules. Fundamentally, treaties codify the obligations of States under the international customary rule of *pacta sunt servanda*, i.e., agreements must be kept by States Parties.²³⁵ The obligations, duties, and rights for which States Parties negotiate are the substance of treaties. Moreover, many of the sources of rules of treaty law derive from international custom, and the codification (to a large extent) of international custom regarding international agreements is found in the *Vienna Convention on the Law of Treaties* (VCLT).²³⁶

²³⁴ Statute of the International Court of Justice art. 38(1)(a).

²³⁵ See BROWNIE *supra* note 4.

²³⁶ Vienna Convention on the Law of Treaties, *opened for signature* May 22, 1969, 1155 U.N.T.S. 331.

It is assumed that States act as individuals in the supranational market of international relations, where the intention of a State may be inferred from its observed State practice in satisfying its valued preferences in relation to other States. Since every State under study is a member of the UN, there is no question as to whether a State under study has the capacity to transact with other States to create and conclude a treaty. Incidentally, this quality permits States to collude, compete, enter or leave any supranational market of international relations or return the purchased obligation subject to the costs and benefits of State practice.

By definition, the international system of States does not exist with a supranational authority over it with the ability to enforce rules of international law.²³⁷ As such, compensating a State that is the victim of a breach of an international obligation does not function in the same way that disputes are resolved in national courts.²³⁸ This, however, does not mean that States cannot find ways to ensure conformity to rules of international law against other States that breach their “bargained for” or purchased legal obligations.²³⁹ When States have disputes, they may seek resolution from a variety of sources.²⁴⁰ Each possible remedy may be cooperative or non-cooperative in nature based on how the valued preference of a State arises in the form of a State practice.²⁴¹ Since State practice is the mechanism by which States supply rules to the supranational market, States may supply rules for dispute resolution mechanisms, e.g., international tribunals or arbitration courts, which may only have a binding legal effect when States consent to the

²³⁷ See BROWNIE *supra* note 4.

²³⁸ *Id.*

²³⁹ See ECONOMIC STRUCTURE *supra* note 4, and *supra* note 96.

²⁴⁰ See BROWNIE *supra* note 4.

²⁴¹ *Id.*

consumption of such rules that they may supply.²⁴² Therefore, a resolution of what the law is occurs from the consensual supply and consumption of rules by States to a third party to adjudicate the dispute, the basis of which is an international agreement.²⁴³

Moreover, since the nature of the international system is based on consent and that consent forms the basis for the mutual exchange of rules of jurisdiction, such rules can only arise from cooperation among and between interested States.²⁴⁴ The primary example of the manifestation of cooperation among and between States is generally observed from the negotiation and conclusion of international agreements.

Fundamentally, an international agreement is the codification of a set of rules of jurisdiction. States consume these rules with respect to the trading in components of power the cost of which may vary depending on the nature of the exchange in the supranational market. Consumption of treaty rules can arise in the form of a State's signature, ratification, accession, or succession to/of a treaty.²⁴⁵ In the case of consuming rules through the price of signature, the associated cost is only that the State has an intention to be bound by the obligations of the treaty's rules, not that the State actually paid the full price of the legal obligation.²⁴⁶ On the other hand, States may have a preference to consume rules by purchasing the legal obligation in order to extend their authority over the subject matter for which rules are supplied to the appropriate supranational market. When States consume rules by paying the price of ratification, accession, or succession, the associated costs is the purchase of the legal obligation that

²⁴² *Id.*

²⁴³ *Id.*

²⁴⁴ *See supra* note 4.

²⁴⁵ *See supra* note 105.

²⁴⁶ The cost incurred takes the form of the full obligation owed to other States Parties to the treaty in the case of ratification. However, in terms of signature, the cost incurred takes the form of a down payment to invoke the rules of the treaty without incurring the full cost of the obligation.

signals to the supranational markets a rule's value and price to other States that could enter the supranational market.

The value of treaty adoption is measured by the number of States that sign and/or ratify a particular treaty. However, the value of any treaty must be taken in relation to the number of States in the international system at a particular point or period in time. This ratio provides an objective measure of a treaty's relative value over time because it considers changes to the number of States that could enter the supranational market of international relations for rule development and consumption.

(a) Treaty Interpretation

As a codification of rules of customary international law, the VCLT provides two important methods in which to gauge the meaning of a treaty and its obligations and terms.²⁴⁷ First, the general rule of treaty interpretation under article 31 of the VCLT provides that

A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose . . . [and] special meaning shall be given to a term if it is established that the parties so *intended*.²⁴⁸ (emphasis added)

²⁴⁷ See *supra* note 236.

²⁴⁸ *Id.*, at art. 31. ("1. A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose. 2. The context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes:

Second, the VCLT allows for supplementary means of interpretation under article 32, which includes “the preparatory work of the treaty and the circumstances of its conclusion . . .” [so that nothing] “leaves the meaning ambiguous or obscure[,] or [] leads to a result which is manifestly absurd or unreasonable.”²⁴⁹

Third, article 33 of the VCLT provides further rules on the authentication of two or more copies of the same treaty when codified in different languages.²⁵⁰ Although the text of each treaty in any official language that the Parties originally adopt is equally authoritative, when due to differences in translations each authoritative text diverges from the others, article 33 provides that “the meaning which best reconciles the texts, having regard to the object and purpose of the treaty, shall be adopted.”²⁵¹ This rule is especially

(a) any agreement relating to the treaty which was made between all the parties in connexion with the conclusion of the treaty; (b) any instrument which was made by one or more parties in connexion with the conclusion of the treaty and accepted by the other parties as an instrument related to the treaty.

3. There shall be taken into account, together with the context:

(a) any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions; (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation; (c) any relevant rules of international law applicable in the relations between the parties.

4. A special meaning shall be given to a term if it is established that the parties so intended.”).

²⁴⁹ *Id.*, at art. 32 (“Recourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances of its conclusion, in order to confirm the meaning resulting from the application of article 31, or to determine the meaning when the interpretation according to article 31:

(a) leaves the meaning ambiguous or obscure; or (b) leads to a result which is manifestly absurd or unreasonable.”).

²⁵⁰ *Id.* (“1. When a treaty has been authenticated in two or more languages, the text is equally authoritative in each language, unless the treaty provides or the parties agree that, in case of divergence, a particular text shall prevail.

2. A version of the treaty in a language other than one of those in which the text was authenticated shall be considered an authentic text only if the treaty so provides or the parties so agree.

3. The terms of the treaty are presumed to have the same meaning in each authentic text.

4. Except where a particular text prevails in accordance with paragraph 1, when a comparison of the authentic texts discloses a difference of meaning which the application of articles 31 and 32 does not remove, the meaning which best reconciles the texts, having regard to the object and purpose of the treaty, shall be adopted.”)

²⁵¹ *See supra* note 236, at art. 33.

important to note given that the Outer Space Treaty and its sister treaties are multilateral treaties adopted in five official languages, each equally authoritative.²⁵²

If or when actual substantive conflict arises between States as to any claim of a breach of an international obligation, duty, privilege, or right, a tribunal, whether international or national, will be required to look to the rules that comprise the corpus of public international law and the *lex specialis* of space law to resolve the dispute. This creates a problem that most treaties face over time, i.e., does modern evidence of intention correspond with the bargained for intent of the parties *when* States Parties concluded and/or ratified the treaty in question? (Emphasis added). In other words, is it permissible to interpret treaties in a manner that does not prohibit the evolution of the meaning of its terms?

Since this thesis depends on an understanding of how rules and rules of law evolve over time, it is important to understand what constitutes rule evolution and how the concept of rule evolution applies to the problems investigated. To begin, as a matter of treaty law, evolutive interpretation can be defined as “an interpretation where a term is given a meaning that changes over time.”²⁵³ As Helmersen notes,

[a]s with all interpretations, the evolutive *interpretation* of a term is distinct from its *application*. This also means that a change of mind is not an evolutive interpretation. In interpreting a term that is open to multiple interpretations, a court may choose one interpretation in one case, and then

²⁵² See *supra* note 105. See also *supra* note 21.

²⁵³ Sondre Torp Helmersen, *Evolutive Treaty Interpretation: Legality, Semantics and Distinctions*, 6 EUROPEAN J. LEG. STUDIES 127 (2013).

change its mind and prefer another in a later case. This way, the term's meaning can be said to have 'changed' over time. However, if the change is not prompted by an evolution intended by the parties, the interpretation is not evolutive. The term has not evolved; only the opinion of the court.²⁵⁴ (Emphasis in the original).

Moreover, a treaty term's meaning usually evolves because of an evolution in the linguistic meaning of the term independent of the interpretation; "[h]owever, a term does not have to evolve linguistically to be interpreted evolutively."²⁵⁵

When States go to the trouble of expending resources to negotiate and conclude treaties, the process of rule development arises from the trading of components of power, i.e., rules of jurisdiction. The substance of this process is grounded in the intent that the States Parties had certain definitions and meanings for terms based on the convergence of their valued preferences into agreed upon rules. An issue then arises as to how temporal effects could change or expand the definition and meaning of terms within a treaty. Since economics, politics, culture, and technology change over time, rules of law are subject to social forces that affect the stability and flexibility of the original intent of the States Parties. While treaty amendment is possible in many cases, amendment is nevertheless difficult in practice and is not observed consistently within the practice of treaty law due to the high transaction costs usually associated with amending treaties.²⁵⁶ To what extent does the evolutive interpretation of treaty terms arise?

²⁵⁴ *Id.*, at 128.

²⁵⁵ *Id.*

²⁵⁶ See *supra* note 105. See also *supra* note 111.

In *THE EVOLUTIONARY INTERPRETATION OF TREATIES*, Bjorge seeks to answer “[w]hat is the place of the evolutionary interpretation of treaties with the rules of treaty interpretation codified in the VCLT.”²⁵⁷ Bjorge’s study reviews approximately two hundred international and national law cases dealing with the methods by which jurists interpret treaty terms.²⁵⁸ Given the various methods of treaty interpretation by courts, the answer Bjorge arrives at is

that the evolutionary interpretation is, in common with others types of interpretation, an outcome of the process described in the general rules of interpretation. There is thus nothing exceptional about evolutionary interpretation; in common with other types of interpretation it is based upon the objective establishment of the *intention* of the parties.²⁵⁹ (Emphasis added).

By way of example, the study begins with an analysis of the phrase “evolutionary interpretation” as proffered by the ICJ in the 2009 case *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)* (*Navigational Rights* case).²⁶⁰ In the *Navigational Rights* case, the question before the ICJ “was whether the phrase ‘for the

²⁵⁷ *Supra* note 219, at 1. *See supra* note 236.

²⁵⁸ *Supra* note 219, at ix-xix.

²⁵⁹ *Id.*

²⁶⁰ *See* *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicar.)* (hereinafter *Navigational Rights* case) (Judgment) 2009 ICJ Rep. 213. *See also* BROWNIE *supra* note 4; *supra* note 105; and Martin Dawidowicz, *The Effect of the Passage of Time on the Interpretation of Treaties: Some Reflections on Costa Rica v Nicaragua*, 24 LEIDEN J. INT’L L. 201 (2011).

purposes of commerce’ in the Nicaraguan-Costa Rican treaty of limits of 1858^[261] covered tourism, [i.e.,] the carriage of passengers for hire.”²⁶² The ICJ held that the phrase “for the purposes of commerce” must be interpreted to extend to all modern forms of commerce.²⁶³ Since the Parties signed the treaty in question in 1858 and given the period of time that has elapsed, any analysis of the meaning of the term “for the purposes of commerce” must consider the “situation in which the parties’ intent upon conclusion of the treaty was, or may be presumed to have been, to give the terms used – or some of them – a meaning or content capable of evolving, not one fixed once and for all, so as to make allowance for, among other things, developments in international law.”²⁶⁴ As Bjorge explains “[w]here the parties have used generic terms in a treaty, the parties necessarily having been aware that the meaning of the terms was likely to evolve over time, and where the treaty has been entered into for a long period of time, . . . , the parties must be presumed, as a general rule, to have *intended* those terms to have evolving meaning.”²⁶⁵ (Emphasis added). Thus the primary issue in treaty interpretation is an analysis into the intent of the States Parties.

As discussed *infra*, the Outer Space Treaty and its subsequent sister treaties are over forty years old. Since technological development tends to occur more rapidly than the development of rules of law, the rules of international law as expressed in the space treaties analyzed will most likely create definition and application problems as outer

²⁶¹ *Supra* note 219, at 1, fn. 3 (“Treaty of Limits, [signed] 15 April 1858, 118 [Consolidated Treaty Series (Oxford Univ. Press 1969)] 439 (in the Spanish original: ‘con objetos de comercio’)”). Term ‘objetos’ in Spanish means ‘objects or things’ in English.

²⁶² *Supra* note 219, at 1.

²⁶³ See Navigational Rights case *supra* note 260.

²⁶⁴ *Id.*, at 45, fn 2.

²⁶⁵ *Supra* note 219, at 1.

space activities continue to evolve with changes in the valued preferences of States. Criticisms today include arguments that view the rules that comprise each treaty, and in particular the Outer Space Treaty, signifying aspirations of law rather than binding legal obligations²⁶⁶ or becoming increasingly irrelevant to deal with the legal issues associated with changes in State practice.²⁶⁷ Such arguments generally do not have legal validity and discount or reject evolutionary interpretative methods to treaties, which is grounded in the intent of the Parties. If the treaty terms are overly broad but clearly express the intent of the Parties, then courts will have recourse to extend such terms to some later in time application to fit within the intent of the States Parties. It should be expected that courts will continue to utilize such evolutionary interpretative methods in the future to reach decisions in disputes regarding State practice in the outer space environment.

3. General Principles of Law

Per article 38(1)(c) of the Statute of the ICJ, general principles of law are recognized as a legitimate, applicable source of rules of public international law that can be applied in international disputes.²⁶⁸ To international legal jurists, general principles of law help fill in the gaps found between other sources of rules of public international law

²⁶⁶ See Jason Koebler, *The US Mulls Breaking an International Treaty So Americans Can Mine Asteroids*, MOTHERBOARD.VICE.COM, May 14, 2015, available at <http://motherboard.vice.com/read/the-us-mulls-breaking-an-international-treaty-so-americans-can-mine-asteroids> (“After a series of heated debates, committee chairman Rep. Lamar Smith (R-TX) stated bluntly that there is “nothing in this act that violates the law. The Outer Space Treaty is a series of guiding principles subject to legal interpretation,” not a binding law.”)

²⁶⁷ See John Hickman, *Still crazy after four decades: The case for withdrawing from the 1967 Outer Space Treaty*, THE SPACE REVIEW.COM, Sept. 24, 2007, available at <http://www.thespacereview.com/article/960/1>.

²⁶⁸ Statute of the International Court of Justice at art. 38(1)(c).

because comparative analysis of national laws provides a measure of consistency in determining rules of decision for particular types of disputes.²⁶⁹ The effectiveness of the use of general principles of law arises because those legal principles that are common to a large number of systems of municipal law (i.e., national law) forms a common foundation of rules of law that are “often the only source of international law in the absence of an applicable treaty.”²⁷⁰ Although States generate national law particularly independent of the supranational market of international relations, the promulgation of national law nevertheless represents a supply of rules to the supranational market of international relations because the act represents a signal of acceptable rules to the international community of States, i.e., acceptable to at least the supplying State. Consequently, the common usage (in terms of definition, meaning, and scope) of rules of jurisdiction among States that may develop from the exchanges and consumption of rules in the supranational market of international relations tends to intersect with rules that derive from the promulgation of national law. Convergence to one definition and meaning, with minimized scope, of a rule of jurisdiction creates observable consensus from among the State practices of the international community of States that may establish a common legal obligation.

Because general principles of law derive from national law, evolution in rules of national law can give rise to changes in general principles of law over time.²⁷¹ If international agreements are codified into the national law of a State, then that supply of

²⁶⁹ See Rudolf B. Schlesinger, *Research on the General Principles of Law Recognized by Civilized Nations*, 51 AM. J. INT’L L. 734, 735 (1957) [hereinafter Schlesinger]; M. Cherif Bassiouni, *A Functional Approach to “General Principles of International Law”*, 11 MICH. J. INT’L L. 768, 798 (1990); and BIN CHENG, *GENERAL PRINCIPLES OF LAW AS APPLIED BY INTERNATIONAL COURTS AND TRIBUNALS* (Cambridge 1953) (2006).

²⁷⁰ Schlesinger *supra* note 270, at 745. See BROWNIE *supra* note 4.

²⁷¹ See Jaye Ellis, *General Principles and Comparative Law*, 22 EUROPEAN J. INT’L L. 949 (2011).

rules may also constitute a resupply of rules in the form of national law or State practice because of the acts of promulgation or ratification. This creates a feedback loop of rules of jurisdiction from State practice to purchasing the obligation arising from an international agreement. Moreover, the content of a rule(s) of jurisdiction, i.e., the definition, meaning, and scope of a rule, may also change due to changes in how a State(s) define(s) a particular rule of jurisdiction as a function of changes to its/their valued preferences. Furthermore, general principles of law are distinct from international custom in that the State practice element is only deemed necessary because the obligation of law is already satisfied by the national law's internal promulgation by the sovereign.²⁷²

For example, the rule of law defined as *due process* is found in many legal systems, both modern and historical.²⁷³ Although defined with greater specificity in some legal systems, *due process* is a general principle of law respected by almost all States because of the recognition that the marginal benefit of affording a person *due process* (i.e., respecting the minimal rights of the accused to enforce the rules of law of the sovereign by prescribing a specific process by which the fair administration justice must follow)²⁷⁴ is greater than the marginal cost of providing no process at all (i.e., arbitrarily ascribing justice to dispense with a perceived violation of a rule of the sovereign).²⁷⁵ Those sovereigns who deny *due process* to persons do so because the State does not price the rights of the accused and therefore the State never had a preference to afford such a right in the first place. Nevertheless, *due process* represents a general principle of law as

²⁷² See *supra* note 232.

²⁷³ See POSNER *supra* note 32. See also Barnabas D. Johnson, *Due Process of Law*, available at <http://www.jurlandia.org/dueprocess.htm> accessed Dec. 10, 2015.

²⁷⁴ See POSNER *supra* note 32.

²⁷⁵ *Id.*

much as it represents an international custom even if a difference in legal obligation exists.²⁷⁶ What matters is how congruent State practice is with respect to a rule(s) in question. Hence, the economic analysis *of* and *in* general principles of law seek to demonstrate the distinctions and connectedness of rules and rules of law arising from rule formation and evolution.

General principles of law derive from two major sources of jurisprudence, i.e., the common law and civil law.²⁷⁷ Stated simplistically, rules of law derived from the common law are said to arise because of the adversarial nature of rule-making, while rules of law derived from the civil law are said to arise from the inquisitorial nature of rule application.²⁷⁸ Where the life of the common law derives consistency and evolution in rule-making from precedent, the life of the civil law builds upon the codification of rules derived from the legislature and applied to each dispute without the need for precedent.²⁷⁹

To illustrate this point, consider how both the common law and the civil law traditions treat the law of contracts. In American common law, the Holmes's option theory of contracts²⁸⁰ posits a general rule of law for contracts in that "there is no

²⁷⁶ The basis for the legal obligation with respect to international custom is that the State, in accordance with its practice which generates the rule, follows the rule in question as a matter of internal legal obligation. Relative to other States, a State following a rule of international custom does so through some expression of its State practice and therefore evidence of legal obligation is necessary to say that a specific rule of international custom exists. Moreover, the legal obligation may be inherent as a matter of general principles of law because it is dependent on the method by which the legal obligation manifests within a State's national legal system. When a group of States follows a rule, as a matter of its internal legal obligation, the commonality that exists in the rule itself across the group of States may raise it to the level of a general principle of law, if no significant deviations exist as a matter of how each State defines the rule within its legal system. *See supra* note 232.

²⁷⁷ *See* POSNER *supra* note 32.

²⁷⁸ *Id.*, at 989.

²⁷⁹ *Id.*

²⁸⁰ *Id.*

obligation to honor a contractual undertaking – just an obligation to pay the other party’s damages if you decide not to perform,” leaving open almost all possibilities of breach to provide for rule formation and evolution in rules of contract law.²⁸¹ In the civil law tradition, the rule of law for contracts follows the rule of *pacta sunt servanda* (“agreements must be kept”), giving direction to the obedience of the obligation where the written source, i.e., the agreement, forms the basis of the obligation.²⁸²

Where differences exist in contract law between the common and civil law traditions, so does State practice. However, the essence of general principles of law is that such rules of law have a common basis, both for procedural and substantive rules of law, across States. Where a State permits the formation of contracts, State practice in regard to contract formation exists and the national law creates an obligation of law internal to the sovereign. Consequently, when a sample of States that permit the activity of contracting, these States may also supply rules to limit how contracts may be formed, given that the appropriate measure of a general principle of law of contract formation exists.²⁸³ However, deviations in State practice with regard to limitations on contract formation can create international custom with respect to contract formation with attendant limitations because the obligation generally arises from the need to apply a State’s authority extraterritorially. Although common rules of contract between States exist, observable deviations in national law rules for contract formation from independent sources of the content, i.e., the definition, meaning, and scope, of the State practice in question and the obligation of law may no longer be assumed relative to other States.

²⁸¹ *Id.*, at 989.

²⁸² *Id.*

²⁸³ This measure may consist of application of comparative legal analysis to determine the common core of a rule’s content, i.e., definition, meaning, and scope.

Thus, such changes can give rise to changes in what may constitute a general principle of law and its ability to fill in gaps under public international law because of the common source and content of rules supplied from the promulgation of national laws indicate independent rule-development and supply.²⁸⁴

²⁸⁴ *See supra* note 270.

CHAPTER II

ANALYTICAL CONCEPTS AND METHODOLOGIES

a. Overview of Methodological Approaches

The sum of this thesis represents the use of several methodological approaches from several fields of study interwoven with contextual historical analysis. This is done for two reasons. First, the quantification of rules requires, at a minimum, both a legal and historical foundation because it provides context to the underlying mathematics. Second, to measure how rules come into existence, proliferate, and evolve, the use of subjective and objective measures of analysis produces a means by which to identify relative patterns in preference revelation and rule development. Although economic methodologies have limitations, grounding how rules become law and how rules and law evolve over time to study patterns in rule development necessitates an evaluation of how an observer views particular problems identified in various literatures against what has historically occurred. Thus, the goal here is to identify those metrics which may be useful for future analyses.

In chapter III, preference revelation and rule development in the formation of the first rule of space law is explored. First, an application of historical analysis of the events leading up to the launch of Sputnik I is utilized to single out the necessary variables that enabled the generation of rules of jurisdiction that produced the supranational market

exchange from the strategic choices of the United States and the Soviet Union. Three variables are defined: (1) the technology to launch objects into the outer space environment, (2) the supply of, but failed consumption of, rules of jurisdiction for verification overflights of the US and the Soviet Union by each State's representatives, and (3) the purchase of rules of jurisdiction relating to the International Geophysical Year of 1957-58. Second, basic game theory is applied to the three variables to test the stratagems used by the US and the Soviet Union leading up to the Sputnik and Explorer launches. Since State practice is the product of preference revelation, the stratagems employed by each State manifest from their respective State practices. Hence, a rule may be measured as a consequence of State practice by the stratagems each State employs.

In Chapter IV, historical, economic, and comparative analyses are applied to rule and supranational market development. First, economic analysis is applied to quantify market participation and rule consumption and generate possible trend lines to predict how future supranational markets and rules might evolve. Second, historical and comparative analyses are utilized to study how preference revelation and rule supply evolved from the State practice of launching objects into the outer space environment.

In Chapter V, economic analysis is applied to quantify rule supply and evolution as well as the growth of market participation. First, the data sets relating to national (space) law promulgation are analyzed as the product of rulemaking. Second, the national law data sets are compared to the treaty data sets to analyze the evolution and rates of rule consumption. Third, both the national law and treaty data sets are analyzed to measure the rate of market participation across the supranational markets for rules and rules of law relating to the activities of States in the outer space environment.

b. Game Theory

Game theory represents the analysis of strategic behavior in competitive situations among a set of players. Each player's payoff relative to the possible strategies chosen by each player in a game is evaluated.²⁸⁵ A game is a mathematical construct that analyzes the interactions of rational, mutually cognizant set of players where each decision made by one player affects the payoffs of other players.²⁸⁶ The number of players, their representative strategies, and the resulting payoffs in a measured outcome comprises the essential elements of a game.²⁸⁷ A set of players may play a game once, over some period of time, for an undetermined period of time, or infinitely.²⁸⁸ But the characteristic element of a game is that each choice made by one player has consequences on the payoff to the other player.²⁸⁹

This thesis uses a very simple model of a game. For the purposes of Chapter III analysis, the game of initial rule formation is played by two players: the United States (US) (player 1) and the Soviet Union (SU) (player 2). Each player has two strategies: cooperate (C) or defect (D). Based on these two strategies, payoffs range between plus one (+1) and minus one (-1), where the value +1 represents the maximum benefit for a particular strategic choice, the value zero (0) represents neither a detriment nor a benefit to the player, i.e., no payoff (status quo), and the value minus one (-1) represents the

²⁸⁵ See GAME THEORY AND THE LAW (Eric B. Rasmusen, ed., Edward Elgar Publ'g 2007), and ERIC RASMUSEN, GAMES AND INFORMATION, AN INTRODUCTION TO GAME THEORY (Basil Blackwell 2001) (1989).

²⁸⁶ *Id.*

²⁸⁷ *Id.*

²⁸⁸ *Id.*

²⁸⁹ *Id.*

maximum detriment for a particular strategic choice.²⁹⁰ The payoff continuum ($[\alpha, \beta] = [1, -1]$) represents the commoditized valued preferences of the players as defined by the historical record.²⁹¹ The payoff scheme applies to each game played.

Table 1: Strategy Payoffs Arising from Initial Rule Formation

Payoffs	US	SU
O	1	-1
NO	0	0
I	1	1
NI	-1	-1

As Table 1 above shows, the United States (US) and the Soviet Union (SU) have payoffs for each strategic choice for each game. With respect to the first game, if the US chooses to cooperate with the SU on the Open Skies Treaty (O), the US will earn a payoff of +1 because it has sought to maximize its valued preference of negotiating for overflight rules.²⁹² If the US chooses to defect and not pursue the Open Skies Treaty (NO), then the US will earn a payoff of zero (0) because no change in circumstances occurred as a result of the strategic choice. Conversely, if the SU chooses to cooperate with the US on the Open Skies Treaty (O), then the SU will earn a payoff of -1 because the strategic choice would expose the military gaps between the two players and would create significant unacceptable strategic risks and costs.²⁹³ If the SU chooses to defect

²⁹⁰ *Id.*

²⁹¹ This range was chosen because it bounds and permits the fractionalization of payoffs. However, for purposes of Chapter III analysis, these values will be taken absolutely in order to keep the analysis simple and clear.

²⁹² See discussion in Chapter III *infra*.

²⁹³ *Id.*

and not pursue an Open Skies Treaty (NO), then the SU will earn a payoff of 0 because no change in circumstances occurred as a result of the strategic choice.²⁹⁴

With respect to the second game, if the US chooses to cooperate as a participant of the International Geophysical Year of 1957-58 (I), the US will earn a payoff of +1 because it has sought to maximize its valued preference of launching an object over the territories of other States for surveillance purposes.²⁹⁵ If the US chooses to defect and not pursue participation in the International Geophysical Year of 1957-58 (NI), then the US will earn a payoff of -1 because it would create a detriment in the form of political and technological outcomes that do not satisfy its valued preference to launch an object over the territories of other States.²⁹⁶ Conversely, if the SU chooses to cooperate as a participant of the International Geophysical Year of 1957-58 (I), then the SU will earn a payoff of +1 because it has sought to maximize its valued preference of launching an object over the territories of other States for technological and political propaganda in the Cold War.²⁹⁷ If the SU chooses to defect and not pursue participation in the International Geophysical Year of 1957-58 (NI), then the SU will earn a payoff of -1 because it would create a detriment in the form of political and technological outcomes that does not satisfy its valued preference to launch an object over the territories of other States.²⁹⁸

The game type used for this game takes the extensive form. In this game, the historical record sets the values for the strategic outcomes, i.e., payoffs. As Figure 3 below illustrates, the US and SU played a sequential game, the payoffs of which have

²⁹⁴ *Id.*

²⁹⁵ *Id.*

²⁹⁶ *Id.*

²⁹⁷ *Id.*

²⁹⁸ *Id.*

Figure 3: Extensive Form of the Game for Initial Rule Formation

sixteen (16) possible outcomes. Of these sixteen (16) possible outcomes, two payoff strategies dominate for the game with three subgame equilibria that represent the optimal strategic set of choices for the players.

Table 2 below illustrates the total number of possible payoff outcomes. The two dominant strategies arising from this game are highlighted in rows (e) and (m). Both are a combination of three equilibria that represent the optimal payoffs for each player. Table 3 below divides the entire game into subgames. Given the possible choices, the US had two optimal strategies represented by (O, I) and (NO, I). The first strategy consists of the US agreeing to negotiate rules for the Open Skies Treaty and participating in the International Geophysical Year of 1957-58. The second strategy consists of the US foregoing cooperating with the Soviet Union on the Open Skies Treaty, but agreeing to participate in the International Geophysical Year of 1957-58. On the other hand, the Soviet Union had only one optimal strategy. This strategy consists of not cooperating in the negotiation for the Open Skies Treaty, while accepting to participate in the International Geophysical Year of 1957-58.

Table 2: Final Payoffs for Each Strategy Employed in the Game of Initial Rule Formation

(US, SU, US, SU)

a	(1, -1, 1, 1)
b	(1, -1, 1, -1)
c	(1, -1, -1, 1)
d	(1, -1, -1, -1)
e	(1, 0, 1, 1)
f	(1, 0, 1, -1)
g	(1, 0, -1, 1)
h	(1, 0, -1, -1)
i	(0, -1, 1, 1)
j	(0, -1, 1, -1)
k	(0, -1, 1, 1)
l	(0, -1, -1, -1)
m	(0, 0, 1, 1)
n	(0, 0, 1, -1)
o	(0, 0, -1, 1)
p	(0, 0, -1, -1)

Table 3: Subgame Strategy Payoffs

	(O, I)	(O, NI)	(NO, I)	(NO, NI)
US	(<u>1</u> , <u>1</u>)	(<u>1</u> , -1)	(<u>0</u> , <u>1</u>)	(<u>0</u> , -1)
SU	(-1, <u>1</u>)	(-1, -1)	(<u>0</u> , <u>1</u>)	(<u>0</u> , -1)

Each subgame assumes that the technological capability to launch an object into outer space is foreseeable because it is the basis for the payoff schema for each State. Since these payoff strategies are a function of the valued preferences of States, the optimal strategies are therefore a product of initial rule formation. No matter the reasons for which States seek to launch objects into the outer space environment, the fact that any reason underlies a valued preference manifested through State practice necessarily gives way to the need to design rules to ensure the continuation of the State practice.

c. Quantification of Rule Supply, Consumption, and Evolution Rates and Market Participation

i. The Sources and Methods Used to Compile Data Sets

A. States Parties to the United Nations

The UN Membership data set comes from the UN's webpage titled "Growth in United Nations membership, 1945-present."²⁹⁹ The data set begins in October 1945 with the thirty-two (32) original Members of the UN. For reasons of temporal congruency between data sets, the UN Membership data set is extrapolated out to October 2015, but

²⁹⁹ United Nations, *Growth in the United Nations membership, 1945-present*, WWW.UN.ORG, <http://www.un.org/en/members/growth.shtml> accessed Dec. 10, 2015.

technically South Sudan became the last State Party to the UN in 2011. Moreover, to account for changes to the political and governmental identities of States since 1945, a pivot table was created to adjust the data set to a continuous set of data points.

The set of the number of States that represent the total number of States Parties to the UN was constructed using a cumulative counting process. The count follows the historical sequence of State membership in the UN. The UN Charter entered into force in October 1945. Between October and December 1945, Argentina, Australia, Belgium, Bolivia,³⁰⁰ Brazil, Byelorussian Soviet Socialist Republic,³⁰¹ Canada, Chile, China, Colombia, Costa Rica, Cuba, Czechoslovakia,³⁰² Denmark, Dominican Republic, Ecuador, Egypt,³⁰³ El Salvador, Ethiopia, France, Greece, Guatemala, Haiti, Honduras, India, Iran,³⁰⁴ Iraq, Lebanon, Liberia, Luxembourg, Mexico, Netherlands, New Zealand, Nicaragua, Norway, Panama, Paraguay, Peru, Philippine Republic,³⁰⁵ Poland, Saudi

³⁰⁰ *Id.* (“On 7 April 2009, Bolivia changed its name to Bolivia (Plurinational State of).”)

³⁰¹ *Id.* (“On 19 September 1991, the Byelorussian Soviet Socialist Republic informed the United Nations that it had changed its name to Belarus.”)

³⁰² *Id.* (“Czechoslovakia was an original Member of the United Nations from 24 October 1945. In a letter dated 10 December 1992, its Permanent Representative informed the Secretary-General that the Czech and Slovak Federal Republic would cease to exist on 31 December 1992 and that the Czech Republic and the Slovak Republic, as successor States, would apply for membership in the United Nations. Following the receipt of their application, the Security Council, on 8 January 1993, recommended to the General Assembly that the Czech Republic and the Slovak Republic be both admitted to United Nations membership. Both the Czech Republic and the Slovak Republic were thus admitted on 19 January of that year as Member States.”)

³⁰³ *Id.* (“Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations. On 2 September 1971, the United Arab Republic changed its name to the Arab Republic of Egypt.”)

³⁰⁴ *Id.* (“On 5 March 1981, Iran informed the Secretary-General that it had changed its name to Iran (Islamic Republic of).”)

³⁰⁵ *Id.* (“In 1947, the Philippine Republic changed its name to Philippines.”)

Arabia, Syria,³⁰⁶ Turkey, Ukrainian Soviet Socialist Republic,³⁰⁷ Union of South Africa,³⁰⁸ Union of Soviet Socialist Republics,³⁰⁹ United Kingdom, United States, Uruguay, Venezuela, and Yugoslavia³¹⁰ all became the first fifty one (51) Member States of the UN.³¹¹

The set of State Parties to the UN has expanded since 1945. Growth of UN Membership continued in 1946 with the addition of Afghanistan, Iceland, Siam,³¹² and Sweden bringing the total to fifty-five (55) State Parties.³¹³

³⁰⁶ *Id.* (“Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations. On 2 September 1971, the United Arab Republic changed its name to the Arab Republic of Egypt.”)

³⁰⁷ *Id.* (“On 24 August 1991, the Ukrainian Soviet Socialist Republic changed its name to Ukraine.”)

³⁰⁸ *Id.* (“In 1961, the Union of South Africa changed its name to South Africa.”)

³⁰⁹ *Id.* (“The Union of Soviet Socialist Republics was an original Member of the United Nations from 24 October 1945. In a letter dated 24 December 1991, Boris Yeltsin, the President of the Russian Federation, informed the Secretary-General that the membership of the Soviet Union in the Security Council and all other United Nations organs was being continued by the Russian Federation with the support of the 11 member countries of the Commonwealth of Independent States.”)

³¹⁰ *Id.* (“The Socialist Federal Republic of Yugoslavia was an original Member of the United Nations, the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945, until its dissolution following the establishment and subsequent admission as new Members of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Slovenia, The former Yugoslav Republic of Macedonia, and the Federal Republic of Yugoslavia. The Republic of Bosnia and Herzegovina was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/237 of 22 May 1992. The Republic of Croatia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/238 of 22 May 1992. The Republic of Slovenia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/236 of 22 May 1992. By resolution A/RES/47/225 of 8 April 1993, the General Assembly decided to admit as a Member of the United Nations the State being provisionally referred to for all purposes within the United Nations as “The former Yugoslav Republic of Macedonia” pending settlement of the difference that had arisen over its name. The Federal Republic of Yugoslavia was admitted as a Member of the United Nations by General Assembly resolution A/RES/55/12 of 1 November 2000. On 4 February 2003, following the adoption and promulgation of the Constitutional Charter of Serbia and Montenegro by the Assembly of the Federal Republic of Yugoslavia, the official name of “Federal Republic of Yugoslavia” was changed to Serbia and Montenegro. In a letter dated 3 June 2006, the President of the Republic of Serbia informed the Secretary-General that the membership of Serbia and Montenegro was being continued by the Republic of Serbia, following Montenegro's declaration of independence. Montenegro held a 21 May 2006 referendum and declared itself independent from Serbia on 3 June. On 28 June 2006 it was accepted as a United Nations Member State by General Assembly resolution A/RES/60/264.”)

³¹¹ *Id.*

³¹² *Id.* (“On 11 May 1949, Siam informed the Secretary-General that it had changed its name to Thailand.”)

³¹³ *Id.*

In 1947, Pakistan and Yemen³¹⁴ joined bringing the total of UN membership to fifty-seven (57).³¹⁵

In 1948, Burma³¹⁶ joined the UN bringing membership to fifty-eight (58).³¹⁷

In 1949, Israel became the fifty-ninth (59) State Party to the UN.³¹⁸

In 1950, Indonesia³¹⁹ joined the UN.³²⁰

UN membership stayed constant until 1955 when Albania, Austria, Bulgaria, Cambodia, Ceylon,³²¹ Finland, Hungary, Ireland, Italy, Jordan, Laos,³²² Libya,³²³ Nepal, Portugal, Romania, and Spain all joined the UN raising membership to seventy-six (76) States Parties.³²⁴

In 1956, Japan, Morocco, Sudan, and Tunisia joined the UN bringing the total number of States Parties to eighty (80).³²⁵

³¹⁴ *Id.* (“Yemen was admitted to membership in the United Nations on 30 September 1947 and Democratic Yemen on 14 December 1967. On 22 May 1990, the two countries merged and have since been represented as one Member with the name “Yemen”.”)

³¹⁵ *Id.*

³¹⁶ *Id.* (“On 18 June 1989, the Union of Burma informed the United Nations that it had changed its name to the Union of Myanmar. On 30 March 2011, the Union of Myanmar changed its name to the Republic of the Union of Myanmar [sic].”)

³¹⁷ *Id.*

³¹⁸ *Id.*

³¹⁹ *Id.* (“By letter of 20 January 1965, Indonesia announced its decision to withdraw from the United Nations “at this stage and under the present circumstances”. By telegram of 19 September 1966, it announced its decision “to resume full cooperation with the United Nations and to resume participation in its activities”. On 28 September 1966, the General Assembly took note of this decision and the President invited representatives of Indonesia to take seats in the Assembly.”)

³²⁰ *Id.*

³²¹ *Id.* (“On 19 September 1991, Ceylon informed the United Nations that it had changed its name to Sri Lanka.”)

³²² *Id.* (“On 2 December 1975, Laos changed its name to the Lao People's Democratic Republic.”)

³²³ *Id.* (“In 1969, the Kingdom of Libya informed the United Nations that it had changed its name to Libyan Arab Jamahiriya. Following the adoption by the General Assembly of resolution 66/1, the Permanent Mission of Libya to the United Nations formally notified the United Nations of a Declaration by the National Transitional Council of 3 August changing the official name of the Libyan Arab Jamahiriya to “Libya” and changing Libya's national flag.”)

³²⁴ *Id.*

³²⁵ *Id.*

In 1957, Ghana and Federation of Malaya³²⁶ became the eighty-first (81) and eighty-second (82) State Parties to the UN.³²⁷

In 1958, Guinea become the eighty-second (82) State Party to the UN after the creation of a plebiscite established by a union of Egypt and Syria and continued as a single Member on February, 21 1958 to form the United Arab Republic.³²⁸

In 1960, Cameroun, Central African Republic, Chad, Congo (Brazzaville),³²⁹ Congo (Leopoldville),³³⁰ Cyprus, Dahomey,³³¹ Gabon, Ivory Coast,³³² Malagasy Republic,³³³ Mali, Niger, Nigeria, Senegal, Somalia, Togo, and Upper Volta³³⁴ joined the UN raising member to one hundred members (100).³³⁵

³²⁶ *Id.* (“The Federation of Malaya joined the United Nations on 17 September 1957. On 16 September 1963, its name was changed to Malaysia, following the admission to the new Federation of Singapore, Sabah (North Borneo) and Sarawak. Singapore became an independent State on 9 August 1965 and a Member of the United Nations on 21 September 1965.”)

³²⁷ *Id.*

³²⁸ *Id.* (“Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations. On 2 September 1971, the United Arab Republic changed its name to the Arab Republic of Egypt.”)

³²⁹ *Id.* (“In 1970, Congo (Brazzaville) changed its name to the People's Republic of Congo, and on 15 November 1971 — to Congo.”)

³³⁰ *Id.* (“Zaire joined the United Nations on 20 September 1960 when it was known as the Republic of the Congo. On 17 May 1997, its name was changed to the Democratic Republic of the Congo.”)

³³¹ *Id.* (“On Nov 30 1974, Dahomey informed the United Nations that it had changed its name to Republic of Benin.”)

³³² *Id.* (“In 1985, Ivory Coast informed the United Nations that it had changed its name to Côte d'Ivoire.”)

³³³ *Id.* (“In 1975, Malagasy Republic changed its name to Madagascar.”)

³³⁴ *Id.* (“In 1984, Upper Volta informed the United Nations that it had changed its name to Burkina Faso.”)

³³⁵ *Id.*

With the acceptance of Mauritania, Mongolia, Sierra Leone, and Tanganyika³³⁶ in 1961, and the resumption of Syria as an independent State,³³⁷ membership in the UN grew to one hundred and five (105).³³⁸

By 1962, the number of States Parties increased to one hundred and eleven (111) with the acceptance of Algeria, Burundi, Jamaica, Rwanda, Trinidad and Tobago, and Uganda to the UN.³³⁹

In 1963, Kenya, Kuwait, and Zanzibar³⁴⁰ joined the UN bringing membership totals to one hundred and fourteen (114).³⁴¹

By 1964, the United Republic of Tanganyika and Zanzibar continued as a single member State, changing its name to the United Republic of Tanzania on 1 November 1964³⁴² and Malawi, Malta, and Zambia joined bringing membership to one hundred and sixteen (116).³⁴³

³³⁶ *Id.* (“Tanganyika was a Member of the United Nations from 14 December 1961 and Zanzibar was a Member from 16 December 1963. Following the ratification on 26 April 1964 of Articles of Union between Tanganyika and Zanzibar, the United Republic of Tanganyika and Zanzibar continued as a single Member, changing its name to the United Republic of Tanzania on 1 November 1964.”)

³³⁷ *Id.* (“Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations. On 2 September 1971, the United Arab Republic changed its name to the Arab Republic of Egypt.”)

³³⁸ *Id.*

³³⁹ *Id.*

³⁴⁰ *Id.* (“Tanganyika was a Member of the United Nations from 14 December 1961 and Zanzibar was a Member from 16 December 1963. Following the ratification on 26 April 1964 of Articles of Union between Tanganyika and Zanzibar, the United Republic of Tanganyika and Zanzibar continued as a single Member, changing its name to the United Republic of Tanzania on 1 November 1964.”)

³⁴¹ *Id.*

³⁴² *Id.*

³⁴³ *Id.*

In 1965, membership in the UN rose to one hundred and nineteen (119) after The Gambia, Maldiv Islands, and Singapore, as a newly formed independent State,³⁴⁴ joined the UN.³⁴⁵

In 1966, Barbados, Botswana, Guyana, and Lesotho joined the UN raising membership totals to one hundred and twenty-three (123).³⁴⁶

In 1967, the Democratic Yemen³⁴⁷ joined the UN as an independent State bringing total membership to one hundred and twenty-four (124).³⁴⁸

In 1968, the UN grew to one hundred and twenty-seven (127) States when Equatorial Guinea, Mauritius, and Swaziland were accepted as member States.³⁴⁹

In 1970, Fiji became the one hundred and twenty-eighth (128) State to be accepted into the UN.³⁵⁰

In 1971, Bahrain, Bhutan, Oman, Qatar, and United Arab Emirates all joined the UN bringing membership to one hundred and thirty-three (133).³⁵¹

³⁴⁴ *Id.*

³⁴⁵ *Id.*

³⁴⁶ *Id.*

³⁴⁷ *Id.* (“Yemen was admitted to membership in the United Nations on 30 September 1947 and Democratic Yemen on 14 December 1967. On 22 May 1990, the two countries merged and have since been represented as one Member with the name “Yemen”.”)

³⁴⁸ *Id.*

³⁴⁹ *Id.*

³⁵⁰ *Id.*

³⁵¹ *Id.*

In 1973, the UN accepted the Bahamas, the Federal Republic of Germany,³⁵² and the German Democratic Republic³⁵³ as member States raising membership to one hundred and thirty-six (136).³⁵⁴

In 1974, Bangladesh, Grenada, and Guinea-Bissau joined the UN raising membership to one and thirty-nine (139).³⁵⁵

By 1975, UN membership increased to one hundred and forty-five members (145) when Cape Verde, Comoros, Mozambique, Papua New Guinea, Sao Tome and Principe, and Suriname joined.³⁵⁶

In 1976, Angola, Samoa, and Seychelles joined the UN increasing membership to one hundred and forty-eight (148).³⁵⁷

In 1977, Djibouti and Viet Nam entered the UN as new States Parties bringing membership to one hundred and fifty (150).³⁵⁸

In 1978, Dominica and Solomon Islands became UN member States raising membership to one hundred and fifty-two (152).³⁵⁹

In 1979, Saint Lucia joined to become the one hundred and fifty third (153) member of the UN.³⁶⁰

³⁵² *Id.* (“The Federal Republic of Germany and the German Democratic Republic were admitted to membership in the United Nations on 18 September 1973. Through the accession of the German Democratic Republic to the Federal Republic of Germany, effective from 3 October 1990, the two German States united to form one sovereign State.”)

³⁵³ *Id.*

³⁵⁴ *Id.*

³⁵⁵ *Id.*

³⁵⁶ *Id.*

³⁵⁷ *Id.*

³⁵⁸ *Id.*

³⁵⁹ *Id.*

³⁶⁰ *Id.*

In 1980, Saint Vincent and the Grenadines and Zimbabwe joined the UN bringing membership to one hundred and fifty five (155).³⁶¹

In 1980, with the inclusion of Antigua and Barbuda, Belize, and Vanuatu, UN membership totaled one hundred and fifty-eight (158).³⁶²

In 1983, Saint Christopher and Nevis³⁶³ became the one hundred and fifty-ninth (159) State to join the UN.³⁶⁴

In 1984, Brunei Darussalam joined the UN to become the one hundred and fifty-ninth (159) State Party.³⁶⁵

In 1990, Liechtenstein and Namibia joined the UN, but with the unifications of Yemen and Democratic Yemen in May to form one State Yemen and the Federal Republic of Germany and the German Democratic Republic in October to form one State the Federal Republic of Germany, this kept membership totals at one hundred and sixty (160).³⁶⁶

By 1991, Democratic People's Republic of Korea, Estonia, Latvia, Lithuania, Marshall Islands, Federated States of Micronesia, and Republic of Korea joined the UN bringing membership totals to one hundred and sixty-seven (167).³⁶⁷

³⁶¹ *Id.*

³⁶² *Id.*

³⁶³ *Id.* ("On 16 December 1986, Saint Christopher and Nevis changed its name to Saint Kitts and Nevis.")

³⁶⁴ *Id.*

³⁶⁵ *Id.*

³⁶⁶ *Id.*

³⁶⁷ *Id.*

In 1992, in light of the breakup of Yugoslavia, Bosnia and Herzegovina³⁶⁸ and Croatia³⁶⁹ formed new States; with the addition of Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, San Marino, Slovenia,³⁷⁰ Tajikistan, Turkmenistan, and Uzbekistan raised UN membership to one hundred and seventy-nine (179).³⁷¹

In 1993, in light of the breakup of Yugoslavia and Czechoslovakia, the acceptance of Andorra, Czech Republic,³⁷² Eritrea, Monaco, Slovakia,³⁷³ and The former Yugoslav

³⁶⁸ *Id.* (“The Socialist Federal Republic of Yugoslavia was an original Member of the United Nations, the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945, until its dissolution following the establishment and subsequent admission as new Members of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Slovenia, The former Yugoslav Republic of Macedonia, and the Federal Republic of Yugoslavia. The Republic of Bosnia and Herzegovina was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/237 of 22 May 1992. The Republic of Croatia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/238 of 22 May 1992. The Republic of Slovenia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/236 of 22 May 1992. . . . The Federal Republic of Yugoslavia was admitted as a Member of the United Nations by General Assembly resolution A/RES/55/12 of 1 November 2000. On 4 February 2003, following the adoption and promulgation of the Constitutional Charter of Serbia and Montenegro by the Assembly of the Federal Republic of Yugoslavia, the official name of “Federal Republic of Yugoslavia” was changed to Serbia and Montenegro. In a letter dated 3 June 2006, the President of the Republic of Serbia informed the Secretary-General that the membership of Serbia and Montenegro was being continued by the Republic of Serbia, following Montenegro's declaration of independence. Montenegro held a 21 May 2006 referendum and declared itself independent from Serbia on 3 June. On 28 June 2006 it was accepted as a United Nations Member State by General Assembly resolution A/RES/60/264.”)

³⁶⁹ *Id.*

³⁷⁰ *Id.*

³⁷¹ *Id.*

³⁷² *Id.* (“Czechoslovakia was an original Member of the United Nations from 24 October 1945. In a letter dated 10 December 1992, its Permanent Representative informed the Secretary-General that the Czech and Slovak Federal Republic would cease to exist on 31 December 1992 and that the Czech Republic and the Slovak Republic, as successor States, would apply for membership in the United Nations. Following the receipt of their application, the Security Council, on 8 January 1993, recommended to the General Assembly that the Czech Republic and the Slovak Republic be both admitted to United Nations membership. Both the Czech Republic and the Slovak Republic were thus admitted on 19 January of that year as Member States.”)

³⁷³ *Id.*

Republic of Macedonia³⁷⁴ brought UN membership to one hundred and eighty-four (184).³⁷⁵

In 1994, Palau joined the UN raising membership to one hundred and eighty-five (185).³⁷⁶

In 1999, Kiribati, Nauru, and Tonga all joined the UN increasing membership to one hundred and eighty-eight (188).³⁷⁷

In 2000, Federal Republic of Yugoslavia³⁷⁸ and Tuvalu joined the UN raising membership to one hundred and eighty-nine (189).³⁷⁹

In 2002, Switzerland and Timor-Leste were accepted as States Parties to the UN increasing membership to one hundred and ninety-one (191).³⁸⁰

In 2006, Montenegro³⁸¹ joined the UN bringing membership to one hundred and ninety-two (192).³⁸²

³⁷⁴ *Id.* (“By resolution A/RES/47/225 of 8 April 1993, the General Assembly decided to admit as a Member of the United Nations the State being provisionally referred to for all purposes within the United Nations as “The former Yugoslav Republic of Macedonia” pending settlement of the difference that had arisen over its name.”)

³⁷⁵ *Id.*

³⁷⁶ *Id.*

³⁷⁷ *Id.*

³⁷⁸ *Id.* (“The Federal Republic of Yugoslavia was admitted as a Member of the United Nations by General Assembly resolution A/RES/55/12 of 1 November 2000. On 4 February 2003, following the adoption and promulgation of the Constitutional Charter of Serbia and Montenegro by the Assembly of the Federal Republic of Yugoslavia, the official name of “Federal Republic of Yugoslavia” was changed to Serbia and Montenegro.”)

³⁷⁹ *Id.*

³⁸⁰ *Id.*

³⁸¹ *Id.* (“In a letter dated 3 June 2006, the President of the Republic of Serbia informed the Secretary-General that the membership of Serbia and Montenegro was being continued by the Republic of Serbia, following Montenegro's declaration of independence. Montenegro held a 21 May 2006 referendum and declared itself independent from Serbia on 3 June. On 28 June 2006 it was accepted as a United Nations Member State by General Assembly resolution A/RES/60/264.”)

³⁸² *Id.*

In 2011, South Sudan³⁸³ joined the UN as the one hundred and ninety-third (193) member States.³⁸⁴

1. United Nations Member States Raw Data Table

To construct the table of raw data composed of UN State Parties from October 1945 to October 2015, a Microsoft Excel spreadsheet was constructed using three columns.³⁸⁵ The first column listed each State Party to the UN. The second column listed the date on which a State in the row became a Member of the UN. The date of ratification used a month and year format. The third column consists of notes on if and when a State in the row changed its international legal personality after some event, e.g., due to revolution, *coup d'état*, de-colonialism, or some other form of political transition.³⁸⁶ This column was necessary to ensure that the graph in the growth of UN Membership was counted correctly over time.

2. United Nations Member States Pivot Table

To fit the raw data to the graph of the Growth of UN Membership over time, a pivot table was designed in Microsoft Excel.³⁸⁷ The UN Membership pivot table was

³⁸³ *Id.* (“The Republic of South Sudan formally seceded from Sudan on 9 July 2011 as a result of an internationally monitored referendum held in January 2011, and was admitted as a new Member State by the United Nations General Assembly on 14 July 2011.”)

³⁸⁴ *Id.*

³⁸⁵ See Appendix for raw data.

³⁸⁶ See *supra* note 48.

³⁸⁷ See Appendix for raw data.

constructed using signature and ratification dates for each Member State over time.³⁸⁸

The list of Member States was manually adjusted for the formation or break-up of States based on UN Membership history.

The pivot table construction followed four general rules. First, if a State never had political or territorial transitions between 1945 and 2015, no changes were made to how that State was counted over time. For example, the US continues to have the same political character despite adding internally to its territory since 1945. Thus no change was made to how the US and other similarly situated States were counted over time.

Second, if a State had a political transition that produced only one new political entity regardless of any loss in territory between 1945 and 2015, then no change was made to the table. For example, as the Soviet Union broke-up, the Russian Federation transitioned politically from the anchor State that formed the political Soviet Union. Thus no change was made to how Russia was counted over time.

Third, if one State broke up into two or more States, a count of one was subtracted from the total count for the loss of the original State and a count of N number of new States into which the original State broke apart was added at the time break-up occurred. For example, in 1992, the Socialist Federal Republic of Yugoslavia broke up into The Republic of Bosnia and Herzegovina, the Republic of Croatia, and the Republic of Slovenia. Here, a count of one (1) was subtracted with the dissolution of the Socialist Federal Republic of Yugoslavia in May 1992. Correspondingly, a count of three (N=3) was added with the acceptance Bosnia and Herzegovina, Croatia, and Slovenia for UN membership.

³⁸⁸ Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

Fourth, if N States combined into one State, a count of N was subtracted from the total number of States at the time, and a count of one was added to account for the final formation of the new State. For example, in May 1990, Yemen and Democratic Yemen merged into one (1) State from two (N=2) States. The rule followed for this case required subtracting a count of two (N=2) and adding a count of one (1) in May 1990.

Once the pivot table was constructed using the adjusted time data for UN membership, a scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 1 below shows the growth of UN membership over time where the number of States admitted to the UN is listed on the y-axis and time, between October 1945 and October 2015, is listed on the x-axis.

3. United Nations Member States Scatterplot

A scatterplot for the Growth of UN membership was graphed (see Graph 4) where the number of States that signed or ratified the UN Charter is listed on the y-axis and time, between October 1945 and October 2015, is listed on the x-axis.³⁸⁹ Because the entire set of rules that comprise public international law is dependent on the number of States putting their valued preferences into effect through State practice at any given time, relative market share and rule consumption may be inferred from observations of exchange.³⁹⁰ In other words, how, when, and how many States engage in the development of rules among and between States is dependent on how many States are

³⁸⁹ Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

³⁹⁰ This is only a relative measure because it only seeks to capture how many possible market participants there are in the international system at each point in time relative to the number of States who supply and consume rules.

actually using particular supranational markets of international relations at any given time. Such changes represent perturbations in the supranational market itself due to shifting preferences of States due to the effects of the entrance and exit of States from the supranational market of international relations over time. Consequently, fewer or more States engaged in the supranational market of international relations may lead to measurable effects that would include, *inter alia*, power-disparities in bargaining between States who engage in rule-making, market failure, lower or higher transaction costs, potential externalities that may impose benefits or costs on some or all States in the system at or for a certain period of time, or less or more variability in preference satisfaction.³⁹¹

Accordingly, determining the total number of States engaged in rule supply and consumption through the various means provided by the supranational market of international relations establishes the upper bound of market participation at any given time. Moreover, changes in the international system of States provides a means by which to measure when and why States may or may not change their valued preferences when engaged in the supranational market of international relations. Over time, as States enter and exit the supranational market of international relations, the reevaluation of valued preferences and underlying facts about those preferences may lead to changes in the social dynamics among and between States and cause fluctuations in the international system. For example, in Graph 1, one can observe several dips and spikes in the number of State parties to the UN. The two most prominent dips and spikes an observer can notice are located around the mid-1950's and the early 1990's. The first dip corresponds

³⁹¹ See *supra* note 4.

generally to de-colonialism, while the second dip corresponds to the breakup of the USSR and Yugoslavia.³⁹²

Moreover, treaty success and the preference to be bound by or intended to be bound by the obligations and duties of a particular treaty can be quantified in terms of a relative percentage measure between the total number of UN member State Parties and the number of States Parties and/or signatories to a target treaty at any given time because the ratio establishes how many States seek to supply and/or consume rules over time.³⁹³ When the curve for the Growth of UN Membership over time is compared with a curve representing observed supply or consumption of rules for space objects, the difference between the two curves provides an inferential general measure of the objective preference values of States. As any given rule supply or consumption curve approaches the curve of the Growth in UN Membership, i.e., the smaller the distance between two points between the baseline curve and test curve, that ratio provides a consistent measure of the successfulness of rule supply or consumption at each point in time. In other words, a measure of treaty success as a function of valued State preferences is based on how many States exist at the time a treaty is concluded or ratified through as long as the treaty remains in force. The larger the ratio, the greater the implied success of rule supply and/or consumption, and vice-versa.

³⁹² See *supra* note 48.

³⁹³ However, this thesis does not propose a way to rank these measured ratios because the sample of rules considered is small. Future analysis and the inclusion of other sets of rules supplied and/or consumed would provide a means by which to more accurately

4. United Nations Member States Data Limitations

While there exists one hundred and ninety-three State Parties to the UN, this does not necessarily represent all entities that may be called States. At least three entities exist that do not have a status of State Party to the UN. These are Kosovo, Taiwan (Republic of China), and the Holy See. Of these three States, Taiwan and the Holy See have either signed or ratified at least one of the four space treaties under study. Of these two, only the Holy See has Permanent Observer status at the UN.³⁹⁴ However, for the sake of congruency between data sets, Kosovo, the Holy See, and Taiwan (Republic of China) are not counted in the data UN set.

³⁹⁴ United Nations, *About Permanent Observers, What are Permanent Observers?*, WWW.UN.ORG, <http://www.un.org/en/members/aboutpermobservers.shtml> accessed Dec. 10, 2015.

Graph 1: Cumulative Count of States Parties to the UN

B. Signatories to and Ratifying States of the Outer Space Treaty

The source of the Outer Space Treaty data set comes from the treaty lists kept in Washington, DC, London, and Moscow.³⁹⁵ The data set starts in January 1967 and is extrapolated out to October 2015, but ends in March 2013 when Lithuania became the last State to ratify the Outer Space Treaty.³⁹⁶ As of October 2015, the Outer Space Treaty has one hundred and four (104) States Parties and twenty five (25) signatories.³⁹⁷

The Outer Space Treaty is a multilateral treaty that is open and remains open to all States to sign and/or ratify. As article XIV states:

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
 2. This Treaty shall be subject to ratification by signatory States.
- Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United

³⁹⁵ See United States Department of State, *Status of Outer Space Treaty*, available at <http://www.state.gov/documents/organization/81123.pdf> accessed Dec. 10, 2015; United Kingdom, Foreign and Commonwealth Office, *Status of Outer Space Treaty*, available at <https://www.gov.uk/government/publications/treaty-on-principles-governing-the-activities-of-states-in-the-exploration-and-use-of-outer-space-including-the-moon-and-other-celestial-bodies-lond> accessed Dec. 10, 2015; and United Nations Office for Disarmament Affairs, *Status of Outer Space Treaty*, available at http://disarmament.un.org/treaties/t/outer_space accessed Dec. 10, 2015.

³⁹⁶ *Id.*

³⁹⁷ U.N. Comm. Peaceful Uses of Outer Space, Legal Sub-Comm., *Status of international agreements relating to activities in outer space as at 1 January 2015*, U.N. Doc. A/AC.105/C.2/2015/CRP.8 (Apr. 8, 2015), available at http://www.unoosa.org/pdf/limited/c2/AC105_C2_2015_CRP08E.pdf.

States of America, which are hereby designated the Depositary Governments.

3. This Treaty shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Treaty.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Treaty, the date of its entry into force and other notices.

6. This Treaty shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.³⁹⁸

Because the Outer Space Treaty was presented for signature and ratification in triplicate, the three lists, each individually maintained by the US in Washington, DC, the UK in London, and the Russian Federation in Moscow, were reviewed for completeness. Each list is authentic as a matter of public international law;³⁹⁹ however, individually, each list is not a complete list of signatory or ratifying States. Only the US and UK lists are publically available online through 2015. Because the Russian Foreign Ministry does

³⁹⁸ Outer Space Treaty *supra* note 21, at art. XIV.

³⁹⁹ See *supra* note 105, at 262.

not have an accessible list online, the list maintained by the United Nations Office of Disarmament Affairs (Disarmament Affairs list) was used in its place because it includes data from all three lists from which all lists could be crosschecked.⁴⁰⁰ Furthermore, the complete list of signatory and ratifying States Parties were checked against the UN COPUOS document with the title “Status of international agreements relating to activities in outer space as at 1 January 2015” to ensure that the number of signatory and ratifying State Parties matched.⁴⁰¹

1. States Parties to the Outer Space Treaty Raw Data Table

The compilation of the data set for the Outer Space Treaty takes two forms. First, a table of raw data was constructed using Microsoft Excel. The table consisted of four columns. The first column listed each State that had either signed or taken steps to ratify, accede, succeed, or withdraw from the Outer Space Treaty. The second column listed the date of signature to the Outer Space Treaty for the State in that row. The third column lists the date of ratification, accession, or succession to the Outer Space Treaty for the State in that row. The fourth column contained notes about any changes to a State’s signatory, ratification, accession, succession, or withdrawal from the Outer Space Treaty.

⁴⁰⁰ United Nations Office for Disarmament Affairs, *Status of Outer Space Treaty*, DISARMAMENT.UN.ORG, available at http://disarmament.un.org/treaties/t/outer_space accessed Dec. 10, 2015.

⁴⁰¹ See *supra* note 397.

2. States Parties to the Outer Space Treaty Pivot Table

To fit the raw data to the graph of the Growth of State Parties to the Outer Space Treaty over time, a pivot table was designed in Microsoft Excel.⁴⁰² The Outer Space Treaty pivot table was constructed using signature and ratification dates for each States Party over time. The list of States Parties was manually adjusted for the formation or break-up of States based on UN Membership history constructed into the UN Membership pivot table. The Outer Space Treaty pivot table construction followed the same rules of construction as the UN Membership pivot table.

3. States Parties to the Outer Space Treaty Scatterplot

Once the Outer Space Treaty pivot table was constructed using the adjusted time data for UN membership, a scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 2 below shows the Growth of States Parties to the Outer Space Treaty over time where the number of States that signed or ratified the treaty is listed on the y-axis and time, between January 1967 and October 2015, is listed on the x-axis.⁴⁰³

Where States have signed or ratified the Outer Space Treaty, those data provide an indication of when and the degree to which a State has purchased those obligations deriving from the treaty. The conclusion of any treaty indicates a supply of rules for which a State may purchase the set of obligations inherent to the substance of the treaty. The graph of the Growth of States Parties to the Outer Space Treaty provides a measure

⁴⁰² See Appendix for raw data.

⁴⁰³ Ratification counts include States that acceded or succeeded to the treaty. See *supra* note 48.

of the rate of rule consumption over time. Furthermore, the number of States that purchase the obligation of the rule in order to assert authority relative to other States Parties also gives a sense of the demand for such rules because it demonstrates a State's willingness to pay a price for the benefit that the treaty is meant to provide.

4. States Parties to the Outer Space Treaty Data Limitations

No data limitations were discovered as each treaty list was checked against multiple sources for completeness.

Graph 2: Cumulative Count of Ratifying and Signatory States to the Outer Space treaty

C. Signatories to and Ratifying States of the Rescue and Return Agreement

The source of the data set comes from the treaty lists kept in Washington, DC, London, and Moscow.⁴⁰⁴ The data set begins in April 1968 with fourteen (14) original signatory States. The data is extrapolated out to October 2015, but ends in March 2013 when Lithuania became the last State to ratify the Rescue and Return Agreement.⁴⁰⁵ As of October 2015, ninety six (96) States have ratified and twenty four (24) have signed the treaty.⁴⁰⁶

The Rescue and Return Agreement is a multilateral treaty that is open and remains open to all States to sign and/or ratify. As article 7 states,

1. This Agreement shall be open to all States for signature. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
2. This Agreement shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which are hereby designated the Depositary Governments.

⁴⁰⁴ See United States Department of State, *Status of Rescue and Return Agreement*, available at <http://www.state.gov/documents/organization/81125.pdf> accessed Dec. 10, 2015, and United Kingdom, Foreign and Commonwealth Office, *Status of the Rescue and Return Agreement*, available at <https://www.gov.uk/government/publications/agreement-on-the-rescue-of-astronauts-the-return-of-astronauts-and-the-return-of-objects-launched-into-outer-space-london-2241968> accessed Dec. 10, 2015.

⁴⁰⁵ *Id.*

⁴⁰⁶ See *supra* note 397.

3. This Agreement shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Agreement.
4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Agreement, it shall enter into force on the date of the deposit of their instruments of ratification or accession.
5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Agreement, the date of its entry into force and other notices.
6. This Agreement shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.⁴⁰⁷

Because States Parties to the Rescue and Return Agreement presented it for signature and ratification in triplicate, there are three lists maintained by the US in Washington, DC, the UK in London, and the Russian Federation in Moscow.⁴⁰⁸ Each list is authentic as a matter of public international law;⁴⁰⁹ however, individually, each list is not a complete list of signatory or ratifying States. Only the US and UK lists are

⁴⁰⁷ Rescue and Return Agreement *supra* note 21, art. 7.

⁴⁰⁸ However, the Moscow list could not be obtained.

⁴⁰⁹ See *supra* note 48.

publically available online through 2015.⁴¹⁰ Because the Russian Foreign Ministry does not have an accessible list online and attempts to locate a list proved unsuccessful, therefore the Russian list was not included in the count that makes up Table 5 in the Appendix. Furthermore, the complete list of signatory and ratifying State Parties were checked against the UNCOPUOS document “Status of international agreements relating to activities in outer space as at 1 January 2015” to ensure that the number of signatory and ratifying State Parties matched.⁴¹¹

1. States Parties to the Rescue and Return Agreement Raw Data Table

The construction of Table 5 consisted of a review of the US, UK, and Russian lists. With the US list, each State and each date of signature and ratification are placed in columns. As discussed above, changes in Statehood and corresponding treaty obligations were accounted for to form a continuous list over time.

The compilation of the data set for the Rescue and Return Agreement takes two forms. First, a table of raw data was constructed using Microsoft Excel. The table consisted of four columns. The first column listed each State that had either signed or taken steps to ratify, accede, succeed, or withdraw from the Rescue and Return Agreement. The second column listed the date of signature to the Rescue and Return Agreement for the State in that row. The third column lists the date of ratification,

⁴¹⁰ See United States Department of State, *Status of Rescue and Return Agreement*, available at <http://www.state.gov/documents/organization/81125.pdf> accessed Dec. 10, 2015, and United Kingdom Foreign and Commonwealth Office, *Status of the Rescue and Return Agreement*, available at <https://www.gov.uk/government/publications/agreement-on-the-rescue-of-astronauts-the-return-of-astronauts-and-the-return-of-objects-launched-into-outer-space-london-2241968> accessed Dec. 10, 2015.

⁴¹¹ See *supra* note 397.

accession, or succession to the Rescue and Return Agreement for the State in that row.

The fourth column contained notes about any changes to a State's signatory, ratification, accession, succession, or withdrawal from the Rescue and Return Agreement.

2. States Parties to the Rescue and Return Agreement Pivot Table

To fit the raw data to the graph of the Growth of State Parties to the Rescue and Return Agreement over time, a pivot table was designed in Microsoft Excel. The Rescue and Return Agreement pivot table was constructed using signature and ratification dates for each States Party over time. The list of States Parties was manually adjusted for the formation or break-up of States based on UN Membership history constructed into the UN Membership pivot table. The Rescue and Return Agreement pivot table construction followed the same rules of construction as the UN Membership pivot table.

3. States Parties to the Rescue and Return Agreement Scatterplot

Once the Rescue and Return Agreement pivot table was constructed using the adjusted time data for UN membership, a scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 3 below shows the Growth of States Parties to the Rescue and Return Agreement over time where the number of States that signed or ratified the treaty is listed on the y-axis and time, between April 1968 and October 2015, is listed on the x-axis.⁴¹²

⁴¹² Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

Where States have signed or ratified the Outer Space Treaty, those data provide an indication of when and the degree to which a State has purchased those obligations deriving from the treaty. The conclusion of any treaty indicates a supply of rules for which a State may purchase the set of obligations inherent to the substance of the treaty. The graph of the Growth of States Parties to the Outer Space Treaty provides a measure of the rate of rule consumption over time. Furthermore, the number of States that purchase the obligation of the rule in order to assert authority relative to other States Parties also gives a sense of the demand for such rules because it demonstrates a State's willingness to pay a price for the benefit that the treaty is meant to provide.

4. States Parties to the Rescue and Return Agreement Data Limitations

All efforts to track down an official Russian list was futile. No Russian list exists online or elsewhere that is publically available and up to date.

Graph 3: Cumulative Count of Ratifying and Signatory States to the Rescue and Return Agreement

D. Signatories to and Ratifying States of the Liability Convention

The source of the Liability Convention data set comes from the treaty lists kept in Washington, DC, London, and Moscow.⁴¹³ The data set begins in March 1972 with fourteen (14) original signatory States. The data are extrapolated out to 2015, but end in July 2014 when Columbia became the last State to ratify the Liability Convention.⁴¹⁴ As of October 2015, ninety five (95) States have ratified and twenty one (21) States have signed the treaty.⁴¹⁵

The Liability Convention is a multilateral treaty that is open and remains open to all States to sign and/or ratify. As article XXIV states:

1. This Convention shall be open to all States for signature. Any State which does not sign this Convention before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
2. This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which are hereby designated the Depositary Governments.

⁴¹³ See United States Department of State, *Status of the Liability Convention*, available at <http://www.state.gov/documents/organization/81127.pdf> accessed Dec. 10, 2015, and United Kingdom, Foreign and Commonwealth Office, *Status of the Liability Convention*, available at <https://www.gov.uk/government/publications/convention-on-international-liability-for-damage-caused-by-space-objects-london-2931972> accessed Dec. 10, 2015.

⁴¹⁴ *Id.*

⁴¹⁵ See *supra* note 397.

3. This Convention shall enter into force on the deposit of the fifth instrument of ratification.
4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.
5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Convention, the date of its entry into force and other notices.
6. This Convention shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.⁴¹⁶

1. States Parties to the Liability Convention Raw Data Table

The compilation of the data set for the Liability Convention takes two forms. First, a table of raw data was constructed using Microsoft Excel. The table consisted of four columns. The first column listed each State that had either signed or taken steps to ratify, accede, succeed, or withdraw from the Liability Convention. The second column listed the date of signature to the Liability Convention for the State in that row. The third column lists the date of ratification, accession, or succession to the Liability Convention

⁴¹⁶ See Liability Convention *supra* note 21, at art. XXIV.

for the State in that row. The fourth column contained notes about any changes to a State's signatory, ratification, accession, succession, or withdrawal from the Liability Convention.

2. States Parties to the Liability Convention Pivot Table

To fit the raw data to the graph of the Growth of State Parties to the Liability Convention over time, a pivot table was designed in Microsoft Excel. The Liability Convention pivot table was constructed using signature and ratification dates for each States Party over time. The list of States Parties was manually adjusted for the formation or break-up of States based on UN Membership history constructed into the UN Membership pivot table. The Liability Convention pivot table construction followed the same rules of construction as the UN Membership pivot table.

3. States Parties to the Liability Convention Scatterplot

Once the Liability Convention pivot table was constructed using the adjusted time data for UN membership, a scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 4 below shows the Growth of States Parties to the Liability Convention over time where the number of States that signed or ratified the treaty is listed on the y-axis and time, between March 1972 and October 2015, is listed on the x-axis.⁴¹⁷

⁴¹⁷ Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

Where States have signed or ratified the Outer Space Treaty, those data provide an indication of when and the degree to which a State has purchased those obligations deriving from the treaty. The conclusion of any treaty indicates a supply of rules for which a State may purchase the set of obligations inherent to the substance of the treaty. The graph of the Growth of States Parties to the Outer Space Treaty provides a measure of the rate of rule consumption over time. Furthermore, the number of States that purchase the obligation of the rule in order to assert authority relative to other States Parties also gives a sense of the demand for such rules because it demonstrates a State's willingness to pay a price for the benefit that the treaty is meant to provide.

4. States Parties to the Liability Convention Data Limitations

All efforts to track down an official Russian list were futile. No Russian list exists online or elsewhere that is publically available and up to date. This created a problem in discovering the correct ratification date for Lebanon. The British list has Lebanon signing the Rescue and Return Agreement.⁴¹⁸ However, the official UN list published by OOSA shows that Lebanon is a ratifying State.⁴¹⁹ To reconcile these two facts, Lebanon's date of signature was chosen as the date of ratification.

⁴¹⁸ Compare Russian Federation, *The list of multilateral international treaties (the Russian Federation is the depositary)*, available at http://archive.mid.ru/spm_md.nsf accessed Dec. 10, 2015, with U.N. Comm. Peaceful Uses of Outer Space, Legal Sub-Comm., *Status of international agreements relating to activities in outer space as at 1 January 2015*, U.N. Doc. A/AC.105/C.2/2015/CRP.8 (Apr. 8, 2015), available at http://www.unoosa.org/pdf/limited/c2/AC105_C2_2015_CRP08E.pdf.

⁴¹⁹ *Id.*

Graph 4: Cumulative Count of Ratifying and Signatory States of the Liability Convention

E. Signatories to and Ratifying States of the Registration Convention

Unlike the Outer Space Treaty, the Rescue and Return Agreement and the Liability Convention, the Registration Convention has only one list of signatory and ratifying States. The data set begins in May 1975 with two (2) original signatory States.⁴²⁰ The data are extrapolated out to 2015, but end in April 2014 when Kuwait became the last State to ratify the Registration Convention.⁴²¹ As of October 2015, sixty five (65) States have ratified and four (4) States have signed the treaty.⁴²²

The Registration Convention is a multilateral treaty that is open and remains open to all States to sign and/or ratify through the UN. As article VIII states:

1. This Convention shall be open for signature by all States at United Nations Headquarters in New York. Any State which does not sign this Convention before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
2. This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Secretary-General of the United Nations.

⁴²⁰ See United Nations Treaty Collection, *Status of the Registration Convention*, available at https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXIV-1&chapter=24&Temp=mtdsg3&lang=en accessed Dec. 10, 2015.

⁴²¹ *Id.*

⁴²² See *supra* note 397.

3. This Convention shall enter into force among the States which have deposited instruments of ratification on the deposit of the fifth such instrument with the Secretary-General of the United Nations.
4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.
5. The Secretary-General shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Convention, the date of its entry into force and other notices.⁴²³

1. States Parties to the Registration Convention Raw Data Table

The compilation of the data set for the Registration Convention takes two forms. First, a table of raw data was constructed using Microsoft Excel. The table consisted of four columns. The first column listed each State that had either signed or taken steps to ratify, accede, succeed, or withdraw from the Registration Convention. The second column listed the date of signature to the Registration Convention for the State in that row. The third column lists the date of ratification, accession, or succession to the Registration Convention for the State in that row. The fourth column contained notes

⁴²³ Registration Convention *supra* note 21, at art. VIII.

about any changes to a State's signatory, ratification, accession, succession, or withdrawal from the Registration Convention.

2. States Parties to the Registration Convention Pivot Table

To fit the raw data to the graph of the Growth of State Parties to the Registration Convention over time, a pivot table was designed in Microsoft Excel. The Registration Convention pivot table was constructed using signature and ratification dates for each States Party over time. The list of States Parties was manually adjusted for the formation or break-up of States based on UN Membership history constructed into the UN Membership pivot table. The Registration Convention pivot table construction followed the same rules of construction as the UN Membership pivot table.

3. States Parties to the Registration Convention Scatterplot

Once the Registration Convention pivot table was constructed using the adjusted time data for UN membership, a scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 5 below shows the Growth of States Parties to the Registration Convention over time where the number of States that signed or ratified the treaty is listed on the y-axis and time, between May 1975 and October 2015, is listed on the x-axis.⁴²⁴

⁴²⁴ Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

Where States have signed or ratified the Outer Space Treaty, those data provide an indication of when and the degree to which a State has purchased those obligations deriving from the treaty. The conclusion of any treaty indicates a supply of rules for which a State may purchase the set of obligations inherent to the substance of the treaty. The graph of the Growth of States Parties to the Outer Space Treaty provides a measure of the rate of rule consumption over time. Furthermore, the number of States that purchase the obligation of the rule in order to assert authority relative to other States Parties also gives a sense of the demand for such rules because it demonstrates a State's willingness to pay a price for the benefit that the treaty is meant to provide.

4. States Parties to the Registration Convention Data Limitations

Since the signatory and ratification lists for the Registration Convention are maintained by the UN, the list is complete.

Cumulative Count of Ratifying and Signatory States to the RC

Graph 5: Cumulative Count of Ratifying and Signatory States of the RC

F. States that Have Implemented the Term Space Object into their National Laws

As described *infra*, the term “object” is extrapolated from the Outer Space Treaty through the Rescue and Return Agreement, the Liability Convention, and the Registration Convention. While an analysis of the evolution from the term “object” to “space object” is discussed in Chapters III through V, it is important to briefly summarize the importance of this approach.

The set of States that have implemented the term “space object” into their national laws comprises States that have some space-faring experience, including being a member State of a multilateral space agency, a partner to the International Space Station, launching humans, animals, or other objects into outer space, or having had another State launch objects into outer space for it. Each State counted has, at a minimum, either signed or ratified the Outer Space Treaty or subsequent space treaties. Since the Outer Space Treaty is an initial set of rules that comprise law for, and uses the term “object” in reference to things launched or intended to be launched to, the outer space environment, those specifically referenced articles represent the baseline for which States have exchanged in the purchase of the treaty’s obligations that give effect to a State’s extraterritorial application of its authority.⁴²⁵

Since all States in the full sample have, at least, signed or ratified the Outer Space Treaty, obligations arising under treaty law may or may not have been given effect into the national law with respect to space objects.⁴²⁶ Moreover, the obligations that arise from any space treaty signed or ratified by the States sampled are with respect to the

⁴²⁵ See discussion *supra* in Chapter I.

⁴²⁶ See *supra* note 48. See also BROWNLIE *supra* note 4.

obligations purchased as a matter of treaty law. However, the obligations that arise from treaty law generally have some legal effect in terms of rule supply within the national law. When States give legal effect to a treaty's obligation under national law, States may publish or promulgate those obligations in the form of national law rules.⁴²⁷ In doing so, States resupply rules to the international market of international relations in the form of their national laws.⁴²⁸ When States resupply rules via the publication or promulgation of their national laws, those rules common to States in content (i.e., a rule's definition, meaning, and scope) may signal to other States of the purchase of obligations relative to their powers as sovereign States.⁴²⁹ This arises because States have generally complete authority over their territories and thus the act of publishing or promulgation a rule internal to the State expresses the preferred source of a rule's obligation.⁴³⁰

1. National Law Data Set

Two samples of State national space laws were taken. The first sample consists of thirty-nine (39) States. This set includes the following States: Algeria, Argentina, Australia, Austria, Belarus, Belgium, Brazil, Canada, Chile, Colombia, China, Czech Republic, Denmark, Finland, France, Germany, Greece, India, Iran, Ireland, Italy, Japan, Kazakhstan, Luxembourg, Mexico, Netherlands, Nigeria, Norway, Republic of Korea, Romania, Russian Federation, South Africa, Spain, Sweden, Switzerland, Ukraine, the

⁴²⁷ See JULIAN HERMIDA, *LEGAL BASIS FOR A NATIONAL SPACE LEGISLATION* (Kluwer 2004).

⁴²⁸ See discussion *supra* in Chapter I.

⁴²⁹ *Id.*

⁴³⁰ *Id.* States have attempted to copy, to some extent, national laws with respect to space objects. This creates a common source of rules for States that may be applied in disputes. See discussion *infra* in Chapter V.

United Kingdom, the United States of America, and Venezuela. This sample consists of States that have promulgated or published national laws with respect to the regulation of space objects and those States that have, at least, signed or ratified the Outer Space Treaty and several other space treaties.⁴³¹ However, not every State sampled has signed or ratified all other space treaties analyzed for this thesis.⁴³²

The second sample consists of twenty-nine (29) States from the sample of thirty-nine States (39).⁴³³ This sample includes: Algeria, Argentina, Australia, Austria, Belarus, Belgium, Brazil, Canada, Chile, Colombia, China, France, Germany, Iran, Italy, Japan, Kazakhstan, Netherlands, Nigeria, Norway, Republic of Korea, Russian Federation, South Africa, Spain, Sweden, Ukraine, the United Kingdom, the United States of America, and Venezuela. The sample of twenty-nine (29) States was constructed because there are, at a minimum, twenty-nine States that have published or promulgated rules for space objects under their national law. This is a separate source of rules distinct from international agreements and international custom.⁴³⁴ As such, they represent some bound on the number of States that engage or participate in a State practice, in some form, of launching into and using space objects in the outer space environment.

The compilation of the data set for National Space Laws is represented in Table 4 in the Appendix. A table of raw data was constructed using Microsoft Excel. The table consists of seven columns. The first column listed each State counted in the sample. The second through fifth columns listed the date of ratification for the four space treaties for each sampled State. The sixth column lists the promulgation of rules regarding space

⁴³¹ See Appendix for raw data.

⁴³² See *supra* note 397.

⁴³³ See Appendix for raw data.

⁴³⁴ See discussion *supra* in Chapter I.

objects. If a State had promulgated a national space law, then that date was used in the table. However, if a sampled State never promulgated a national space law, then the date of the last ratification of a definition of space object was chosen because the act of ratification integrates a treaty's obligation into a State's national law. The seventh column lists the dates on which States promulgated a national space law regarding space objects and does not incorporate any State sampled that has not promulgated a national space law in relation to other States sampled.

2. National Law Pivot Table

Due to the limited number of sampled States, the construction of a pivot table was unnecessary.

3. National Law Scatterplot

A scatterplot was designed to graph the sample of national space laws data in Microsoft Excel. Graph 6 below shows the growth of the number of States that have promulgated national space laws regulating space objects and that have also incorporated obligations from one or more space treaties. The number of States that have published or promulgated a national (space) law is listed on the y-axis and time, between July 1958 and October 2015, is listed on the x-axis.⁴³⁵

⁴³⁵ Ratification counts include States that acceded or succeeded to the treaty. *See supra* note 48.

A curve was generated for each sample. The first curve relates to the sample of thirty-nine (39) States and is designated as NL uncorrected (uncorr.). This means these States have at least purchased the obligations of the Outer Space Treaty and/or gave effect to the treaty's obligations through the publishing or promulgation of a national law.⁴³⁶ The second curve relates to the sample of twenty-nine (29) States that have only published or promulgated national laws relating to the launching into or use of space objects in the outer space environment. This curve is designated NL corrected (corr.) and represents the supply of rules to the supranational market of international relations. Each curve provides evidence of rule supply as a function of rules of general principles of law and rule consumption as a function of rules from international agreements. Generation of these curves enables comparison across the types of rules supplied and consumed across various supranational markets of international relations.

4. National Law Data Limitations

Most national space laws surveyed are published in official or unofficial versions in English. The English versions are the basis for the construction of the table of national space laws. Each national space law was screened to ensure that each law or regulation had some mention of space object. For national laws sampled that did not have an English translation, Google Translator was utilized to distinguish whether the national law reviewed had some mention of the regulation of space objects. The procedure used

⁴³⁶ Again, the set of States sampled comprises those States that have some space-faring experience, including being a member State of a multilateral space agency, a partner to the International Space Station, launching humans, animals, or other objects into outer space, or having had another State launch objects into outer space for it. *See supra* note 427. *See also* BROWNLIE *supra* note 4.

involved looking for words like “object,” “space object,” satellite, launch vehicle, spacecraft, or payload.

Graph 6: Cumulative Count of the Sample of National Space Laws (Space Object)

G. Member States of the COPUOS

1. COPUOS Data Set

The compilation of the data set for the Growth of Membership in COPUOS is represented in Table 6 in the Appendix. First, a table of raw data was constructed using Microsoft Excel. The table consisted of three columns. The first column listed each State that had become a member of COPUOS. The second column lists the date on which the listed State became a member of COPUOS. The third column lists the cumulative count of membership in COPUOS over time.

2. COPUOS Pivot Table

No pivot table was designed for COPUOS membership because no State member has transitioned off due to significant changes in its political composition over time.

3. COPUOS Scatterplot

A scatterplot was designed to graph the pivot table data in Microsoft Excel. Graph 7 below shows the growth in COPUOS membership over time where the cumulative number of member States is listed on the y-axis and time, between December 1958 and October 2015, is listed on the x-axis.

The curve COPUOS generated represents market participation within the specialized UN committee regarding the outer space environment. COPUOS is its own

supranational market of international relations because each Member State of COPUOS has the ability to engage in preference revelation with other committee members as well as supply possible rules for States.⁴³⁷ Changes in membership to COPUOS indicate how States use the committee and therefore offer a measure of market participation. All of the space treaties analyzed were developed within COPUOS and COPUOS continues to facilitate exchanging ideas and rules for various types of space activities between and among States.

4. COPUOS Data Limitations

No limitations on COPUOS data were discovered. All member States are accounted for.

⁴³⁷ Since COPUOS members cannot put into force international agreements, the best the Committee can do is supply rules to the international community of States via processes internal to United Nations administration. Nonetheless, the supply of rules emanating from COPUOS may become consumed rules if the international agreement reaches beyond the Committee, i.e., to the General Assembly or open to all States to purchase the obligation.

Graph 7: Growth of COPUOS Membership

d. Quantification of Supranational Market Participation

A Herfindahl Index is a general measure of the relative market power of an individual participant in relation to the total number of participants in an industry as an indicator of the level of competition within a particular market.⁴³⁸ A Herfindahl index is usually used in relation to competition among firms in an industry. In particular, the US Department of Justice uses a Herfindahl Index to determine whether the merger of two firms would produce market shares for the new firm in excess of the number permitted by law.⁴³⁹ This is done by looking at the relative market share of each firm and squaring the value of the market share to determine how much competition exists in a particular industry.⁴⁴⁰

Competition for rules can be a basic measure of determining preference revelation. As discussed in subsequent chapters, market participation across different supranational markets of international relations can vary. Consequently, these changes can give rise to different ways in which rules of jurisdiction are supplied to the supranational market. Moreover, market participation also is indicative of what States value in particular supranational markets, those rules supplied, and rules consumed in any given supranational market because different States will seek to satisfy their valued preferences in different ways, which may not include the consumption of most or many rules already supplied or consumed by other States based on the source of the rule(s) in question. Hence, a Herfindahl index can be a useful tool to analyze to what extent States

⁴³⁸ See *supra* note 36.

⁴³⁹ *Id.* See, .e.g., United States Department of Justice, *Herfindahl-Hirschman Index*, [WWW.JUSTICE.GOV, http://www.justice.gov/atr/herfindahl-hirschman-index](http://www.justice.gov/atr/herfindahl-hirschman-index) accessed Dec. 10, 2015.

⁴⁴⁰ *Id.*

compete for the supply and consumption of rules within any given supranational markets of international relations.

The use of a Herfindahl index is adapted here where States take the form of the traditional firm and pool of market participants by which competition among them is measured. To date, the total population of the international System of States that are members of the UN is $N=193$ States. As a function of sovereign equality, each State has the same market share of the supranational market of international relations

In relation to rules supplied as a matter of international custom, market shares in the supranational market may be calculated by looking at the ratio of each individual UN member State in relation to the total number of States in the UN. Today, for example, a State has a market share of $\frac{1}{N} * 100 = \frac{1}{193} * 100 = 0.52\%$.⁴⁴¹ An individual value below 25% market share is considered a competitive market.⁴⁴² Therefore, the supranational market of international relations is a highly competitive market because any given State has a market share quantified to 0.52% relative to other States, which enables States to supply any rules to the supranational market as a function of State practice.

In relation to rules supplied as a matter of international agreements, market shares in the supranational market may be calculated by looking at the ratio of members States of COPUOS in relation to the number of States that have consumed the space treaties analyzed at any given time. This measure provides a sense to which States may seek

⁴⁴¹ This measure will vary in time and therefore the market share concentration of States will fluctuate over time providing a relative sense of the degree of market participation, rule supply, and rule consumption.

⁴⁴² See *supra* note 36. See also *supra* note 439.

participation in a particular supranational market and the extent to which States clearly have an interest in rule development for activities in the outer space environment.

Furthermore, market shares may be analyzed in relation to the number of member States of COPUOS and all members of the United Nations. Where generally States have an equal market share in the supranational market of international relations for rules of international custom, the measure of the share of market concentration within COPUOS will vary over time. Today, for example, within COPUOS a member State has a market share of $\frac{1}{N} * 100 = \frac{1}{83} * 100 = 1.25\%$.⁴⁴³ COPUOS market shares are significantly greater than the general share of market concentration that States have with respect to rules of international custom. Thus, COPUOS member States have greater market power relative to non-member States – a factor of almost two and half times greater.⁴⁴⁴

In relation to rules supplied as a matter of national law, market shares in the supranational market of international relations may be calculated by looking at the number of States that have published or promulgated a national (space) law. This provides a measure of how States supply rules to the supranational market and provides an indication of their valued preferences. For example, today, in terms of rule supply, of the twenty-nine (29) States sampled, each State has an individual market share in the supply of rules relative to all other States. Thus, each State in the sample has a market share of $\frac{1}{N} * 100 = \frac{1}{39} * 100 = 2.56\%$. Furthermore, this measure provides a sense of individual market participation for rule supply that may be compared to participation in other supranational markets of international relations.

⁴⁴³ This measure will vary in time and therefore the market share concentration of States will fluctuate over time providing a relative sense of the degree of market participation, rule supply, and rule consumption.

⁴⁴⁴ While I do not provide an in depth analysis of this issue, I leave it for future work.

Graph 8 below represents the supranational markets of international relations with respect to each source of rules of public international law studied in this thesis. Each market provides different risks, benefits, and costs to States and therefore give a sense of how States seek to be involved in supranational markets for rule development, rule supply, and rule consumption. As the graph seems to show, while the number of States in the international system continues to grow, market participation has only recently begun to increase, in the last fifteen to twenty years, where market participation was previously relatively flat. This seems to indicate that States have started to value the need to enter the supranational market of international relations for the outer space environment. Whether a State consume rules supplied once it enters a supranational market is a separate question generally addressed in the following chapters of this thesis.

Graph 8: Growth in Supranational Market Participation

CHAPTER III

THE EXISTENCE OF RULES FOR THE OUTER SPACE ENVIRONMENT

a. Introduction

Chapter III analyzes the initial rule formation for the outer space environment, which arose from the State practice of launching objects over the territories of other States. This chapter begins with a brief historical analysis of the supranational market of international relations for launching of objects into outer space that establishes the variables of study for the game theory approach to initial rule formation for the outer space environment. Game theory is applied as a means to assess the potential outcomes for initial rule formation that could have arisen from the Sputnik and Explorer launches and those solutions sets are analyzed against the observed historical outcomes.

As a product of the Cold War, the programs to develop launch vehicle technology in the Soviet Union and the US had different meanings to each State.⁴⁴⁵ While the proliferation of dual-use launch vehicle technology spread among States throughout the 1950's, generally in the form of Intercontinental Ballistic Missiles, only two States had the capabilities, capacity, and resources to develop programs that could develop technology that would enable the launching of objects beyond the Earth's atmosphere.⁴⁴⁶

⁴⁴⁵ *See supra* note 17.

⁴⁴⁶ *Id.*

Consequently, the legal aspects of these motivations did not go unnoticed and there was some doubt initially as to the legal validity of launching objects over the territories of other States.⁴⁴⁷

Irrespective of the possible legal concerns of the time, States were aware that this new technological capability would likely require interested States to enter the supranational market of international relations to ensure that the preference of continued use of launching objects into outer space environment remained a viable preference.⁴⁴⁸ To this end, States were and are willing to trade in State sovereignty in the form of rules of prescriptive jurisdiction over activities involving the launch of objects over the territories of States into the outer space environment. Consequently, various supranational markets of international relations arose for rules relating to the outer space environment as a function of State practice.

However, the source of these rules may be observed in the valued preferences materialized as State practice, which equates to both the supply and pricing of rules. The consumption of rules over time can lead to a variety of outcomes whether or not a State supplies, sells, or buys rules of prescriptive jurisdiction. In particular, as a function of the evolution of individual or collective valued preferences of a State(s), the potential outcomes of rule supply can take several forms, e.g., proposed rules may never be consumed (i.e., no buyers), supplied rules may converge into rules of law (i.e. market transition from the consumption of rules), markets may cease to produce rules (i.e.,

⁴⁴⁷ See *supra* note 163. See also *supra* note 141.

⁴⁴⁸ See ASIF A. SIDDIQI, RECONSIDERING SPUTNIK: FORTY YEARS SINCE THE SOVIET SATELLITE 43 (John M. Logsdon & Robert W. Smith ed., Harwood Academic Publ'rs 2000) [hereinafter SIDDIQI], available at <http://history.nasa.gov/sputnik/siddiqi.html>. See also *supra* note 141.

possible market failure), or rules and rules of law may converge as a function of rule consumption across supranational markets (i.e., possible obligatory convergence).

In each case, initial rules that may converge into rules of law are the product of State practice. State practice is the basic measure of how rules arise, develop, and evolve over time. Therefore, with respect to initial rule formation, the genesis of all rules studied in this thesis started with the State practice of launching objects into the outer space environment over the territories of other States with the launching of the Sputnik and Explorer objects.

b. From Proto-Market Signaling to Market Creation: Initial Development of Supranational Markets for the Outer Space Environment

The preference to launch objects over the territories of States into and through the outer space environment arose at a time when two clear hegemonic States competed in the domain of international politics.⁴⁴⁹ Thus, the supranational market of international relations over initial activities in the outer space environment consisted of two States, which may be termed a duopoly, i.e., a market consisting of only two suppliers of rules. Each State had a market share equal to its capabilities starting at a particular time. For example, when Sputnik I launched on October 4, 1957, the Soviet Union had a monopoly on the supply of rules for the outer space environment because it had the capabilities to define such rules.⁴⁵⁰ As the Soviet Union was the only State with the necessary capabilities of spaceflight at the time, it controlled the market in terms of supply of

⁴⁴⁹ See *supra* note 17.

⁴⁵⁰ *Id.*

rules.⁴⁵¹ Consequently, the price and supply of rules of prescriptive jurisdiction over these types of activities was initially set by the Soviet Union. All other States in the international system would remain buyers of rules of jurisdiction until such time as they developed the same preferences and capabilities to compete in the supranational market of international relations.⁴⁵²

On January 31, 1958, the United States entered the supranational market of international relations when it launched Explorer I into the outer space environment.⁴⁵³ Starting at this time, the United States had an equal share in the development of rules (e.g., through initial supply of rules and technological capabilities) for the outer space environment. Because the United States had an equal share of the supply of rules of jurisdiction with the Soviet Union, each State had to compete with each other and use diplomacy and other means to attract buyers of rules of jurisdiction for activities that could occur in the outer space environment. Without other buyers in the market, the market would turn into a duopsony, i.e., a market which consists of only two buyers. Since rules of jurisdiction are considered purely substitute goods in the supranational market of international relations, the United States and Soviet Union were initially left to figure out who supplies and buys which rules of jurisdiction over what types of activities.⁴⁵⁴ However, the fact that a competition for rules of jurisdiction arose from the

⁴⁵¹ *Id.*

⁴⁵² Thus, market entrance is a function of a State's valued preferences in relation to particular supranational markets for rules and rules of law for the outer space environment.

⁴⁵³ See *supra* note 17.

⁴⁵⁴ If both States had been the only two buyers and suppliers of rules of jurisdiction, each would be left to develop rules between each other with no other possible buyers. If these two States were the only State's that existed at the time, it would have been an interesting observation because it would put into question the structure of international political alignments at the time.

“space race” and this competition resulted from the hierarchical alignments between the hegemons necessarily increased the value of such rules rather quickly.⁴⁵⁵

Generally, where no international forum exists, State practice represents the supply of rules to the supranational market of international relations. State practice is the physical manifestation of a State’s valued preferences. As such, when States conduct activities or preform actions outside their territories, they are subject to a variety of risks and costs to their authority. In order to manage these risks in relation to the activities of other States, States may seek to sell rules of prescriptive jurisdiction in the form of their State practice. While not every State practice may constitute a supply of possible rules, e.g., when States give notice that their respective practice is not conducted or followed out of a legal obligation,⁴⁵⁶ State practice nevertheless does supply rules. The question is how does an observer measure the formation and development of such rules?

The next section describes the historical events that helped catalyze the launching of the Sputnik and Explorer objects.

⁴⁵⁵ See *supra* note 17. See also LAKE *supra* note 9.

⁴⁵⁶ See BROWNIE *supra* note 4.

c. The Historical Bases for the Valued Preferences of the United States and the Soviet Union that Catalyzed Initial Rule Development for the Outer Space Environment⁴⁵⁷

Scholars of space history have termed the date October 4, 1957, as the date on which the “space race” between the United States and the Soviet Union began.⁴⁵⁸

However, the date also signifies another major moment, i.e., the initial State practice of launching and orbiting a space object over the sovereign territories of other States.⁴⁵⁹ In other words, the creation of the first rule regarding the activities and conduct of States in outer space. The establishment of this initial rule laid the foundation for subsequent rules regarding the outer space environment. But what were the specific catalyzing events that precipitated the development and formation of the initial rules for the outer space environment? From where did the valued preferences to launch objects derive and how did it manifest into State practice?

This section summarizes the historical and necessary variables that helped catalyze the initial launching of objects into the outer space environment. Three critical variables are identified that represent catalysts for the launch of the Sputnik and Explorer objects. The first variable is the necessary technological development and utilization of rockets and payloads. This variable is implicit to the following analysis because it is common to both the US and the Soviet Union, but nonetheless a necessary element to

⁴⁵⁷ See Christopher M. Hearsey, A Historical Analysis of the Administrative Origins of NASA (Jan. 17, 2011) (unpublished manuscript on file with author) *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1742163. This section is adapted from unpublished work based on research while a Graduate Fellow at the Smithsonian National Air and Space Museum in 2008.

⁴⁵⁸ See *supra* note 17.

⁴⁵⁹ *Id.*

enter the supranational market for international relations relating to outer space activities. The second variable is the supply of a set of rules of jurisdiction for an Open Skies Treaty on the supranational market of international relations.⁴⁶⁰ This variable influenced the development of a preference to launch objects into outer space over the territories of States because the US and the Soviet Union could not converge on a price for negotiating rules for an Open Skies Treaty. In other words, the supranational market never produced a rule either State would be willing to buy. The third variable relates to the acceptance of the informal obligations arising from the goal of the International Geophysical Year of 1957-58 (IGY).⁴⁶¹ This variable represents the valued preference of seeking to purchase the authority to launch and orbit objects over the territories of States into the outer space environment pursuant to an international scientific project. Thus, the Open Skies Treaty and the IGY are linked because the valued preferences manifested simultaneously in time and form the basis of the stratagems and their constraints to the valued preferences of the US and Soviet Union.

i. Origins of the Structure of the Supranational Market of International Relations Relating to Outer Space Activities

Before the surrender of the Axis powers during World War II, President Franklin D. Roosevelt began advocating for and sought the drafting of two major new multilateral treaties. The first new multi-lateral treaty would establish the framework and legal structures for a post-War international civil aviation authority.⁴⁶² Although signed onto in

⁴⁶⁰ *Id.*

⁴⁶¹ *Id.*

⁴⁶² *See* Convention on International Civil Aviation, *opened for signature* Dec. 7, 1944, 15 U.N.T.S. 295.

1944 by fifty-two States, the Chicago Convention on International Civil Aviation did not go into force until 1947.⁴⁶³ The second multilateral treaty would replace the League of Nations⁴⁶⁴ with an international organization built to minimize international conflict and increase dialogue between States in order to prevent another World War.⁴⁶⁵ Even before the Empire of Japan had formally surrendered to Allied Forces, the victors of World War II finalized and signed the Charter of the United Nations.⁴⁶⁶ This new Charter significantly changed many fundamental relationships at the international level including, *inter alia*, the institution of new legal rules and governing structures.⁴⁶⁷ These two new multilateral treaties would reshape international relations and legal relationships and provide a backdrop to the birth of rules for the outer space environment.

The Chicago Convention is considered a major accomplishment of post-War international governance.⁴⁶⁸ As the basis for the regulation of international civil air travel, the Chicago Convention imported several well regarded rules of public international law. In particular, article I of the Convention states that “[t]he contracting States recognize that every State has complete and *exclusive* sovereignty over the airspace above its territory.”⁴⁶⁹ (Emphasis added). Moreover, despite several attempts to reach the upper atmosphere and the edge of outer space before October 1957, States still generally accepted that their sovereignty over their airspace was exclusive.⁴⁷⁰ However, the issue of

⁴⁶³ *Id.*

⁴⁶⁴ See The Covenant of the League of Nations, *opened for signature* Jun. 28, 1919, 13 AM. J. INT’L L. SUPP. 128 (1919), available at http://avalon.law.yale.edu/20th_century/leagcov.asp.

⁴⁶⁵ U.N. Charter.

⁴⁶⁶ *Id.*

⁴⁶⁷ See BROWNIE *supra* note 17.

⁴⁶⁸ See I.H.PH DIEDERIKS-VERSCHOOR & PABLO MENDES DE LEON, AN INTRODUCTION TO AIR LAW (Kluwer 2012).

⁴⁶⁹ See *supra* note 462.

⁴⁷⁰ See *supra* note 17.

the delimitation of the airspace environment from the outer space environment did arise in discourse prior to October 1957 and continues to this day.⁴⁷¹

The delimitation issue illustrates the effects of rule-making based on shifting valued preferences with respect to State practice, including the evolution of rules of public international law in relation to the boundary between the airspace and outer space environments. The fact that States have not consumed many rules of airspace delimitation implies that the price of these rules so far supplied do not satisfy the valued preferences of many States. Interestingly, despite the lack of supply or consumption of delimitation rules, this trend has not stopped the proliferation of outer space activities and the attendant rules generated by such activities. As the discussion in the following section presents, valued preferences are subject to change and change can manifest over a nominally long period of time.

ii. The Formation of Valued Preferences to Launch into and Orbit Objects in the Outer Space Environment Over the Territories of States⁴⁷²

One form of a valued preference manifests through a State's foreign policy. Generally, a State's foreign policy tends to be complicated, varied, and subject to change. Changes in and to the international system of States may force a State to revalue, replace, and/or innovate its valued preferences as a function of their foreign policies. For example, in the US, the doctrine of using science and technology as a means to achieve

⁴⁷¹ Since the delimitation of the airspace environment from the outer space environment still has not produced a rule that has been significantly consumed by States, it does not arise as an initial rule of space law. *See supra* note 16 & 163.

⁴⁷² *See supra* note 457.

foreign policy goals began in the Truman Administration.⁴⁷³ Two principle proponents of this doctrine were Lloyd Berkner and James Webb.

In April 1950, Berkner wrote a report for the State Department titled “Science and Foreign Relations.”⁴⁷⁴ In the report, Berkner “describe[ed] the nature and significance of basic problems in international relations raised by scientific and technical developments.”⁴⁷⁵ In a secret supplement to the report, Allan Needell notes that “Berkner ... emphasized the usefulness for intelligence gathering from increased international contacts by American scientists.”⁴⁷⁶ Berkner believed that “[s]cience and national interest were both powerful motivations... [a]nd since they reinforced each other, it [was] difficult to rank them.”⁴⁷⁷ Webb was instrumental in trying to implement Berkner’s recommendations due to Webb’s seniority at the State Department.⁴⁷⁸

On April 5, 1950, the same month in which Berkner finished his “Science and Foreign Relations” report, Berkner was invited to a dinner party at the home of James van Allen in Silver Spring, Maryland.⁴⁷⁹ Several historians have noted that during dinner Berkner reportedly proposed that the “world’s scientists organize a third international polar year to take place during the period of maximum solar activity expected during 1957 and 1958.”⁴⁸⁰ The outcome of the van Allen dinner ultimately resulted in the

⁴⁷³ See ALLAN A. NEEDELL, *SCIENCE, COLD WAR AND THE AMERICAN STATE: LLOYD V. BERKNER AND THE BALANCE OF PROFESSIONAL IDEALS* 297-98 (Hardwood Academic Publ’rs, 2000).

⁴⁷⁴ See Lloyd Berkner, *Science and Foreign Relations: Berkner’s Report to the U.S. Department of State*, BULLETIN OF THE ATOMIC SCIENTISTS 293 (1950).

⁴⁷⁵ HENRY W. LAMBRIGHT, *POWERING APOLLO: JAMES E. WEBB OF NASA* 63 (Johns Hopkins Univ. Press 1995).

⁴⁷⁶ *Supra* note 473, at 297-99.

⁴⁷⁷ JOHN E. NAUGLE, *FIRST AMONG EQUALS: THE SELECTION OF NASA SPACE SCIENCE EXPERIMENTS* (NASA SP-4215 1991).

⁴⁷⁸ The report itself strongly demonstrates Webb and Berkner’s shared attitude toward government-funded science and its relationship to foreign policy.

⁴⁷⁹ See *supra* note 473, at 297-99.

⁴⁸⁰ *Supra* note 477.

creation of the International Geophysical Year (IGY), which in seven years would result in the launch of the first artificial satellite, Sputnik I.⁴⁸¹

For two years, Berkner worked on organizing an IGY with the help of Sydney Chapman, another van Allen dinner guest. In October 1952, the International Council of Scientific Unions (ICSU) approved the idea and created the Comité Spécial de l'Année Géophysique Internationale (CSAGI) to plan the IGY.⁴⁸² Chapman was elected president and Berkner vice-president by members of the CSAGI. Chapman and Berkner then lobbied Detlev Bronk, President of the National Academy of Sciences (NAS), and the National Research Council for help in organizing US participation in the IGY. On February 10, 1953, the United States National Committee for the IGY (USNC-IGY) was created and Joseph Kaplan was appointed as its Chair.⁴⁸³ A year later, “members of CSAGI recognized the possibility of using ... ballistic missiles to place satellites in orbit.”⁴⁸⁴ On October 4, 1954, CSAGI sent letters to President Eisenhower and Soviet Premier Bulganin asking them to participate in the IGY by “plac[ing] small scientific spacecraft in orbit [with their ballistic missiles] to measure solar radiation and its effect on the upper atmosphere.”⁴⁸⁵ On July 29, 1955, the United States agreed to the CSAGI

⁴⁸¹ See DONALD T. ROTUNDA, THE LEGISLATIVE HISTORY OF THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958 21-22 (NASA HHN-125 Sept. 1972) [hereinafter ROTUNDA]. Donald Rotunda and other historians claim that the IGY idea was conceived by Lloyd Berkner, while John Naugle claims that the IGY idea originated from Berkner's wife Abbie. Compare *supra* note 473, at 299, with *supra* note 477, at Chapter I, and ROTUNDA, at 4. No matter who suggested it first, it “set off,” as Naugle notes, “a chain of events that helped to create NASA.” *Supra* note 477, at Chapter I.

⁴⁸² See *supra* note 477, at Chapter I.

⁴⁸³ *Id.*

⁴⁸⁴ *Id.*

⁴⁸⁵ *Id.*

request to place a small scientific satellite into orbit with an American missile for the IGY.⁴⁸⁶

However, the Soviet Union's participation in the IGY was far from clear at the time. Although Soviet representatives served on the CSAGI, their contributions to the proceedings were insignificant.⁴⁸⁷ As Siddiqi notes "the May 1954 deadline for submissions for participation in the IGY passed without any word from Soviet authorities."⁴⁸⁸ Moreover, on October 4, 1954, Soviet representatives watched silently as the CSAGI adopted the US's plan for the IGY.⁴⁸⁹ However, US agenda setting at the CSAGI surprised the Soviets and they subsequently moved to organize an internal Commission that would determine the plan for contributing to the IGY.⁴⁹⁰

Although the CSAGI was successful in securing government support of satellite launches, the idea of using satellites for science did not originate with the CSAGI. Naugle notes that "even before the formation of CSAGI, the members of the Upper Atmosphere Rocket Research Panel [UARRP] had recognized that sounding rockets could play an important role in the IGY."⁴⁹¹ Moreover, the UARRP members were well aware of an earlier report on the subject of Earth satellites, first brought up in 1945 by the Navy's Bureau of Aeronautics.⁴⁹² The Bureau created a Committee for Evaluating the Feasibility of Space Rocketry (CEFSR). The CEFSR published their study in 1946 recommending that the Joint Research and Development Board should attempt to place a small satellite

⁴⁸⁶ *Id.*

⁴⁸⁷ *See supra* note 448.

⁴⁸⁸ *Id.*

⁴⁸⁹ *Supra* note 477, at Chapter I.

⁴⁹⁰ *Id.*

⁴⁹¹ *Id.*

⁴⁹² RICHARD HIRSCH AND JOSEPH J. TRENTO, *THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION* 11 (Praeger Publ'rs 1973).

in Earth orbit. The proposal was later rejected by the DOD for having an “insufficient military requirement.”⁴⁹³ Later, in April 1947, the Air Force’s Project RAND published a study on the feasibility of launching satellites with sounding rockets. The RAND study served as the basis for the military services’ development of their own rocket programs, which eventually led to the formation of the UARRP in 1946. Richard Hirsch and Joseph Trento note that James van Allen “proposed an Earth satellite experiment at the 1948 meeting of the International Union of Geodesy and Geophysics.”⁴⁹⁴ However, van Allen’s early call for science satellites went nowhere due to the conservative mindedness of academe in the US at the time.

By early 1950, scientists in government could not find support within the military for launching satellites. Scientists outside of government did not have the funding or facilities to build rockets nor did they have access to the rockets being developed by the US military in an effort to deter the Soviets from attacking the US. A shift in science policy occurred in 1954 when Eisenhower issued an Executive Order “declar[ing] ... that the NSF should ... be responsible for all federally funded basic research, while other agencies [must] stick to applied research related to their missions.”⁴⁹⁵ As a consequence, the “executive order ... reduc[ed] D[O]D and AEC support for pure science, while the NSF lacked the funds to take up the slack[.]”⁴⁹⁶ In response, NSF Director “Alan Waterman protested, styling his appeal to the White House as a program for

⁴⁹³ *Id.*, at 11.

⁴⁹⁴ *Id.*

⁴⁹⁵ *Supra* note 17, at 159. *See* Exec. Order No. 10,521 (Mar. 17, 1954) (“Administration of Scientific Research by Agencies of the Federal Government”).

⁴⁹⁶ *Supra* note 17, at 159.

“Maintenance of Technological Superiority.””⁴⁹⁷ Waterman’s protest was ignored at the fiscally conservative White House.

The funding issue came to a head in July 1957 when scientist I.I. Rabi and the Office of Defense Mobilization (ODM) Science Committee reported to the White House that

the welfare of the U.S., incomparably more than at any other time in its history[,] [was] dependent on new scientific knowledge for the welfare of its people, for the advancement of its economy, and for its military strength...Research is a requisite for survival.⁴⁹⁸

I.I. Rabi pleaded with the Eisenhower Administration, arguing that “government could encourage private investment in R & D, perhaps through tax policy, but [acknowledged that] the time had passed when national needs could be met from private sources.”⁴⁹⁹

McDougall notes that this was a sudden change and that “[a]fter 1945, scientists advised Truman that even military related research ought to be directed and funded by a civilian agency . . .and [by] 1957, scientists advised Eisenhower that even civilian basic research ought to be sponsored by the military[.]”⁵⁰⁰ By the mid-1950’s, obstacles to increased science funding were already reaching critical mass. Coincidentally, satellites were seen as feasible means of conducting science in space, and the US military services were

⁴⁹⁷ *Id.*

⁴⁹⁸ *Id.*

⁴⁹⁹ *Id.*

⁵⁰⁰ *Id.* at 160.

developing ballistic missiles with sufficient thrust to place a satellite into orbit around the Earth.

When Eisenhower was elected President, he brought with him not only a fiscally conservative attitude toward government, but also a real fear of Soviet aggression.

President Eisenhower was very concerned about a surprise attack from the Soviets and wanted better surveillance of Soviet movements and installations.⁵⁰¹ On July 26, 1954, the President ordered the creation of a panel of scientists to advise him on the state of US technology and offer recommendations for national defense. James Doolittle, James Killian, and several other prominent scientists formed the Technological Capabilities Committee (TCP). In February 1955, the TCP “recommended accelerating procurement of intercontinental ballistic missiles ... [and] a program to develop a small scientific satellite that would operate at extreme altitudes above national airspace.”⁵⁰² The satellite recommendation was based upon a RAND follow-up study from 1954 on the technical feasibility of satellites for military observations.⁵⁰³ The first RAND study in 1947 was initially dismissed by the military before it was widely understood that a satellite could provide intelligence on the Soviet Union. However, as Hall notes, “James Killian, who chaired the TCP, viewed RAND’s ... propos[al] [for a] military observation satellite as a “peripheral project” and ... refus[ed] to support it until the Soviets launched Sputnik I nearly three years later.”⁵⁰⁴ Even without Killian's support, what later came to be known

⁵⁰¹ *Id.*

⁵⁰² Cargill Hall, *Origins of U. S. Space Policy: Eisenhower, Open Skies and Freedom of Space*, in *EXPLORING THE UNKNOWN, VOLUME I: ORGANIZING FOR EXPLORATION* 213-29 (John M. Logsdon ed., NASA SP 2001-4407 1995).

⁵⁰³ MICHAEL D. RICH, *RAND’S ROLE IN THE CORONA PROGRAM: REMARKS ON THE 35TH ANNIVERSARY OF THE FIRST SUCCESSFUL MISSION* (RAND 1998).

⁵⁰⁴ *Supra* note 502, at 220.

as Operation Feed Back marked the beginning of the covert US satellite reconnaissance program, which represented first US military satellite program..⁵⁰⁵

It is not entirely clear who among the USNC-IGY knew of Operation Feed Back or, if they did know, when they knew it. Historians have not thoroughly explored this issue. Needell notes that there is no evidence of Berkner's involvement in the 1954 RAND study or the TCP.⁵⁰⁶ Berkner's previous clashes with the Air Force and RAND would have made it unlikely that he was consulted. However, there is some evidence Berkner was briefed on the RAND study prior to leaving for Europe for CSAGI meetings.⁵⁰⁷ Needell claims that "[t]he case is much stronger, although still circumstantial, that Berkner would have been familiar with the deliberations of the TCP."⁵⁰⁸ Needell writes that at the January 7, 1955, USNC Executive Committee meeting, Berkner suggested that the recently enlarged USNC Panel on Rocketry meet in closed session to "study [the] proposal of launching [an] artificial satellite during or near the IGY."⁵⁰⁹ Moreover, Needell points out that the committee members were willing to act secretly to make the satellite launch happen even if the answer was no from the Eisenhower Administration.⁵¹⁰

Following the closed meeting, the USNC-IGY Executive Committee met on January 22, 1955, to form a special group to report on technical feasibility of satellites. The Executive Committee named it the Long Playing Rocket (LPR) Committee, chaired

⁵⁰⁵ *Id. See, e.g.,* PAUL B. STARES, THE MILITARIZATION OF SPACE: US POLICY 29-30 (Cornell Univ. Press 1985).

⁵⁰⁶ *See supra* note 473, at 329.

⁵⁰⁷ *Id.* at 329-30.

⁵⁰⁸ *Id.* at 330.

⁵⁰⁹ *Id.* at 335.

⁵¹⁰ *Id.* at 336.

by Fred Whipple. During the LPR meeting, “[Athelstan] Spilhaus recommended that the USNC accept the task of building a completely unclassified instrument “head” section, which could be turned over to the military for launch on a rocket.”⁵¹¹ Needell notes that Merle Tuve objected to the idea. Needell writes that “[g]iven the origins of the project and the degree of collateral interest, [Tuve] thought the entire project should be undertaken by the military.”⁵¹² In response, Whipple “asserted, without elaboration, that the IGY association was necessary to “ease permission to go over other countries.””⁵¹³

With the satellite proposal finally adopted by the CSAGI in early 1955, USNC-IGY members started to solicit the Eisenhower Administration for support. NSF Director Alan Waterman approached Secretaries Donald Quarles and Allen Dulles, of the Defense and State Departments, respectively, as well as Richard Bissell of the CIA regarding how to go about selling the IGY satellite proposal. Quarles, Dulles, and Bissell suggested obtaining high-level endorsements, which Waterman did. At this time, the DOD was reviewing Killian’s TCP report and Dulles agreed to bring the matter to the NSC’s Operations Coordinating Board.⁵¹⁴

While Waterman was soliciting support, so too was Berkner. Berkner was asked to a meeting on March 22, 1955, with Detlev Bronk and Robert Murphy at the State Department to discuss the satellite proposal. In late April, Murphy wrote a letter to Berkner giving him the go ahead from the State Department to proceed. Murphy’s letter

⁵¹¹ *Id.*

⁵¹² *Id.*

⁵¹³ *Id.* It is not clear how Whipple knew of such a claim a month before the TCP recommendations were to be published unless he had some part in the recommendations or had seen a draft before the LPR meeting.

⁵¹⁴ *Id.* at 338-40. The eventual outcome was the adoption of NSC 5520, which laid the policy position of the US government with respect to establishing the “freedom of space” by launching the first satellite into space. *See supra* note 141.

noted that “if successful, it would, as a matter of fact, undoubtedly add to the scientific prestige of the United States, and it would have a considerable propaganda value in the cold war.”⁵¹⁵

As the Eisenhower Administration figured out how to implement the TCP recommendations, the IGY Executive Committee presented its own proposal for the US government to launch a scientific satellite in support of the IGY’s goals. The proposal was approved by the NAS, which would organize the effort, while the NSF would fund the program. In tandem with the IGY proposal, the TCP panel’s recommendation, and the need for better intelligence of the Soviet Union, the National Security Council drafted NSC 5520, “which stated that the United States should develop small scientific satellite weighing 5 to 10 pounds.”⁵¹⁶ The report also urged the development of large reconnaissance satellites, but only after a scientific satellite launch had established the principle of “freedom of space.”⁵¹⁷

Eisenhower and his national security advisors had been looking for ways to penetrate the Soviet Union. At first, US intelligence agencies attempted to float high altitude balloons across the Soviet Union, but this was not very reliable since the balloons could not be controlled remotely.⁵¹⁸ It was ultimately decided that satellites would be the best means to keep constant surveillance on the Soviet Union, but the earliest a

⁵¹⁵ See *supra* note 473, at 337-38. However, it was not until October 4, 1957, that the propaganda value of a satellite launch had been realized, but not by the United States.

⁵¹⁶ Dwayne A. Day, *Invitation to Struggle: The History of Civilian-Military Relations in Space*, in *EXPLORING THE UNKNOWN, VOLUME II: EXTERNAL RELATIONSHIPS 233-70* (John M. Logsdon, ed., NASA SP 2001-4407 1995). See also *supra* note 141.

⁵¹⁷ *Id.*, at 241.

⁵¹⁸ See MATT BILLE, AND ERIKA LISHOCK, *THE FIRST SPACE RACE: LAUNCHING THE WORLD’S FIRST SATELLITES 75* (Texas A & M Univ. Press 2004).

reconnaissance satellite would be available would be 1958.⁵¹⁹ Moreover, it was quickly realized that a covert satellite program could potentially violate international law.⁵²⁰ As a way of dealing with a potential violation of international law, Eisenhower's national security strategy required that the principle of "freedom of space" be considered instant customary international law.⁵²¹ Hence, the Eisenhower Administration deemed it critical that the US start a civilian operation to launch the first successful scientific satellite into outer space so as to be able to later argue that it is permissible to launch covert satellites into orbit.⁵²²

On May 27, 1955, Eisenhower approved NSC 5520, authorizing the US to launch a scientific satellite, but stressed that the satellite proposals would only go forward as long as they did not interfere with the development of ballistic missiles.⁵²³ Deputy Secretary of Defense Donald Quarles then instructed the Committee on Special Capabilities to review the satellite proposals of the Navy, Army, and Air Force.⁵²⁴ On July 29, 1955, the U.S. formally announced to the world that it would launch a small scientific satellite as part of the International Geophysical Year of 1957-58.⁵²⁵ Later, in November 1956, Quarles made it known to the other branches that in no way would a military satellite precede a scientific one.⁵²⁶

⁵¹⁹ See *supra* note 502.

⁵²⁰ See *supra* note 141.

⁵²¹ *Id.* See Bin Cheng, *United Nations Resolutions on Outer Space: "Instant" International Customary Law?*, 5 INDIAN J. INT'L L. 23 (1965).

⁵²² *Id.*

⁵²³ *Id.*

⁵²⁴ See *supra* note 502.

⁵²⁵ *Id.*

⁵²⁶ *Id.*

On July 21, 1955, over a week before the US announced its participation in the IGY, President Eisenhower approached the Soviet Premier Nikolai Bulganin with the idea of an “Open Skies Treaty” at a summer conference in Geneva, Switzerland.⁵²⁷ At the time, the treaty would have called for the United States and the Soviet Union to exchange maps denoting military installations in their respective States and then authorize overflights of each State by the other States’ personnel.⁵²⁸ Immediately, Soviet Secretary General Nikita Khrushchev instructed Bulganin to reject the Open Skies Treaty because of Cold War concerns driven largely by the fact that the Soviet Union lagged behind in military capabilities and wanted to hide that fact from the United States.⁵²⁹ Ironically, the repeated overtures to Premier Bulganin to negotiate an Open Skies Treaty ended in failure precisely because the Soviet Union did not value overflights of its sovereign territory without permission. The launch of Sputnik I undercut the Soviet position and Eisenhower was free to move forward with developing a foreign policy that would include both military and civilian components.⁵³⁰

The announcement by the US that it would seek to launch “small Earth-circling satellites” for the IGY set the Soviet Union into action.⁵³¹ The first clear indication of Soviet IGY participation occurred following a US announcement regarding the IGY on August 2, 1955, in which Leonid I. Sedov told journalists “In my opinion, it will be possible to launch an artificial Earth satellite within the next two years,” and adding

⁵²⁷ See *supra* note 17.

⁵²⁸ *Id.*

⁵²⁹ *Id.*

⁵³⁰ *Id.*

⁵³¹ See SIDIQI *supra* note 448. See also *supra* note 17.

“[t]he realization of the Soviet project can be expected in the near future.”⁵³²

Coincidentally, on July 16, 1955, Soviet Chief Designer Sergei P. Korolev finished his co-authored study on arguments for the design of an object to launch on the R-7 launch vehicle.⁵³³ Korolev’s most provocative argument was that “the creation of [a satellite] would have enormous political significance as evidence of the high development level of our country’s technology.”⁵³⁴ Oddly enough, Soviet officials were initially tepid to the idea of launching a satellite on the R-7 launch vehicle as well as the political benefit argument.⁵³⁵ However, on August 30, 1955, Korolev won over Sputnik Committee Chairman Vasily Ryabikov, who approved the use of the R-7 for a modest satellite program.⁵³⁶

Several reasons have been put forth as for why the Soviets decided to participate in the IGY. For one, it is speculated that the deliberations may have turned on the possibility of using satellites for military purposes.⁵³⁷ However, what is clear is that once the Soviet leadership approved Korolev’s plans for the IGY, Korolev, spurred by the US announcement in July 1955, moved to finish the satellite and set the launch date before the official start of the IGY in order to achieve the political victory of demonstrating Soviet technological superiority before the US could launch.⁵³⁸

On October 4, 1957, less than three months after the official start of the IGY, Korolev’s team successfully launched “object-D” (later named Sputnik I) into orbit.⁵³⁹

⁵³² *Id.*

⁵³³ *Id.*

⁵³⁴ *Id.*

⁵³⁵ *Id.*

⁵³⁶ *Id.*

⁵³⁷ *Id.*

⁵³⁸ *Id.*

⁵³⁹ *Id.*

Months later, in January 1958, the US successfully launched its Explorer I object under project Vanguard.⁵⁴⁰ These two launches set in motion the “space race” where the US and the Soviet Union battled for “space firsts” in a bid to demonstrate technological and scientific superiority. Although the Soviets met their foreign policy objectives with the launch of Sputnik I and II, the Soviets also engaged in the first clear State practice of launching objects over the territories of sovereign States. Without objection from other States, the State practice of launching objects over the territories of sovereign States slowly proliferated among the international system of States, but States generally supported the State practice. As discussed in Chapter IV, support for this State practice quickly spread as States began to value space activities as part of their valued preferences.

In the next section, game theory is applied to the two main events that necessarily facilitated the development of the initial rule formation for the outer space environment. In particular, the rejection of rules with respect to mutually consented overflights of the US and Soviet Union and participation in the launching of objects into the outer space environment for the international scientific program the IGY. These two events helped define the valued preferences of the US and Soviet Union as well as defined the possible strategic outcome for developing a rule of State practice that permits States to launch objects over the territories of sovereign States. These events are modelled as iterative games to demonstrate how rules based on State practice arise from the strategic positions of the United States and Soviet Union.

⁵⁴⁰ *See supra* note 17.

d. Game Theory Model of Initial Rule Development

As previously mentioned, preference revelation may be measured by looking at the strategic choices of the players in a game. Initial rule formation is the product of progenitor events that manifest in the form of State practice. State practice can take the form of cooperation or defection from rule formation and supply. The strategic outcomes of State practice may be modeled from history and relative payoffs constructed based on the relationship between outcomes for each potential action a State might take.

As Table 1⁵⁴¹ above shows, the United States (US) and the Soviet Union (SU) have payoffs for each strategic choice for each game. With respect to the first game, if the US chooses to cooperate with the SU on the Open Skies Treaty (O), the US will earn a payoff of +1 because it has sought to maximize its valued preference of negotiating for overflight rules. If the US chooses to defect and not pursue the Open Skies Treaty (NO), then the US will earn a payoff of zero (0) because no change in circumstances occurred as a result of the strategic choice. Conversely, if the SU chooses to cooperate with the US on the Open Skies Treaty (O), then the SU will earn a payoff of -1 because the strategic choice would expose the military gaps between the two players and would cause significant strategic risks and costs. If the SU chooses to defect and not pursue an Open Skies Treaty (NO), then the SU will earn a payoff of 0 because no change in circumstances occurred as a result of the strategic choice.

With respect to the second game, if the US chooses to cooperate as a participant of the International Geophysical Year of 1957-58 (I), the US will earn a payoff of +1

⁵⁴¹ See Table 1.

because it has sought to maximize its valued preference of launching an object over the territories of other States for surveillance purposes. If the US chooses to defect and not pursue participation in the International Geophysical Year of 1957-58 (NI), then the US will earn a payoff of -1 because it would create a detriment in the form of political and technological outcomes that do not satisfy its valued preference to launch an object over the territories of other States. Conversely, if the SU chooses to cooperate as a participant of the International Geophysical Year of 1957-58 (I), then the SU will earn a payoff of +1 because it has sought to maximize its valued preference of launching an object over the territories of other States for surveillance purposes. If the SU chooses to defect and not pursue participation in the International Geophysical Year of 1957-58 (NI), then the SU will earn a payoff of -1 because it would create a detriment in the form of political and technological outcomes that do not satisfy its valued preference to launch an object over the territories of other States.

From these strategies and payoff schema, there were only three paths to the initial rule formation of launching objects into the outer space environment. In this game, the historical record sets the values for the strategic outcomes, i.e., payoffs. As Figure 3⁵⁴² above illustrates, the US and SU played a sequential game, the payoffs of which have sixteen (16) possible outcomes. Of these sixteen (16) possible outcomes, two payoff strategies dominate for the game and three equilibria arise from three subgames. Table 2⁵⁴³ above illustrates the total number of possible payoff outcomes. The two dominate strategies arising from this game are highlighted in rows (e) and (m). Both are a combination of three equilibria that represent the optimal payoffs for each player.

⁵⁴² See Figure.

⁵⁴³ See Table 2.

Table 3⁵⁴⁴ above divides the entire game into subgames. Given the possible choices, the US had two optimal strategies represented by (O, I) and (NO, I). The first strategy consists of the US agreeing to negotiate rules for the Open Skies Treaty and participating in the International Geophysical Year of 1957-58. The second strategy consists of the US foregoing cooperating with the Soviet Union on the Open Skies Treaty, but agreeing to participate in the International Geophysical Year of 1957-58. On the other hand, the Soviet Union had only one optimal strategy. This strategy consists of not cooperating in the negotiation for the Open Skies Treaty, while accepting to participate in the International Geophysical Year of 1957-58.

The model of the game represented by Figure 3⁵⁴⁵ not only shows the optimal strategies, but also the suboptimal strategies. The suboptimal strategies did not arise because the strategic constraints placed on both States by their valued preferences could not have enabled those suboptimal outcomes. For example, if the US and the Soviet Union agreed to conclude and ratify and Open Skies Treaty as well as publically accepted the obligations of the goals of the IGY, this would have exposed the Soviet Union to costs associated with the gaps resulting in the military positions between both States. Thus, for each suboptimal strategy, there is a corresponding limitation built into their valued preferences that would not have enabled deviation without incurring significance risks and costs to both States.

Once the initial rules for launching objects into outer space was initiated from the maximization of the valued preferences of the US and Soviet Union, various supranational markets of international relations began to form. In particular, member

⁵⁴⁴ See Table 3.

⁵⁴⁵ See Figure 3.

States of the UN would create a special committee to deal with the outer space environment and State interests in conducting activities in it. As discussed in the next chapter, this new supranational market enabled exchanges in information, trades in valued preferences, and development of rules of jurisdiction for the outer space environment. This evolution of State practice laid the foundation for subsequent rule development and evolution.

e. Conclusion

Sergei Korolev's R-7 rocket launched a tiny sphere originally known as "object D" designated Sputnik I into orbit around the Earth on October 4, 1957. The launch of Sputnik I began an iterative game of rule formation and development in a newly created supranational market of international relations for outer space activities. As a consequence, the supranational market enabled the establishment of order without (space) law through the supply of rules that States began to accept and consume. In other words, the space race enabled spontaneous coordination for mutual benefit between the US and the Soviet Union without imposition by a supra-State or other States. This coordination, while self-serving, helped establish the rules by which the United States, the Soviet Union, and all other participating States in outer space activities would play the "game" for exchanges in the supranational market of international relations. Despite the lack of certainty about what future activities could or will eventually occur throughout the outer space environment, States nevertheless started a process by which rules could be developed for the proliferation of such activities.

CHAPTER IV

THE SUPPLY AND PROLIFERATION OF RULES FOR THE OUTER SPACE ENVIRONMENT

a. Introduction

On October 8, 1957, four days after the Soviet Union gave notice to States that it had launched an object into Earth orbit, Donald Quarles, US Deputy Secretary of Defense in the Eisenhower Administration, is reported to have commented in a meeting that “the Russians have . . . done us a good turn, unintentionally, in establishing the concept of freedom of international space.”⁵⁴⁶ As NSC 5520 had originally laid out, the Eisenhower Administration had the goal of getting greater surveillance of the Soviet Union and getting the concept of “freedom of international space” accepted by States without objection served that goal.⁵⁴⁷ To underscore this point, once Quarles made the comment, “The President then looked ahead . . . and asked about a reconnaissance [satellite] vehicle.”⁵⁴⁸ Whether or not States would accept the orbiting of objects over their territory was affirmed and this affirmation changed how States reacted to the first rule for the outer space environment.

Chapter IV seeks to analyze two issues. First, how did States organize to develop and supply rules of jurisdiction for the outer space environment after initial rule

⁵⁴⁶ DAVID S.F. PORTREE, NASA’S ORIGINS AND THE DAWN OF THE SPACE AGE (NASA Sept. 1998), available at <http://history.nasa.gov/monograph10/> accessed Dec. 10, 2015.

⁵⁴⁷ *Id.*

⁵⁴⁸ *Id.*

formation? Second, how did the evolution in the supply of rules of jurisdiction lead to changes in the definition, meaning, and scope of the term space object subsequent to initial rule formation?

b. Market Participation, Rule Supply, and Market Transitions after October 1957

The international system is the product of State practice. Since the conclusion of the Treaty of Westphalia in 1648, the international system has undergone several transitions in the way States promote their interests and protect those interests in relation to the interests of other States.⁵⁴⁹ As noted previously, the most significant change to the international system arose from the Allied Powers preference to replace the League of Nations with a United Nations Charter. The relative stability of the UN governance structure has further changed how States interact with each other in a forum outside the usual embassy system.⁵⁵⁰

As stated previously, the supranational market of international relations can take many forms. These forms must be a function of State sovereignty so that States have at least one commodity in which to trade on the supranational market of international relations. Therefore, any forum where rules of jurisdiction over State activities can be supplied and bought and sold is a supranational market of international relations. Where State practice forms the basis of possible rules of jurisdiction as a function of international custom, political institutions like the UN offer the ability to create supranational markets for which States can trade in value preferences and rules. For

⁵⁴⁹ See *supra* note 48.

⁵⁵⁰ See BROWNIE *supra* note 4.

example, while COPUOS is a UN committee, it is also a supranational market of international relations. While COPUOS does not promulgate rules of law like a legislature, it does provide a market mechanism by which to order the flow of information regarding valued preferences of States and for rules over outer space activities. Hence, growth in COPUOS membership provides a measure of market participation and concentration.

Shortly after the launch of Sputnik I, several States called for the UN to investigate State activities in the outer space environment.⁵⁵¹ Consequently, the UN General Assembly approved the creation of an *ad hoc* Committee on the Peaceful Uses of Outer Space (COPUOS).⁵⁵² The UN General Assembly, itself a supranational market of international relations for valued preferences and rules regarding outer space activities, created the *ad hoc* Committee on December 13, 1958, with eighteen (18) initial State members.⁵⁵³ By December 12, 1959, COPUOS grew to twenty-four (24) in membership and also became a permanent UN committee.⁵⁵⁴ Since 1959, membership in COPUOS has grown 71.1% to 83 State members.⁵⁵⁵ Graph 7 shows how the growth of membership in COPUOS has increased over time.⁵⁵⁶ The growth of so many member States in the committee clearly demonstrates significant investment for discussing valued preferences

⁵⁵¹ See I.H. PH. DIEDERIKS-VERSCHOOR & V. KOPAL, AN INTRODUCTION TO SPACE LAW (Kluwer 2008).

⁵⁵² See G.A. Res. 1348 (XIII), U.N. Doc. A/RES/1348 (Dec. 13, 1958).

⁵⁵³ See EDMUND JAN OSMANCZYK, ENCYCLOPEDIA OF THE UNITED NATIONS AND INTERNATIONAL AGREEMENTS, VOL. 1, A-F 1708 (Anthony Mango ed., Routledge 2003). See also G.A. Res. 1348 (XIII), U.N. Doc. A/RES/1348 (Dec. 13, 1958). G.A. Res. 1472 (XIV), U.N. Doc. A/4351 (Dec. 12, 1959).

⁵⁵⁴ United Nations Office of Outer Space Affairs, *Committee on the Peaceful Uses of Outer Space: Membership Evolution*, <http://www.unoosa.org/oosa/en/ourwork/copuos/members/evolution.html> accessed Dec. 10, 2015.

⁵⁵⁵ See Table 6 in Appendix.

⁵⁵⁶ See Graph 7.

and rules for the outer space environment in a supranational market that has a barrier to entry the payment of which requires the votes of UN Member States.⁵⁵⁷

An interesting consequence of the COPUOS market is that as the acceptance of States onto the committee increases, the risk of a committee veto from a member State also increases because of the consensus voting rules: more State members equals more chances for a veto.⁵⁵⁸ Thus the cost of coordinating consensus on any discussion of valued preferences and rules regarding the outer space environment also increases. The question thus is what is the likely upper bound of marginal benefit beyond which States no longer participate in the COPUOS market because the cost exceeds the benefit?

A likely but probably coincidental bound may be gleaned from the curve OSTRATF in Graph 9 below. First, as the graph below shows, the COPUOS curve is higher and outpaces the RCRATF and NL (corr) curves. Thus, the growth in COPUOS membership outpaces the development of national space law and the last set of treaty based rules regarding space objects that has the lowest ratification rate of any other space treaty in the sample.⁵⁵⁹ Second, the COPUOS curve has a positive slope and is trending toward the OSTRATF curve. Since the Outer Space Treaty has the highest ratification rate of all the space treaties, the total number of States Parties (in relation to the total number of UN Member States) indicates the greatest number of States that have accepted

⁵⁵⁷ See *supra* note 551. See, e.g., Jonathan Wachtel, *Israel clinches place on key UN space coalition*, FOX NEWS.COM, Oct. 30, 2015, available at http://www.foxnews.com/science/2015/10/30/israel-clinches-place-on-key-un-space-coalition.html?utm_content=buffer876cb&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer accessed Dec. 10, 2015.

⁵⁵⁸ See *supra* note 551.

⁵⁵⁹ Except for the Moon Agreement.

Graph 9: Scope of Exchanges in the Supranational Market of International Relations for Space Activities

rules of jurisdiction regarding activities in outer space at each time interval. While it remains to be seen, predictably, as the total number of States to COPUOS increases and approaches the total number of States Parties to the Outer Space Treaty, the benefits of discussing valued preferences and rules regarding the outer space environment may marginally increase until the costs of achieving the goals of the COPUOS exceed the marginal benefits. At which point State members likely would turn to other means and forms of rule development to maximize their valued preferences regarding outer space activities.⁵⁶⁰

The rate at which States entered the supranational market of international relations for the outer space environment rapidly increased over the first two ten year intervals after the launch of Sputnik I. As observed in the data relating to rule development, a movement toward the development of rules arose under national law, treaty law, and international custom within the span of the first ten years from the launch of Sputnik I.⁵⁶¹ However, the overall growth in the pool of potential buyers (i.e., States) significantly outpaced the growth of buyers for rules of jurisdiction over activities in the outer space environment.

Graph 9 above shows where changes took place in the period from October 1957 to October 1977. First, in October 1957 there were eighty-two (82) States in the international system. By October 1967, the international system had increased to one hundred and twenty-two (122) States. That is a 32.8% increase in the number of States in the international system. Between October 1957 and October 1967, twenty-eight (28)

⁵⁶⁰ This transition could be under way by means of increased rule development outside of COPUOS, including the increase in national space laws and through other international fora.

⁵⁶¹ See *supra* note 20.

States had signed and twenty (20) States had ratified the Outer Space Treaty, one State had promulgated a national space law, and most likely at least one rule of international custom arose. Hence, relative to the total number of States in the international system, by October 1967, 23% of States intended to be bound by treaty rules, 16.4% of States consented to be bound by treaty rules, and 0.82% of States invested in a national space law; but 1.64% of States had engaged in sufficient State practice to be considered a rule under international custom to launch and orbit an object over the territories of other States for peaceful purposes.⁵⁶²

Second, by October 1977 there were one hundred and forty nine (149) States in the international system. This represents an increase of 18.1% in the pool of potential supranational market participants. Corresponding along the same interval of time, seventy-six (76) States had ratified and twenty-eight (28) States had signed the Outer Space Treaty. That is an increase of 73% of ratifying and, no change in the number of signatory, States. Thus, the second ten (10) year interval measured the greatest growth of States consenting to be bound to a set of rules relating to the outer space environment.⁵⁶³

Comparing the growth of the international system of States to the development of rules for the outer space environment, within the period of time where the activity in spaceflight was dominated by the space programs of US and Soviet Union, gives an indication of the market concentration. In particular, interested States aligned with the US and the Soviet Union sought to consolidate interest in the supranational market through the UN General Assembly and bilaterally.⁵⁶⁴ Moreover, the UNGA created first

⁵⁶² See discussion *supra* in Chapter III.

⁵⁶³ See Graph 9.

⁵⁶⁴ See MANUAL *supra* note 104.

an *ad hoc* and then a permanent COPUOS. From Sputnik to the Outer Space Treaty's entry into force as a set of rules of public international law, membership in COPUOS grew 35.7%. By December 1977, COPUOS membership increased 40.4%. Thus, following twenty years after the launch of Sputnik I, membership in COPUOS grew 61.7%.

As these data indicate, in over twenty years membership in the UN grew 45%, COPUOS membership grew 61.7%, and ratifying and signatory States Parties of the Outer Space Treaty grew 100%. Furthermore, because the growth in UN membership lagged behind the growth of COPUOS membership and States Parties to the Outer Space Treaty, in the twenty years since the launch of Sputnik the greatest supranational market concentration was observed.

c. Evolution of the Term Space Object in Rules of Jurisdiction for Activities in the Outer Space Environment

To date, the definition, meaning, and scope of the term “space object” has undergone various transitions over time. When the Soviet Union launched their Sputnik (meaning “fellow-traveler”)⁵⁶⁵ objects and the United States subsequently followed suit with the launch of their Explorer objects, the nomenclature of the time termed these objects “artificial Earth satellites.”⁵⁶⁶ Today, objects launched into outer space have a variety of names depending on the context, but the most common term of art used is a shortened version of the old term, namely “satellite”. No matter the term of art used to

⁵⁶⁵ See *supra* note 17.

⁵⁶⁶ *Id.*

describe these objects, i.e., things without international legal personality,⁵⁶⁷ the focus of this thesis is on how any term used to describe a thing launched or intended to be launched by a State into outer space has evolved as a primary element of rules for the outer space environment. Over time, the content (i.e., the definition, meaning, and scope) of the term “space object” and its relation to rules became a legal definition with legal meaning and scope forming the foundation of much of the laws that govern the outer space environment.

i. Scope of the Issues Investigated

The theme of this thesis revolves around the term space object as it is used as a necessary element of rules and rules of law that apply to State activities within the outer space environment. The goal here is to define how the term “space object” and its associated terms of art have evolved over time into rules of law as well as how the term space object subsequently evolves in definition, meaning, and scope.

The term “space object” and its associated terms of art are found today in rules of national law and the corpus of public international space law. As discussed in Chapter V, States have defined the term “space object” in their national laws in different ways. In order to understand the meaning and scope of the definition of the term “space object” under public international law, two issues must be addressed. The first issue is whether the way States have used and defined the term “space object” in their State municipal laws in conformity with the treaty definition demonstrates evolution in rule adoption into

⁵⁶⁷ See BROWNIE *supra* note 4.

national space laws. If States have implemented only the treaty definition into their national law, then States are subject to that specific definition. If States have not implemented the treaty definition but instead have redefined the meaning of space object, then a question arises as to how this difference might affect the scope and meaning of the treaty definition and the duties and obligations of States under general public international law. In other words, to what extent can we say that the use of the term “space object” in State municipal law expresses a general principle of law and thus provides a mechanism to address international space issues not already subject to treaty provisions?

The second issue is whether States that use the term “space object” to form rules for the outer space environment that represent a general and consistent State practice and are performed with a sense of legal obligation, thereby extending the evolution of the term space object underlying such rules, potentially transcend the rule’s original use and application by States. If a rule composed of the term “space object” represents an international custom, then that rule’s content and obligation would supersede the content and obligation of a treaty rule because international custom would bind all States that have purchased the rule via State practice while the obligation of a treaty only binds those States Party to it.⁵⁶⁸ Moreover, if a rule depends on a specific meaning of the term “space object” and that term does not categorically represent a set of specific rules carved out by a particular source of rules, then its utility as an element of a rule may be inapplicable as a source of specific obligations because they are distinct obligations. As will be discussed in Chapter V, the way States have constructed the term “space object,” and have made

⁵⁶⁸ *Id.*

the term a necessary element of rules and rules of law for the outer space environment, arises relative to a particular source of rules. Thus, objects made in, used in, and launched or intended to be launched into outer space may be outside the scope of the terms original meaning and intent thereby necessitating further rule evolution. Thus, a resolution of both issues will determine the meaning and scope of the definition of space object and provide an objective standard with which to understand the meaning of the term “space object” under general public international law and thus demonstrates the point of rule evolution this thesis seeks to show.

Finally, while important, the study developed in Chapter V does not determine when the use of the term space object applies or what principles apply in what types of circumstances involving space objects. This study means only to clarify the meaning of space object in international law through a review of treaty acceptance, State practice, and national law definitions of space object as a function of rule evolution.

ii. The Importance of this Study to the Development and Evolution of Space Law

This section lays the foundation of the study conducted in Chapter V. This is important because it analyzes the extent to which States have complied with duties and obligations under each treaty that defines legal rules for space objects. Since the term space object arises in different treaties in different ways, a particular treaty limits the applicability of the term space object. This is important because not all States that have signed or ratified the Outer Space Treaty have also signed or ratified all the other space

treaties; however, some have signed one or more of the other space treaties and not the Outer Space Treaty.⁵⁶⁹

To illustrate this point, let us consider some of the important rules that form some important duties and responsibilities of States Parties to the first four space treaties that relate specifically to the use of space objects. Under the Outer Space Treaty, space object implicates, *inter alia*, international liability and responsibility, jurisdiction and control, registration, and the prohibition on the placement of weapons of mass destruction into outer space.⁵⁷⁰ Under the Rescue and Return Agreement, *inter alia*, the treaty defines whether a State can request or send back a space object found in its territory, as well as the extent to which a State may be compensated for the effort.⁵⁷¹ Under the Liability Convention, *inter alia*, space object defines the extent to which a State can apply a theory of liability and specific proceedings in seeking compensation or restitution for damage caused by a space object to other objects in outer space, on the surface of the Earth, or aircraft in flight as a matter of treaty law.⁵⁷² Finally, under the Registration Convention, *inter alia*, a State party must register its space objects in order to give notice to other States of its existence and provides a mechanism by which a State can assign nationality to a space object.⁵⁷³

Thus, as a matter of public international law, the various treaty definitions and meanings of space object show specific application of rules under different treaties.

Therefore, it becomes important to discover whether a broader meaning exists under

⁵⁶⁹ See Table 5 in Appendix.

⁵⁷⁰ See Outer Space Treaty *supra* note 21, at arts IV, VII, VIII & X.

⁵⁷¹ See Rescue and Return Agreement *supra* note 21, at art. V.

⁵⁷² See Liability Convention *supra* note 21, at arts. II & III.

⁵⁷³ See Registration Convention *supra* note 21, at arts. I, II, IV & V.

public international law, including under international custom and general principles of law. Changes over time to the application and characteristics of the term space object demonstrate rule evolution because the definition, meaning, and scope of the term space object represents a necessary element to particular rules that apply to various types of activities that the space treaties seek to regulate. Whether such rules are or become legal rules is a matter of how a State may purchase the obligation of the rule.

“Space object” has a variety of meanings depending on its application in a particular context. Given the increase in the number of States operating in outer space, whether individually or multilaterally, what exactly constitutes a space object continues to evolve beyond what States contemplated beginning in the late 1950’s. Because the term “space object” represents a treaty term, only a State Party has purchased the obligation to follow provisions to which it is subject under a particular treaty.⁵⁷⁴ Moreover, the term space object forms the keystone of the Outer Space Treaty, the Rescue and Return Agreement, the Liability Convention, and the Registration Convention because the term itself activates obligations, affects rights, as well as establishing duties under each specific space treaty and generally under public international law. Therefore, the evolution of much of space law is centered on the definition, meaning, and scope of the term space object over time.

Additionally, this study is important because not every State Party to the Outer Space Treaty is a party to either the Liability or Registration Conventions – treaties that actually define space object in the exact same way.⁵⁷⁵ Most States have ratified the Outer

⁵⁷⁴ See *supra* note 236.

⁵⁷⁵ See MANUAL *supra* note 104.

Space Treaty; however, some States that have ratified the Outer Space Treaty have not ratified either or both the Liability and Registration Conventions.⁵⁷⁶ Since only these two treaties specifically define space object, this study therefore seeks to find those common elements that give meaning to the term space object under general public international law and to eventually show how States have evolved the codification of the term in their national laws.⁵⁷⁷

A discussion of the types of objects that could constitute a space object in scholarly writings abound. A review of literature written by international legal scholars shows that under the space treaties the term of “space object” can mean almost anything that a State can, at least, attempt to launch into outer space. This invites representative and tautological problems. The first problem, which may be termed the “ham sandwich problem,” indicates that anything launched into outer space, even a ham sandwich could be considered a space object. As stated, this example probably elicits an absurd reaction in the reader, yet when scholars speak of rocket fuel exhaust as representing an example of a space object, as such, strains the history of the meaning of the term space object.⁵⁷⁸ Fortunately, State practice does not seem to have borne out these absurdities because States tends to constrain how the term is defined and used under their national (space)

⁵⁷⁶ See Tables 4 & 5 in Appendix.

⁵⁷⁷ As no definition for space object existed prior to the Liability Convention, commentators drew inferences on the term’s meaning. Writing in 1969, Gal notes that the Outer Space Treaty employed the term space object as “a collective term . . . [used] to designate objects ‘launched into outer space’ (Article 7 and 8), objects ‘placed into orbit around the Earth’ (Art. 4), or simply ‘launched’ (Art. 10).” GYULA GAL, SPACE LAW 207 (I. Mora trans., Oceana Publ’ns 1969) [hereinafter GAL]. Gal points out that the Outer Space Treaty did not define space object and that the definition in the Outer Space Treaty was developed vis-à-vis aircraft taken *à rebours*. *Id.*

⁵⁷⁸ As discussed *infra*, the delegates to the Liability Convention discussed to some degree the scope of this problem. In particular, if rocket fuel exhaust could be considered a space object, then damaged caused to the surface of the Earth by the exhaust would subject a launching State to strict liability under the Liability Convention; something not contemplated by the drafters of the Liability Convention.

laws. Therefore, the study presented in Chapter V seeks to parse out those elements of the term space object that could represent a rule of international custom or a general principle of law within national legal systems demonstrating rule evolution.

The second problem involves the “tautological problem.” This problem has two sides. On one hand, when exactly does a space object become a space object? On the other hand, when does a space object cease to be a space object? This problem arises partly because no legal definition has been accepted that delimits the sovereign airspace of States in public international law.⁵⁷⁹ While scholarly writings have cut one way or another, very few States have yet to indicate through practice or law where they divide airspace and outer space, i.e., the legal altitude where a State ends its sovereignty in the airspace above its territory.⁵⁸⁰ Does an object become a space object when it enters outer space?⁵⁸¹ Where does outer space begin?⁵⁸² Delegates to the Liability Convention negotiations seemed to have sidestepped these questions and instead discussed an intent element of launching an object into outer space as part of the definition of space object.⁵⁸³ Consequently, for example, this has had a major impact on the development of space

⁵⁷⁹ See *supra* note 16.

⁵⁸⁰ See *supra* note 551, at 15-19.

⁵⁸¹ By way of example, when NASA developed the Space Transportation System (Space Shuttle), a question of whether it was a space object was raised by the Federal Aviation Administration (FAA). See OUTLOOK ON SPACE LAW OVER THE NEXT 30 YEARS 117 (Gabriel Lafferranderie & Daphne Crowther eds., Kluwer 1997). Because the Space Shuttle could launch like a rocket, but return like an aircraft, the question arose whether the flight of the Space Shuttle required aircraft like regulation from the FAA. It was determined that since the purpose of the Space Shuttle was intended for movement in outer space, the Space Shuttle qualified as a space object and did not fall within the sphere of the FAA. Furthermore, the dichotomous technology of the Space Shuttle, i.e., the spatial and aerial abilities, poses a continuing issue in the context of suborbital launch vehicles. Some scholars have dubbed these types of technologies aerospace objects. This further confuses the term space object, especially if one type of technology is used to launch the object into outer space and it breaks off and lands under its own power or is launched by an aircraft. Nevertheless, this issue has yet to be taken up by the Legal Subcommittee of COPUOS. However, the issue has made some movement with the adoption of the demarcation of the airspace agenda item.

⁵⁸² See *supra* note 16.

⁵⁸³ See MANUAL *supra* note 104.

debris mitigation guidelines and has led to ways in which proponents of debris removal seek to redefine the meaning of space object in order to justify removal.⁵⁸⁴ Hence, if the term space object could mean specific types of objects, then the definition could be limited to certain types of objects and not others.

iii. Definition, Meaning, and Scope of the Term Space Object

When *Sputnik I* became the first object launched into Earth orbit on October 4, 1957, no definitive legal classification existed for such an object.⁵⁸⁵ Considered State property, objects launched by the United States and the Soviet Union into orbit represented the height of technological capability at the time.⁵⁸⁶ By 1975, two international treaties legally classified objects launched or intended to be launched into space as “space objects.” Article I of both the Liability and Registration Conventions define a space object as including the space object itself and “component parts of [the] space object as well as its launch vehicle and parts thereof.”⁵⁸⁷ Because international negotiation for a definitive term proved difficult to devise, States settled on a definition of space object that would not require definitive classifications.⁵⁸⁸ As discussed *infra*, the debate continues to persist as to the scope of the meaning of the term space object.

The term space object has had a curious evolution. The term object in reference to outer space was first used in 1961 in UNGA Resolution 1721 (XVI) titled *International*

⁵⁸⁴ See FRANCIS LYALL & PAUL LARSEN, *SPACE LAW: A TREATISE* 253-58 (Ashgate 2009).

⁵⁸⁵ See J. Sztucki, *Legal Status of Space Objects*, 9 PROC. COLL. L. OF OUTER SPACE 108 (1966).

⁵⁸⁶ See *supra* note 17.

⁵⁸⁷ See *supra* note 21, Liability Convention and Registration Convention.

⁵⁸⁸ See MANUAL *supra* note 104, at 116-19.

co-operation in the peaceful uses of outer space, which issued an invitation to record any object launched by States into outer space with the UNCOPUOS through the UN Secretary General.⁵⁸⁹ In context, object meant such things that could assist in the exploration and understanding of outer space such as scientific instruments, satellites, and launch vehicles.⁵⁹⁰ In 1967, the term object became a binding treaty term for the first time when the term found its way into the Outer Space Treaty.⁵⁹¹ However, a definition for the term did not arise until the 1972 Liability Convention came into force.⁵⁹²

Generally, space object includes terms of art used in the commercial, civil, and military space sectors. As noted in statutes, codes, and regulations as well as by scholars and commentators, Earth manufactured technologies colloquially termed “space vehicle”, “spacecraft”, “spaceship”, “satellite”, and “space station” represent the types of objects launched into outer space.⁵⁹³ Cheng has noted that members of the COPUOS during negotiations over the space treaties treated spacecraft and space vehicles as synonymous terms.⁵⁹⁴ This point is illustrated by the fact that article V of the Outer Space Treaty uses the term “space vehicle;” articles I(1), II, III, and IV of the Rescue and Return Agreement use the term “spacecraft;” and article XII of the Outer Space Treaty “distinguishes ‘space vehicles’ on celestial bodies from ‘stations, installations, [and] equipment’, to which the

⁵⁸⁹ See G.A. Res. 1721 B (XVI), ¶ 1, U.N. Doc. A/4987 (Dec. 20, 1961) (“Calls upon States launching *objects* into orbit or beyond to furnish information promptly to the Committee on the Peaceful Uses of Outer Space, through the Secretary-General, for the registration of launchings” (emphasis added)), available at http://www.unoosa.org/pdf/gares/ARES_16_1721E.pdf accessed November 30, 2015. *But see* G.A. Res. 1472 (XIV), U.N. Doc. A/4351 (Dec. 12, 1959) (“Noting with satisfaction the successes of great significance to mankind that have been attained in the exploration of outer space in the form of the recent launching of artificial earth *satellites* and space rockets, . . .” (emphasis added)), available at http://www.unoosa.org/pdf/gares/ARES_14_1472E.pdf accessed Dec. 10, 2015.

⁵⁹⁰ See *supra* note 17.

⁵⁹¹ See Outer Space Treaty *supra* note 21.

⁵⁹² See Liability Convention *supra* note 21.

⁵⁹³ See BIN CHENG, STUDIES IN INTERNATIONAL SPACE LAW 463 (Clarendon Press 1997).

⁵⁹⁴ *Id.*, at 462.

Moon Treaty”⁵⁹⁵ uses the term facilities (articles VIII, X, XI, XII & XV) and spacecraft (articles III & X).⁵⁹⁶

During the Liability Convention negotiations, delegates debated two definitions for the term space object. The first definition was a narrow definition that “included the object itself and its component parts, as well as the means of delivery and its component parts.”⁵⁹⁷ A second definition consisted of a broader meaning for the term space object in that it “would have included articles on board the space object and articles detached, thrown or launched from the space object.”⁵⁹⁸ Delegates chose the former definition to classify a space object.⁵⁹⁹

In addition, the delegates debated the scope of the term “space object.”⁶⁰⁰ A proposal submitted by Argentina, Belgium, and France, which was not adopted, included a definition of space object without mention of outer space.⁶⁰¹ The proposal suggested that a space object mean: “any object made and intended for space activities” and that “For the purpose of [the] Convention, the term ‘space object’ also includes a launch vehicle and parts thereof, as well as all component parts on board, detached or torn from the space object.”⁶⁰² The reason for the proposal was to move away from a discussion of where airspace ended and outer space began.⁶⁰³ The United States, in particular, neither

⁵⁹⁵ *Id.*

⁵⁹⁶ The Moon Agreement is not analyzed in this thesis and only represents a further illustration of the evolution of terms of art that potentially comprise a further definition of what space objects could be.

⁵⁹⁷ GLENN H. REYNOLDS & ROBERT P. MERGES, *OUTER SPACE: PROBLEMS OF LAW AND POLICY* 210 (Westview Press 1997) (1989).

⁵⁹⁸ *Id.*

⁵⁹⁹ See *MANUAL* *supra* note 104, at 116.

⁶⁰⁰ *Id.*

⁶⁰¹ *Id.*

⁶⁰² U.N. Comm. on the Peaceful Uses of Outer Space (UNCOPUOS), Legal Sub-Comm., Working Group 1, U.N. Doc. PUOS/C.2/70/WG.1/CRP.16 (reproduced as U.N. Doc. A/AC.105/85). See *supra* note 17 at 116 & 159.

⁶⁰³ See Gyula Gal, *Thirty Years of Functionalism*, 40 *PROC. COLL. L. OUTER SPACE* 125 (1997) [hereinafter *Functionalism*].

wanted to get into the technical aspects of delimitation of outer space in order to preserve the greatest latitude for technological development of launch vehicles and space systems nor wanted to agree to any limitations on State sovereign airspace.

Under the Liability and Registration Conventions, a space object includes component parts to the launch, but neither the treaty's *travaux préparatoires* nor scholars agree which component parts remain space objects after launch. Gorove has concluded that "the component parts of a space object would include all elements normally regarded as making up the space object, including fuel tanks and perhaps even the fuel itself. Thus any object without which the spacecraft would be regarded incomplete, may be taken to be a component part."⁶⁰⁴ Cheng has suggested that a space object covers "any object launched by humans into outer space, as well as any component part thereof, together with its launch vehicle and parts thereof."⁶⁰⁵ Thus, objects launched into orbit are *ipso facto* space objects. Nevertheless, the definitions advanced by Gorove and Cheng generally conform to what the delegates to the Liability Convention had contemplated, however it is unclear how far the treaty negotiators wanted to extend the definition of "objects" to things like fuel exhaust.⁶⁰⁶

⁶⁰⁴ STEPHEN GOROVE, *STUDIES IN SPACE LAW: ITS CHALLENGES AND PROSPECTS* 105 (1997) [hereinafter GOROVE STUDIES]. See H.A. BAKER, *SPACE DEBRIS: LEGAL AND POLICY IMPLICATIONS* 63 (1989).

⁶⁰⁵ Bin Cheng, "Space Objects", "Astronauts" and Related Expressions, 34 *PROC. COLL. L. OUTER SPACE* 17, 18 (1991). Kopal has also suggested a similar definition of space object. See Vladimír Kopal, *Some Remarks on Issues Relating to Legal Definitions of "Space Object", "Space Debris" and "Astronaut"*, 37 *PROC. COLL. L. OUTER SPACE* 99, 101 (1994).

⁶⁰⁶ See GOROVE STUDIES *supra* note 603, at 105.

A. Space object: Spatialist vs. Functionalist Arguments

When does an object become a space object? The delimitation of airspace issue centers on the spatialist and functionalist arguments.⁶⁰⁷ The spatialist argument advances the point that where the atmosphere legally terminates, outer space legally begins.⁶⁰⁸ Gal raises the point of airspace demarcation, i.e., altitude in flight/orbit, which affects when an object launched becomes a space object.⁶⁰⁹ Gal concludes, “only those objects can be regarded as space objects which perform an orbiting movement round the earth or other celestial bodies, or which have been launched with that purpose,” with the deciding criterion of a space object dependent upon its orbital motion.⁶¹⁰ If the space object does not have sufficient velocity to achieve orbit, then it is not a space object.⁶¹¹

The functionalist argument rejects a technical or arbitrary delimitation of airspace but delimits legal airspace from outer space by the character or nature of the activity under regulation.⁶¹² Thus, an object becomes a space object by virtue of how the object is placed into outer space, i.e., launched by a launching State.⁶¹³ Kopal has suggested that

⁶⁰⁷ See *Functionalism supra* note 602, at 125.

⁶⁰⁸ *Id.*

⁶⁰⁹ *Supra* note 577, at 208.

⁶¹⁰ *Id.*

⁶¹¹ Gal goes on to argue that “In order to achieve the practical uniformity of space activity, the corresponding rules of the law of space (e.g. state responsibility) should apply in respect of such objects as have been launched with the aim of an orbital motion, but they need not necessarily be considered as space objects. Thus, e.g., when resulting from a single launching not only the artificial satellite but also its orbiting carrier rocket stage may be a space object, while other devices (e.g. the burnt-out and returning first stage) cannot be regarded as such.” *Supra* note 577 GAL, at 208-09. While some of Gal’s arguments persist today, the narrow definition of article I of the Liability and Registration Conventions supersedes Gal’s last argument.

⁶¹² See *supra* note 603.

⁶¹³ Hurwitz categorizes the term launching State to mean “(1) the State which launches the space object . . . ; (2) the State which orders the launching; (3) the State where the launch takes place; [or] (4) the State which owns the facility used in the launching.” BRUCE A HURWITZ, STATE LIABILITY FOR OUTER SPACE ACTIVITIES IN ACCORDANCE WITH THE 1972 CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE

“Space Objects should be considered any object launched by man for a mission into outer space, be it into orbit around the Earth, or beyond into planetary space to and around the Moon and other celestial bodies of the Solar system, or into deep space.”⁶¹⁴ As noted Chapter V, the functionalist paradigm reigns dominate within national space laws. Only a few States have adopted the spatialist paradigm.

B. Problems with the Scope of the Space Object Definition under the Space Treaties

Several additional problems arise with respect to the scope of the meaning of space object under the Liability and Registration Conventions. First, some commentators argue that the term space object is an incomplete term because it fails to address the issue of functional vs. nonfunctional objects in outer space.⁶¹⁵ While the intent to launch a space object is the first threshold question, once launched, which element of the launch is still a space object and how long does it legally remain a space object? Hurwitz notes that ambiguity arises as to whether an object continues to have the legal status of a space object under the Liability Convention when it is abandoned and uncontrolled, or destroyed in outer space.⁶¹⁶ Past scholarship seems to conclude that no limit exists in

CAUSED BY SPACE OBJECTS 22 (Martinus Nijhoff 1992) [hereinafter HURWITZ]. Further, Böckstiegel has noted that when a State actively requests, initiates, or promotes the launching of a space object procured for launch the link between the nationality of a private launch operator and its parent State is sufficient to make the parent State a launching State. See Karl-Heinz Böckstiegel, *The Term “Launching State” in International Space Law*, 37 PROC. COLL. L. OUTER SPACE 80, 81 (1994). It should also be noted that States are not required to register every component part of a space object nor to register space objects that States attempted to launch. See MANUAL *supra* note 104, at 116.

⁶¹⁴ DIEDERIKS & KOPAL *supra* note 472, at 9.

⁶¹⁵ See MANUAL *supra* note 104, at 180.

⁶¹⁶ *Supra* HURWITZ note 612, at 24.

which an object ceases to be classified as a space object under the article I definition of the Liability and Registration Conventions.⁶¹⁷ However, a debate has arisen challenging the current space object paradigm utilizing maritime law analogies and general international law.⁶¹⁸ However, States have yet been observed to adopt such changes to the term space object in practice.

Second, a question arises as to whether the launch of a space object must originate from Earth.⁶¹⁹ This question presented itself in the policy debates surrounding the development of an international space station.⁶²⁰ If a structure is built in outer space from “materials not originating from the Earth and if, as a result, those materials are not regarded as a “space object”, there may be no State required to register the object” and a State may not be liable for damage caused by its object under the Outer Space Treaty or Liability Convention.⁶²¹ Resolution of these issues could be found in analyzing

⁶¹⁷ See Cheng *supra* note 604, and *supra* Kopal note 604. See also GOROVE STUDIES, *supra* note 603.

⁶¹⁸ See, e.g., James Rendleman, *Non-cooperative Space Debris Mitigation*, 53 PROC. COLL. L. OUTER SPACE 308 (2010), and Martha Mejia-Kaiser, *Removal of Non-Functional Space Objects without Prior Consent*, 50 PROC. COLL. L. OUTER SPACE 153 (2007).

⁶¹⁹ See STEPHEN GOROVE, DEVELOPMENTS IN SPACE LAW: ISSUES AND POLICIES 329 (Martinus Nijhoff 1991).

⁶²⁰ *Id.*, at 326-29.

⁶²¹ *Id.*, at 329. However, this raises a question of international responsibility. Under article VIII of Outer Space Treaty, “A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object . . . while in outer space” Outer Space Treaty, *supra* note 21, at art. VIII. Jurisdiction under space law derives from the principles of sovereign equality of States, non-appropriation, and general principles of space law. See IMRE CSABAFI, THE CONCEPT OF STATE JURISDICTION IN INTERNATIONAL SPACE LAW: A STUDY IN THE PROGRESSIVE DEVELOPMENT OF SPACE LAW IN THE UNITED NATIONS 124 (Martinus Nijhoff 1971). See also CHENG STUDIES *supra* note 592, at 72 & 86. However, control is more than competence in technical capability; it is the right of a State “to adopt technical rules to achieve the space object mission,” as well as “to direct, to stop, modify and correct the elements of the space object and its mission.” G. Lafferranderie, *Jurisdiction and control of Space Objects and the Case of an International Intergovernmental Organization (ESA)*, 54 ZEITSCHRIFT FÜR LUFT- UND WELTRAUMRECHT 228, 230 (2005). Consequently, as Lafferranderie points out, “Jurisdiction should induce control, and control should be based on jurisdiction.” *Id.*, at 231. Even when a space object becomes non-functional, a State does not lose its jurisdiction and control, ownership, or obligation to register. See Registration Convention *supra* note 21, at art. II, and COLOGNE COMMENTARY ON SPACE LAW: OUTER SPACE TREATY 154 (Hobe, et al. eds., Heymanns 2009).

international responsibility under public international law, generally, and the Outer Space Treaty, specifically, which would limit this issue to jurisdiction and control over State property or responsibility over the activities and conduct of non-governmental entities.⁶²² However, the application of rules different than those expressed under a particular treaty or more generally the use of a definition of the term space object different from its meaning and scope under treaty law requires the interpolation of the term space object to other sources of law. This too demonstrates rule evolution from its previous in time usage and rule applicability.

Third, a space object's presence in outer space does not affect its ownership or nationality.⁶²³ Ownership extends beyond the operation of the space object, including when it ceases to function at end-of-life, malfunctions, or fails to reach intended orbit because of a failed launch.⁶²⁴ Moreover, States have the responsibility to ensure that the rights of entities subject to its jurisdiction follow accepted rules and practices in outer space.⁶²⁵ Hence, national law plays an important role in defining the scope of the rights, duties, and obligations of States and their non-governmental entities who conduct activities or have traceable interests in outer space. Thus, national legal obligations

⁶²² See Outer Space Treaty *supra* note 21, at art. VII. See also ANTONIO CASSESE, INTERNATIONAL LAW 241-45 (Oxford Univ. Press 2005) (2001) [hereinafter CASSESE].

⁶²³ See PAMELA L. MEREDITH & GEORGE S. ROBINSON, SPACE LAW: A CASE STUDY FOR THE PRACTITIONER 54 (Martinus Nijhoff 1992) [hereinafter MEREDITH & ROBINSON]. Compare George S. Robinson, *Artifacts, Abandonment, Salvage . . . And the Jolly Roger in Space*, 2 SAN. FRAN. ST. U. BUS. J. 65 (1990) (where although NASA transferred ownership of the Viking I lander, still located on Mars, to the Smithsonian Institution indicating that NASA believed that it retained ownership of the space object, Viking I, beyond its operational life) with Leonard David, *Privately Owned Soviet Moon Rover Sparks Space Law Talks*, SPACE.COM, available at <http://www.space.com/8073-privately-owned-soviet-moon-rover-sparks-space-law-talks.html> accessed Dec. 10, 2015.

⁶²⁴ See MEREDITH & ROBINSON, at 55.

⁶²⁵ See Outer Space Treaty *supra* note 21, art. VI. See also CASSESE *supra* note 622.

undertaken by States help reinforce the basis of principles, duties, and obligations of the space treaties and public international law in general.

Finally, given the possibilities of interpretation, space object could have no upper limit in meaning under the space treaties. However, because the term space object implicates different treaties, national regulations, and terms of art, it becomes important to figure out what space object means in a variety of contexts to determine which obligations States purchase with respect to the source of rules. Chapter V thus studies how State municipal law and State practice affects and has affected the definition of space object and provides possible answers to the issues presented in this thesis.

d. Conclusion

The proliferation of market participants and rule supply led to the creation of several supranational markets of international relations regarding the outer space environment. Within a year of the launch of Sputnik I, interested States cooperated to create COPUOS as a forum to discuss the international issues associated with the outer space environment. Moreover, COPUOS enables trading in valued preferences and the development of rules of jurisdiction among and between States. Between October 1958 and October 1975, COPUOS grew from eighteen members to thirty seven members. Although market participation grew 50%, relative to the entire pool of potential market participant States, COPUOS membership reflected the views of a minority of States who had in interest in developing such rules.

Coincidentally, while the number of COPUOS member States has almost tripled since October 1975, the rate of rule supply to the international system remains steady, but consumption of rules generated out of COPUOS has significantly declined. The process by which COPUOS supplies rules of jurisdiction to States through supranational market mechanisms is consent based. However, this defining aspect of COPUOS also limits member States' abilities to supply rules where there is no consensus, but may have value to other States. This characteristic of COPUOS illustrates that rule supply in one supranational market does not produce the same effects in other markets.

CHAPTER V
THE EVOLUTION OF RULES FOR THE OUTER SPACE ENVIRONMENT

a. Introduction

In July 1958, the United States enacted the *National Aeronautics and Space Act of 1958* that established the National Aeronautics and Space Administration.⁶²⁶

Consequently, the United States became the first State to enact a national space law. Since then at least twenty nine States have promulgated national space laws the content of which governs the launch into and operation of space objects in the outer space environment.

Space object is arguably the most important term in all of the corpus of space law because the entire legal regime for space is centered on what is launched into and used in outer space. Since the term space object has been defined rather broadly in the outer space treaties, the definition, meaning, and scope of the term as a function of rules of jurisdiction takes on important meaning as State practice evolves. Moreover, since the definition, meaning, and scope of terms that define a State's legal obligation in relation to the international community of States must have some common basis, the supply of rules over time may provide further clarity to the extent to which a State has authority over persons, objects, and events in the outer space environment. Therefore, this Chapter

⁶²⁶ National Aeronautics and Space Act of 1958, Pub. L. 85-568, 72 Stat. 426.

analyzes how States have supplied rules of jurisdiction in the form of rules of national and the extent to which States have defined the content of the the term “space object.”

b. Evolution toward Convergence of Rules into Rules of Law for the Outer Space Environment

This case study comprises a comparative study of the definition of the term “space object” in national space laws. This chapter analyzes those States that have or have not implemented the term “space object” and its definition into their national legal systems and the legal effect it has under international law. This study surveys the supply of rules to the supranational market from a sample of States.⁶²⁷ The first sample consists of thirty-nine States, all of which have purchased rules with respect to the regulation or use of space objects. Each State has some space-faring experience, including being a member State of a multilateral space agency, a partner to the International Space Station, launching humans, animals, or other objects into outer space, or having had another State launch objects into outer space for it.⁶²⁸ The second subsample consists of those States that have internally promulgated or published rules with respect to the regulation or use of space objects as a matter of rule supply. Moreover, the survey also includes a review

⁶²⁷ Algeria, Argentina, Australia, Austria, Belarus, Belgium, Brazil, Canada, Chile, Colombia, China, Czech Republic, Denmark, Finland, France, Germany, Greece, India, Iran, Ireland, Italy, Japan, Kazakhstan, Luxembourg, Mexico, Netherlands, Nigeria, Norway, Republic of Korea, Romania, Russian Federation, South Africa, Spain, Sweden, Switzerland, Ukraine, the United Kingdom, the United States of America, and Venezuela.

⁶²⁸ In addition, each State surveyed has membership in COPUOS, except for Denmark, Finland, Ireland, Luxembourg, and Norway. See United Nations, Office of Outer Space Affairs, *List of UN COPUOS Members*, available at <http://www.unoosa.org/oosa/COPUOS/members.html> accessed Dec. 10, 2015.

of which States in the sample are party to the first four space treaties and analyzes whether States have implemented the treaties into their national law.⁶²⁹

i. Space Object Defined Under National Space Laws

This section discusses how the thirty-nine (39) States sampled define space object. Not all States have defined space object using the definition expressed in the Liability and Registration Conventions. Several States have redefined space object in their national law using terms of art generally through national licensing and registration regimes. Moreover, national licensing and registration regimes seem to form the basis for which States either use the treaty definition of space object or redefine the term to include a specific list of objects that States consent to launch into outer space. These national legal requirements seem to limit generally the scope of the type of object a space object can be via State practice.

Generally, States segment the scope of their national space laws between civil and military space activities, while some States also permit commercial/private space activities.⁶³⁰ States regulate civil, military, and commercial activities through a variety of national law mechanisms. Depending upon the structure of government, some States have created regulatory agencies or have created regimes that require government authorization for entities under their jurisdiction to seek approval for launching objects into outer space, while some States allow other States to launch objects into outer space for them. Hence, those types of “objects” States generally launch into the outer space

⁶²⁹ See *supra* note 21.

⁶³⁰ See, e.g., SPACE POLITICS AND POLICY 33-39 (Eligar Sadeh ed., Kluwer 2002).

environment represent State practice necessary by which to judge what may or may not be a “space object.” The measure the evolution of the term depends on how a State manifests its valued preferences for the classification of the term “space object.”

A. Thirty-Nine States Sampled

1. States with “Space Object” Defined in National Law

For States that have defined space object in their national law, this analysis reveals two types of definitions utilized. The first category of States define space object utilizing a specific national law definition of space object. The second category of States define space object in national law utilizing the article I definition from the Liability and Registration Conventions. Each category is listed below.

(a). Category I States: Specific Definitions

Australia defines space object under Section 8 of the *Space Activities Act of 1998*.

⁶³¹ Under Section 8,

‘space object’ means a thing consisting of: (a) a launch vehicle; and (b) a payload (if any) that the launch vehicle is to carry into or back from an area beyond the distance of 100 km above mean sea level; or any part of such a thing, even if: (c) the part is to go only some of the way towards or

⁶³¹ See NATIONAL REGULATION OF SPACE ACTIVITIES 37-59 (Ram S. Jakhu ed., Springer 2010) (Australia has promulgated a national space law that includes a licensing and registration regime).

back from an area beyond the distance of 100 km above mean sea level; or

(d) the part results from the separation of a payload or payloads from a launch vehicle after launch.⁶³²

Russian Federation law currently defines space object in a variety of ways. Russian law defines space object as “an immovable property that is subject to registration;”⁶³³ “an object designed for exploration and use of outer space, the Moon and other celestial bodies for civil purposes;”⁶³⁴ and “a space mechanical device, which is designed to conduct specific tasks and is capable of independent long-term functioning in outer space.”⁶³⁵

Several States use the term “any object” to define a space object. These States qualify the term “any object” with an intent element. States that define “any object” include Netherlands – space object “is any object launched or destined to be launched into outer space;”⁶³⁶ Norway – space object is “any object” launched with permission of government;⁶³⁷ and Republic of Korea – ““space objects” are objects designed and manufactured for use in outer space including space launch vehicles, artificial satellites, and spaceships and their components.”⁶³⁸ Furthermore, Iran’s Statute of the Iranian Space Agency defines the scope of its regulatory powers in article (3)(IV), which states

⁶³² Space Activities Act 1998, No. 123, Section 8 (Austl.), *available at* http://corrigan.austlii.edu.au/au/legis/cth/consol_act/saa1998167/s8.html accessed Dec. 10, 2015.

⁶³³ *Supra* note 631, at 315-34.

⁶³⁴ *Id.*

⁶³⁵ *Id.*

⁶³⁶ *Supra* note 631, at 225-46. *See* Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act), BILL (13.06.06), 1.1.c (2006) (Neth.).

⁶³⁷ Act on launching objects from Norwegian territory etc. into outer space. (13 June. 1969) (Nor.).

⁶³⁸ Space Development Promotion Act, Art. 2(3) (2005) (S. Korea).

“Agency’s tasks and authorizations are as follows: . . . Doing research, designing, manufacturing and launch of the commercial, scientific and research satellites, and designing and establishing control center and launch of national satellites in cooperation with related institutions.”⁶³⁹ Nigeria’s National Space and Development Space Agency is “charged with the responsibility for building and launching satellites.”⁶⁴⁰ Thus, any object intended to be launched into the outer space environment is a space object.

(b). Category II States: Article I Definitions

Austria, Belgium, China, Spain, and the United Kingdom utilize the article I definition of space object. The *Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry* defines space object as “an object launched or intended to be launched into outer space, including its components.”⁶⁴¹ Belgium’s *Law on the Activities of Launching, Flight Operation or Guidance of Space Objects* defines space object as “any object launched or intended to be launched into outer space, including the material elements composing that object.”⁶⁴² Under the Outer Space Ordinance, China defines space object as the space object itself “includ[ing] the

⁶³⁹ Statute of the Iranian Space Agency 10 Dec. 2003 (Iran), in 34 J. SPACE LAW 492 (2008), available at <http://www.spacelaw.olemiss.edu/jsl/pdfs/back-issues/jsl-34-2.pdf>.

⁶⁴⁰ An Act to establish the National Space Research and Development Agency; and for related matters, § 6(b) (2010), available at <http://nass.gov.ng/document/download/5892> accessed Dec. 10, 2015.

⁶⁴¹ Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Registry [Austrian Outer Space Act], Oct. 11, 2011, § 2(2) (Austria), available at <http://www.oosa.unvienna.org/pdf/spacelaw/national/austria/austrian-outer-space-actE.pdf> (English translation provided by the Government of Austria) accessed Dec. 10, 2015. The Austrian government must authorize all space activities, which requires approval from the Minister for Transport, Innovation, and Technology.

⁶⁴² Law on the Activities of Launching, Flight Operations or Guidance of Space Objects, Art. III(1) (Belg.). Interestingly, the *Law* does note that component parts of a space object includes *material elements*. Thus, e.g., rocket fuel exhaust would not likely be considered a space object under Belgium law.

component parts of a space object, its launch vehicle and the component parts of such launch vehicle.”⁶⁴³ Spain has defined the term space object “to include both component parts thereof and the launch vehicle and parts thereof,”⁶⁴⁴ while the United Kingdom has defined space object to “include[] the component parts of a space object, its launch vehicle and the component parts of that.”⁶⁴⁵

2. States That Do Not Have “Space Object” Defined in Their National Space Law, But Have a Licensing or Registration Regime as Part of Their National Law

Some States have established a licensing or registration regime in which to govern space activities. In most cases, either regime will use the term space object without definition, define a synonymous term to represent a space object, or will only mention specific types of objects, e.g., satellites. Those States that have developed a law, regulation, or decree to establish a licensing or registration regime demonstrate some compliance with certain outer space treaty obligations. A list of those States that have developed a licensing or registration regime follows.

Argentina has no licensing regime or procedures to regulate the authorization of launch services.⁶⁴⁶ However, under Executive Decree 125/1995, “all acts related to a space object launched or promoted by the national State or launched from its territory or

⁶⁴³ Outer Space Ordinance, P.R.C. LAWS CAP 523.

⁶⁴⁴ Royal Decree 278/1995, Feb. 24 1995.

⁶⁴⁵ Outer Space Act, 1986, Eliz. 2, c. 2, § 13(1)(b) (Eng.).

⁶⁴⁶ See Argentine Decree 995/1991, art. 2, available at <http://www.conae.gov.ar/eng/sobre/legislaciones/199591.pdf> (Spanish version) accessed November 30, 2015. See also *supra* note 631, at 23-35, and *supra* note 627. CONAE has no regulatory authority, but adopts resolutions with wide legal scope and effect; however, CNC has overlapping jurisdiction and authority with CONAE.

facility, whether by the State itself or private entities, are to be recorded in the National Registry.”⁶⁴⁷ At a minimum, the National Registry provides a list of objects that could be considered a space object, if registered.

Brazil has a licensing and authorization regime that focuses on launch activities.⁶⁴⁸ Under its License Regulation, Brazil defines launch activities as “the operation to place or attempt to place a launching vehicle and its payload into suborbital trajectory, in Earth orbit or otherwise in outer space.”⁶⁴⁹ Hence, by the plain reading of the language, the License Regulation provides a list of objects that can represent a space object. Furthermore, Brazil uses several terms in its national space laws to denote the types of things that require license, registration, promotion, and protection under national law, including launch or space activities, space systems, space products and services, satellite, and launch vehicle.⁶⁵⁰

Under the National Aeronautics and Space Act of 1958 (as amended), the United States defines “space vehicles [as] . . . satellites, and other space vehicles, manned and unmanned, together with related equipment, devices, components, and parts.”⁶⁵¹ While the United States Code and the Code of Federal Regulations do not explicitly define space object, each does however define synonymous terms. 51 U.S.C. § 50902(10) defines payload as “an object that a person undertakes to place in outer space by means of a launch vehicle or reentry vehicle, including components of the vehicle specifically

⁶⁴⁷ *Supra* note 631, at 30.

⁶⁴⁸ *See supra* note 631, at 61-80.

⁶⁴⁹ *Supra* note 631, at 75.

⁶⁵⁰ *Id.*

⁶⁵¹ 51 U.S.C. § 20103(2).

designed or adapted for that object.”⁶⁵² Further, the United States Code defines launch vehicle as “(A) a vehicle built to operate in, or place a payload or human beings in, outer space; and (B) a suborbital rocket.”⁶⁵³ Finally, 14 C.F.R. § 417.19 mentions the term space object as part of the implementing regulation for the Registration Convention as it pertains to commercial launch vehicles, but also does not define the term independently.⁶⁵⁴

Lastly, Canada, France, India, South Africa, Sweden, and Ukraine all have licensing regimes incorporated into their national laws.⁶⁵⁵ However, none of these States have defined space object in their national law. A review of the States with licensing regimes reveals no evidence of terms or phrases to indicate the types of object that may be considered a space object, except for the specific terms object, satellite, and launch vehicle.⁶⁵⁶

3. States That Neither Have “Space Object” Nor Have a Licensing or Registration Regime as Part of Their National Law

A review of the national laws of the Chile, Columbia, Czech Republic, Denmark, Finland, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Kazakhstan, Mexico, Romania, and Switzerland found that none of these States have promulgated a national

⁶⁵² *Id.* at. § 50902(10).

⁶⁵³ *Id.* at § 50902(8). See Sara Langston, *Suborbital Flights: A Comparative Analysis of National and International Law*, 37 J. SPACE L. 321-23 (discussing whether a suborbital rocket is a space object).

⁶⁵⁴ 14 C.F.R. § 417.19 (2011) (“all objects placed in space by a licensed launch, including a launch vehicle and any components, . . . ”. This regulation applies to commercial launches regulated by the Secretary of Transportation not launches by the US Government).

⁶⁵⁵ *Supra* note 631, at 81-107.

⁶⁵⁶ See *supra* note 631, at 81-122, 153-98, 267-314 & 335-56. See also Act on Space Activities (1982:963) (Swed.).

space law or defined space object in national law. Of these fifteen States, all States have ratified, acceded, or succeeded to the Liability Convention and only the Czech Republic, Denmark, Greece, Japan, Kazakhstan, Mexico, and Switzerland have ratified, acceded, or succeeded to the Registration Convention. Furthermore, of these sixteen States, all have ratified or succeeded to the Outer Space Treaty and only Luxembourg has not ratified or succeeded to the Rescue and Return Agreement. Thus, these States have at least incorporated the Liability Convention's article I definition of space object into their national laws.

B. Analysis of the Thirty-Nine Sampled States

Because every State has its own internal processes for internalizing its international obligations, the treaty provisions of the first four space treaties do not oblige a State to pass national space laws to implement the duties and obligations of each treaty only that it finds some way to do so.⁶⁵⁷ Recently, however, many States have promulgated implementing legislation to authorize and supervise the space activities of governmental and nongovernmental entities. Licensing and registration regulations and decrees provide sources of rules that describe how States define the content of the term "space object."

⁶⁵⁷ See HERMIDA *supra* note 627, at 244.

1. Observations on the Way in Which States Have Sought to Define Space Object in Their National Law

Some States have attempted to define space object in a specific way, while most States promulgate the term space object in close conformity to the article I definition of the Liability and Registration Conventions. Of the thirty-nine (39) States surveyed, nineteen have licensing regimes for civil and commercial space objects, five have an authorization regime, and fifteen do not have a licensing regime for the launching of space objects. Of these thirty-nine States, thirty eight are party to the Liability Convention and thirty three are party to the Registration Convention.

These data reveal several observations worth noting. First, Australia, Netherlands, Norway, Republic of Korea, and Russia have defined space object in a particular way under their national laws. Australia is the only State surveyed that used a spatialist paradigm to delimit airspace. In addition, while Australia's *Space Activities Act* does not define payload, the Australian Communications and Media Authority (ACMA), an independent statutory authority required to manage the radio spectrum for the Australian government, does have the authority to determine what types of objects are or are not space objects for the purposes of the *Radiocommunications Act of 1992* (RA92).⁶⁵⁸ RA92 uses the terms satellite, satellite system, and space system to describe the types of space objects under ACMA authority that may be licensed and regulated in the context of space telecommunications.⁶⁵⁹

⁶⁵⁸ *Supra* note 631, at 57-59.

⁶⁵⁹ *Id.* (Australian law also makes a distinction between Australian space objects and foreign space objects.)

Second, no Argentine national law specifically defines a space object, but several decrees mention the term satellite and Argentine Decree 532/2005 mentions space vehicles.⁶⁶⁰ Since Argentina has ratified the first four outer space treaties, the treaty definition of space object has binding legal effect as a matter of national law.⁶⁶¹

Third, Brazil's License Regulation seems to incorporate a hybrid spatialist and functionalist definition of space object. A launch vehicle and payload must achieve at least suborbital velocity without specifying the type of trajectory a suborbital trajectory would represent. Again, intent language appears with respect to launch, but the License Regulation does not specify the type of payloads that could be launched.⁶⁶²

Fourth, a common theme among States that have codified the term space object in their respective national laws is that those States have utilized the article I definition rather than devise a more sophisticated definition. Further, Netherlands, Norway, and the Republic of Korea do not place limits on the types of objects that require authorization for launch. Hence, any object launched with the approval of the State is a space object.

Fifth, ten of the States surveyed (Czech Republic, Denmark, Finland, Greece, India, Ireland, Luxembourg, Mexico, Romania, and Switzerland) have not promulgated a national law space law. Each State has accepted as a matter of treaty law the term space object.

⁶⁶⁰ Argentine Decree 532/2005. See *supra* note 631, at 23-36.

⁶⁶¹ Argentina ratified the Outer Space Treaty on December 4, 1968 and ratified the Rescue and Return Agreement on March 26, 1969, as well as subsequently ratified the Liability Convention pursuant to Act No. 23335 of July 30, 1986 and the Registration Convention pursuant to Act 24158 on September 30, 1992. See Office of Outer Space Affairs Treaty Database, *available at* <http://www.oosa.unvienna.org/oosatdb/showTreatySignatures.do> accessed Dec. 10, 2015.

⁶⁶² Moreover, the License Regulation states that "liability for damages due to space launching shall be settled in accordance with space treaties and conventions to which Brazil is a signatory. . . ." *Supra* note 631, at 76. See art. 4(1). As of October 2015, Brazil has ratified the Liability Convention and the Outer Space Treaty as well as acceded to the Registration Convention and the Rescue and Return Agreement.

2. Common Elements of a Space Object in National Space Laws

A review of the sampled national space laws has yielded seven common definition elements: (1) object, (2) intent to launch, (3) launched, (4) launch vehicle, (5) payload, (6) component parts and parts thereof, and (7) satellite. First, the meaning of the term object has a narrow meaning in some States under domestic registration and licensing regimes. In addition, object tends to be defined with respect to the functional paradigm. Second, almost all States sampled with a definition of space object, whether specifically or by synonym, utilize an intent element relative to the action of launch. Thus, a space object is not a space object unless launched. Third, an object has been qualified in many national space laws by terms of art that include satellite, rocket, payload, spacecraft, space system, and launch vehicle. For each term, the definition of space object includes, from almost every State sampled, those component parts of each constitute a space object. This would suggest that the physical component parts of these types of objects would be considered a space object, but not necessarily rocket fuel or humans. Finally, the term satellite has tended to have a specific meaning under the national laws of States sampled. In most cases, the term “satellite”, while considered a space object is limited by two types of objects: telecommunications and remote sensing satellites. Because of the importance of these types of objects, States tend to clearly regulate their uses. As such, this indicates that States seek to constrain or provide a clear label or definition of the meaning of satellite and thus the meaning of space object in their national laws.

c. Conclusion

The term space object is arguably the most important legal term in all of space law. Without a definition of space object, the rights, duties, and obligations of States engaged in activities in the outer space environment would have no meaning. As a treaty term, space object only has legal effect with respect to States that have ratified the outer space treaties. Moreover, the scope of the legal effect the term has on States is limited by the provisions that give the term legal effect and the number of State parties to the treaty that utilize the term space object. In order to understand the scope of the legal effect of the term space object outside of any of the space treaties, an inquiry must be made in which to discern whether the space object has risen to the status of consisting as a rule of customary international law or a general principle of law.

The use of the term “space object” has most likely reached a level of practice beyond the space treaties. All States surveyed have purchased the obligation relating to the term space object as a matter of treaty and national law. Consistent use of the term as a purchased obligation has most likely given the term a status under customary international law. Moreover, the article I definition of the term has most likely reached the level of a rule of customary international law because the launching of objects is fundamental to all other types of rules and their associated obligations across all supranational markets. At a minimum, the national laws that define those objects registered or licensed as a space object, whether termed a launch vehicle, payload or satellite as well as its component parts, provide the operative source of the type of objects that can be a space object. As such, space object includes at least the following elements:

(1) an object, (2) intended to be launched, or (3) launched, that includes a (4) launch vehicle, (5) payload, or (6) satellite – which also includes remote sensing, scientific, telecommunication satellites, as well as (7) including the component parts and parts thereof of a launch vehicle, payload, or satellite. In addition, almost all of the States surveyed utilized the legal meaning of the term space object under a functionalist paradigm. Moreover, only two States sought to define space object by when an object reaches outer space.

CHAPTER VI

CONCLUSIONS AND OBSERVATIONS

a. Conclusions

States are the primary units of analysis in the international system. As such, they are endowed with sovereignty. Moreover, the rule of sovereign equality with other States can manifest in a variety of ways. However, States are not necessarily commensurate, *inter alia*, in resources, capabilities, or State practice.

As individual actors in the international system, States seek to maximize their valued preferences within and outside their territory. In particular, State's seek to extend their authority beyond their territory in relation to certain types of activities. In order to manage the risk and minimize the costs of extending State authority extraterritorially, States may seek to trade in components of power to ensure their authority extends beyond their territorial borders with respect to the need to satisfy valued preferences. To accomplish this extension of authority extraterritorially, States may engage in State practice the act of which supplies rules of jurisdiction to the supranational market of international relations.

By seeking to maximize State preferences, States tend to design their State practice in accordance with rules supplied and/or consumed by States as a function of their sovereignty. Not every State practice connotes a bargained for legal obligation the product of which manifests from the consumption of rules through State practice.

Nevertheless, because the international system is based on the consent of States, the rules that govern international relations can take the form of choice of law rules (cooperative) or rules of prescriptive jurisdiction (non-cooperative).

Since States supply rules of jurisdiction to the supranational market of international relations, other States may bargain for such rules in a variety of international fora. The act of bargaining can take many forms. In particular, international fora for bargaining may be open and multilateral or closed to States without a need or reason to enter the supranational market. As such, by measuring market participation in rule supply, negotiation, and consumption, an observer may draw inferences from which and how many States engage in the supranational market of international relations. In the case of rules for the outer space environment, the data show variation, but some growth, in market participation and rule supply. However, rule consumption has remained relatively flat since about 1980 in terms of choice of law rules, but there has been substantial growth in rule supply and consumption among States that enact national space laws. This is a curious trend because since October 1957, only thirteen (13) States have developed their own launch capabilities. Furthermore, as of October 2015, approximately fifty-eight (58) States have space objects of some variety in orbit around the Earth or beyond cis-lunar space. Yet one hundred and four (104) States have ratified the Outer Space Treaty. So what do these facts mean in light of rule formation and evolution?

One possible explanation is that given the importance of rules for outer space activities, States initially benefited from international negotiations within the UN system. The supply of rules through COPUOS to the UNGA and consequently to all States provided a means to more efficiently bargain for rules because only a few States self-

selected into the COPUOS supranational market. Subsequently, States that did not participate in rule-making were supplied rules and thus the rules developed from the first four space treaties were easy to consume. Furthermore, political alignments among and between States affected how States valued these rules in relation to the hegemons (US and Soviet Union) whose initial State practice set the foundation for subsequent rules. Therefore, collectively, the initial rule development arose because the market participants reacted to the signals provided by States that initially engaged in the practice of launching objects into the outer space environment.

A second possible explanation is that the majority of States on Earth find value in basic rules of jurisdiction. However, rules that do not align with a State's valued preferences will tend not to be consumed by the State. States that have no capabilities or resources to enter the outer space environment may use other States capabilities and resources to do so. Moreover, those States will bargain only for rules that are commensurate with the valued preferences of States despite not possessing the technology to launch objects into the outer space environment. Conversely, if the value of the rules supplied diminishes over time, the probability of rule consumption will tend to decline. Thus, changes in how States value rules will also evolve where the measurable effect on rule supply and consumption may shift across the different types of supranational markets of international relations.

Finally, as rules get more detailed and sophisticated to handle changes in the valued preferences of States, State practice will supply additional rules for potential consumption. Consequently, changes in State practice will also lead to changes in the content of rules. Because a re-supply of rules must necessarily include rules not

specifically on the supranational market, new rules will always seek to augment the old rules. The consequence of this process is that rules may have shifting meaning to States. When States try to shift the meaning of consumed rules of jurisdiction, they engage in a redistribution of the intent of the State Parties to the original rule. Depending on the valued preferences of other States in the supranational market, new rules supplied to the supranational market may or may not be valued or consumed by States. However, State cooperative behavior tends to assist in the supply, negotiation, and consumption of rules of jurisdiction over time. This process closes the loop on rule evolution enabling the process to reinitiate over time.

Graph 10 below illustrates the complexity and interconnectedness of the supranational market of international relations for the outer space environment. Each source or rules is analyzed against how many States engage in a practice to launch objects over the territories of other States into the outer space environment, or engage in rule supply, rule consumption, and preference revelation. Moreover, the entire international legal system is bounded by the number of States in existence at any given time. Therefore, when States begin to supply or consume rules, you can measure how many States engage in a practice against how many States there are in the international system at any observable time.

Consumption of rules is also indicated in Graph 10. With respect to the space treaties, each State that signs or ratifies one or more of the space treaties has consumed the obligation of the rule in return for a trade in extraterritorial authority relative to other States Parties. Relative to non-States Parties to the space treaties, the OSTRATF curve provides an upper bound on the consumption of rules of law relating to the launching of

space objects. The variability in the consumption of rules across all supranational markets indicates a level of supply and demand through supranational market participation because of the price paid in the consumption of rules, i.e., the consensual exchange of an obligation for a right among the group of interested States.

However, States also supply rules relative to their State practice in a nonconsensual manner. If a State manifests a valued preference to launch objects over the territories of States into the outer space environment, then it may supply rules by some internal manifestation of its valued preferences or it may engage in a State practice and give notice of the acceptance of the rule's obligation. If a State promulgates a national law that regulates the launching and use of space objects, it has engaged in preference revelation and rule supply. If a State gives notice to the international community without clearly and consistently objecting to the obligation of a rule, it has supplied rules to the supranational market of international relations as an international custom. However, the State practice must be consistent and persist for some period of time in order to give the international system sufficient time to observe the State practice. Since States continued to engage, without objection, in the State practice of launching objects over the territories of States into the outer space environment for at least ten years from the launch of Sputnik I, such a State practice has certainly been purchased by mutual consent among the international community of States who engage in such a State practice. Therefore, to what degree has the particular uses or activities of space objects been supplied, priced, or consumed on the supranational market and thereby enabling the measure of the rate of consumption? This is left for future study.

Graph 10: Growth in Market Participation, Rule Supply, and Rule Consumption in the Supranational Market of International Relations for the Outer Space Environment

i. Case Study I

As a result of the launches of the Sputnik and Explorer objects, the initial supply of rules of prescriptive jurisdiction provided a framework by which States could negotiate future rules regarding the outer space environment. The origin of the supranational market for outer space activities is the consequence of the development of the first rule of State practice relating to the launching of an object into the outer space environment over the territories of States. The supranational market for space activities arose in October 1957 as a monopoly until January 1958 when it became a duopoly. For ten years, both the United States and the Soviet Union dominated State practice in space activities. Moreover, the competition in terms of State practice in the outer space environment can be traced back to a series of events that produced the catalysts for the launch of Sputnik I. Thus, the launch of Sputnik I necessitated the creation of a supranational market for the trading in valued preferences to produce rules and rules of law for outer space activities because a few States chose to engage in the State practice of launching objects over the territories of States into the outer space environment.

ii. Case Study II

The proliferation of market participation and rule supply led to the creation of several supranational markets of international relations regarding the outer space environment. Within a year of the launch of Sputnik I, interested States cooperated to create COPUOS as a forum to discuss the international issues associated with the outer

space environment. Moreover, COPUOS enables trading in valued preferences and the development of rules of jurisdiction among and between States. Between October 1958 and October 1975, COPUOS grew from eighteen members to thirty-seven members. Although market participation grew 50%, relative to the entire pool of potential market participant States, COPUOS membership reflected the views of a minority of States who had an interest in developing such rules. Coincidentally, while the number of COPUOS member States has almost tripled since October 1975, the rate of rule supply to the international system remains steady, but consumption of rules generated out of COPUOS has significantly declined. The process by which COPUOS supplies rules of jurisdiction to States through supranational market mechanisms is consent based. However, this defining aspect of COPUOS also limits member States' abilities to supply rules where there is no consensus, but may have value to other States. This characteristic of COPUOS illustrates that rule supply in one supranational market does not produce the same effects in other markets.

A rule of customary international law must include general and consistent State practice performed out of a sense of legal obligation.⁶⁶³ A rule of international custom can be confined to a region, among States who use the term in the course of a specific State practice, or broadened to all States who use the term in practice out of a sense of legal obligation. The term space object could also extend as a rule of international custom to those States that do not engage in outer space activities depending on if and how the obligation of the rule is purchased, i.e., that supranational market from where the rule could be purchased.⁶⁶⁴ This analysis of State practice indicates that out of the thirty-nine

⁶⁶³ See *supra* BROWNLIE note 4.

⁶⁶⁴ *Id.*

space-faring States surveyed, all States have incorporated the term “space object” into their national laws in some form. Thus, all States sampled generally use the term “space object” out of a sense of legal obligation, i.e., all States surveyed in some form have at least purchased the obligation of the term and have launched or attempted to launch space objects for State purposes. On the other hand, the definition of space object has evolved over time with the innovation in the types of technologies that can be launched into outer space. States have sought to generalize how they define such objects or kept the terminology open-ended.

To a large degree, treaties govern the national activities of States in outer space. One hundred and four States have ratified the Outer Space Treaty; ninety-six States have ratified, acceded, or succeeded to the Rescue and Return; ninety-five States have ratified, acceded, or succeeded to the Liability Convention; and sixty-five States have ratified, acceded, or succeeded to the Registration Convention. On one hand, a large number of States, i.e., one hundred and four, have purchased the obligation of the rule relating to the term space object by ratification of any of the first four outer space treaties. On the other hand, a significant number of States, i.e., ninety-five States, have purchased the article I definition of space object.

By utilizing articles 31 and 32 of the VCLT, an understanding of the intention of the term arises. However, the definition of space object, as expressed in article I of the Liability and Registration Conventions, provides only a basis by which to understand the content of the term’s legal effect under public international law. Thus, through State practice, a State could specifically define the types of objects launched into outer space.

A review of national law indicates, moreover, that States have regarded the use of the term generally within a functionalist paradigm. In addition, given the history of the Liability Convention negotiations, the term space object has generally meant those objects such as a launch vehicle, spacecraft, or satellite. Subsequent treaties have narrowed the meaning of the term by leaving off humans, i.e., astronauts, as space objects. In the same way, national law has begun to narrow the meaning of space object through the promulgation of national space laws. Because an open-ended treaty definition leaves open possibilities for States to cap the meaning of the term space object, those terms used to describe space object can take legal effect parallel to the treaty term and definition.

iii. Case Study III

States will seek the most efficient means by which to develop and supply rules that maximize the utility of their valued preferences, but efficiency in the supply of rules does not translate into the efficient consumption of rules. States define and use their technologies to launch into and orbit objects in the outer space environment in ways that maximize the utility of their valued preferences. However, seeking to maximize the utility of their valued preferences can arise through any supranational market to which States have access. In particular, the most efficient way States develop rules is through promulgating national laws. While supplying rules through State practice does not necessarily lead to rule consumption, when States agree on rules that are traceable across States with the same or similar practice in outer space activities they create general

principles among and between those interested States. These general principles manifest from the national law and collectively represent the consensus among States regarding the content (i.e., the definition, meaning, and scope) of rules that apply to all States that engage in the same or similar types of State practice. Finding a common basis for the rules promulgated by States, without objection and put into effect through their international relations, establishes the foundation of the consent required to consume rules of jurisdiction from the promulgation of their national laws.

General principles of law are those legal principles that are common to a large number of systems of municipal law. At least ninety-five States have incorporated the specific definition of space object from the Liability Convention into national law through domestic ratification processes. All States sampled have incorporated the term space object into their respective national laws. In addition, every State sampled has incorporated the article I space object definition, of the Liability or Registration Convention, into their national laws. Nevertheless, thirteen States (Australia, Russian Federation, United States, Canada, France, Iran, Netherlands, Nigeria, Norway, Republic of Korea, South Africa, Sweden, and Ukraine) have promulgated into national law a specific definition using synonymous terms. Each State has generally restricted objects intended to be launched into outer space to objects termed payload, satellite, launch vehicle, and the component parts of each. These terms could represent rules of general principles of law limited by the State practice of those objects launched or registered under national law.

A space object has legal effect as a general principle of law if the object launched falls into two categories. The first category is any object intended to be launched into

outer space by an authorizing government, as registered, or by way of a national activity. This first category is the broadest. The second category includes those terms of art that express a space object in national law that are intended to be launched into outer space by an authorizing government, as registered, or by way of a national activity. Thus, while the term most likely represents a general principle of law, the definition of space object is subject to two constraints, i.e., (1) any object and (2) those objects specifically defined in a State's national law subject to licensing or registration regimes.

b. Observations for Future Research

Since the fall of 1957, rules for outer space have proliferated across national laws and regulations, treaties, international declarations, arbitration rules, nonbinding agreements, and other written media. All of these rules, however, can be traced back to the events that precipitated the space race. Nonetheless, looking at how States have evolved their State practice over time, new activities and proposed activities will necessarily lead to the supply of rules of jurisdiction through State practice. When States seek to cooperate in developing and supplying rules to supranational markets, it is implicit that these rules are meant to manage risk and minimize costs relative to the benefits of engaging in activities in the outer space environment. However, it is not entirely clear that rules of jurisdiction to which States have agreed are sufficient to deal with the proposed State practices currently being contemplated by a variety of States. This trend toward the evolution of rules for the outer space environment based on State practice will test the limits of the authority for which States have bargained. For example,

what happens when the definition of a space object and the scope of the bargained for rule no longer applies because the object launched or made in situ is not launched from Earth? How will States develop, supply, and consume rules for activities in environments significantly distant from their territory?

As States seek to develop and achieve new valued preferences for activities in the outer space environment, the bargained for rules thus far will most likely be inadequate to deal with the extension of authority over persons and things subject to their jurisdiction. Is it possible to measure these transitions and provide results by which States seek to manage their own risks or will the economics of rule formation strain the international system of States as activities proliferate in the outer space environment? Further analysis will be needed to determine whether the current system set up on Earth to develop and supply rules relative to the number of States participating in such supranational markets will evolve or break down as humans move beyond the confines of the Earth. If such events transpire, this should lead to a new cycle of evolution in the formation and development of rules of jurisdiction because such rules provide States the glue that binds their authority over objects and subjects of such rules.

APPENDIX

a. Glossary of Terms

Basis of State Authority – Jurisdiction (e.g., Territorial, Nationality, Passive Personality, Protective, Universal).

Buying/Purchasing – Accepting the costs of the obligation and benefits of the extension of authority from the rule(s) supplied.

Choice of Rules (of Law) – Generally, the bi- or multi-lateral supply of rules regarding the consensual allocation of obligations and authority in a supranational market of international relations.

Consumption – The act of giving notice to the acceptance of the obligation of a rule of jurisdiction.

Environments – Any location outside the territory of a State where the State may engage in a State practice.

International Legal System – System of rules based on the principle of consent that gives rise to obligations and the extension of extraterritorial authority among and between States.

Market Participation – State practice in the form of exchanges (occurrences or transactions) in the supranational market of international relations.

Preference revelation – Measuring the valued preferences of a State.

Prescriptive Rules (of Law) – The unilateral assertion of authority extraterritorially.

Rule(s) – A rule is defined as one or more instruction(s) of a policy. Policy is defined as a valued preference that guides a course of action from a subjectively legitimate source of authority that directs a subject's act or omission to prevent a breach of the rule(s).

Rule Development – The processes by which States seek to design rules that are supplied to the international legal system through the supranational markets of international relations.

Rule Formation – The observable processes of States engaged in the supranational market of international relations to supply to and consume rules from supranational markets of international relations.

Rule(s) of Law – The product of exchanges in the supranational market of international relations where the price paid takes the form of a legal obligation; the extent to which a State's authority may apply extraterritorially.

Rule(s) of Jurisdiction – A component of State power as the basis for a State's authority as a function of State sovereignty within the international system.

State – An entity that has a territory, a population, a government, and the ability to conduct foreign relations.

State Practice – Observable acts or omissions of a State in the course of conducting its international relations.

Sovereignty (Westphalian) – Territoriality and Exclusion of External Actors from Domestic Authority (Presumption Against Nonconsensual Rulemaking).

Sources of Rules – These include State practice, scholarship, opinions of tribunals, public international law (i.e., International Custom, International Agreements, General Principles of Law).

Selling – Rules supplied for consumption by States via some State practice.

Valued Preferences – Economic and national security, foreign policy concerns of a State.

b. Raw Data Sets

i. National Law Data Set

Table 4: National Law Data Set

State	OST RATF	RRA RATF	LC RATF	RC RATF	NL (uncorr)	NL (corr)
United States	Oct-67	Dec-68	Oct-73	Sep-76	Jul-58	Jul-58
Japan	Oct-67	Jun-83	Jun-83	Jun-83	Jun-69	Jun-69
Norway	Jul-69	Apr-70	Apr-95	Jun-95	Jun-69	Jun-69
Ireland	Jul-68	Aug-68	Jun-72	-	Jun-72	-
Switzerland	Dec-69	Dec-69	Jan-74	Feb-78	Jan-74	-
Mexico	Jan-68	Mar-69	Apr-74	Mar-77	Apr-74	-
Finland	Jul-67	Sep-70	Feb-77	-	Feb-77	-
Denmark	Oct-67	May-69	Apr-77	Apr-77	Apr-77	-
Greece	Jan-71	Jul-75	Apr-77	Mar-03	Apr-77	-
Romania	Apr-68	Jun-71	Mar-80	-	Mar-80	-
Sweden	Oct-67	Jul-69	Jun-76	Jun-76	Nov-82	Nov-82
Italy	May-72	Mar-78	Feb-83	Dec-05	Jan-83	Jan-83
Luxembourg	Jan-06	<i>Signatory</i>	Oct-83	-	Oct-83	-
United Kingdom	Oct-67	Dec-68	Oct-73	Mar-78	Jul-86	Jul-86
Canada	Oct-67	Feb-75	Feb-75	Aug-76	May-90	May-90
Czech Republic	Jan-93	Jan-93	Jan-93	Feb-93	Jan-93	-
South Africa	Sep-68	Sep-69	Dec-11	Jan-12	Jun-93	Jun-93
Russian Federation	Oct-67	Dec-68	Oct-73	Jan-78	Aug-93	Aug-93
Brazil	Mar-69	Feb-73	Mar-73	Mar-06	Feb-94	Feb-94
Spain	Nov-68	Feb-01	Jan-80	Dec-78	Feb-95	Feb-95
Argentina	Mar-69	Mar-69	Nov-86	May-93	Jul-95	Jul-95
Ukraine	Oct-67	Jan-69	Oct-73	Sep-77	Nov-96	Nov-96
India	Jan-82	Jul-79	Jul-79	Jan-82	Jun-97	-
Australia	Oct-67	Mar-86	Jan-75	Mar-86	Dec-98	Dec-98
Belarus	Oct-67	Dec-68	<i>Signatory</i>	Jan-78	Dec-98	Dec-98
People's Republic of China	Dec-83	Dec-88	Dec-88	Dec-88	Feb-01	Feb-01
Chile	Oct-81	Oct-81	Dec-76	Sep-81	Jul-01	Jul-01
Iran	<i>Signatory</i>	Dec-70	Feb-74	<i>Signatory</i>	Jun-05	Jun-05
Belgium	Mar-73	Apr-77	Aug-76	Feb-77	Sep-05	Sep-05
Republic of Korea	Oct-67	Apr-69	Jan-80	Oct-81	Dec-05	Dec-05
Algeria	Jan-92	<i>Signatory</i>	Oct-06	Mar-07	Jun-06	Jun-06
Colombia	<i>Signatory</i>	<i>Signatory</i>	Jul-14	Jan-14	Jul-06	Jul-06
Netherlands	Oct-69	Feb-81	Feb-81	Jan-81	Jan-07	Jan-07

Venezuela	Mar-70	<i>Signatory</i>	Aug-78	-	Oct-07	Oct-07
Germany	Feb-71	Feb-72	Aug-72	Oct-79	Nov-07	Nov-07
France	Aug-70	Dec-75	Dec-75	Dec-75	Jun-08	Jun-08
Nigeria	Nov-67	Mar-73	Dec-05	Jul-09	Aug-10	Aug-10
Austria	Feb-68	Feb-70	Jan-80	Mar-80	Dec-11	Dec-11
Kazakhstan	Jun-98	Jun-98	Jun-98	Jan-01	Jan-12	Jan-12

ii. Comparative Analysis Data Set

Table 5: Comparative Analysis Data Set

[illegible]

Sep-62	108											
Oct-62	110											
May-63	111											
Dec-63	113											
Dec-64	115											
Sep-65	117											
Sep-66	118											
Dec-66	122											
Jan-67			20									
Feb-67			24									
Mar-67		1										
Apr-67		2	25									
May-67		3	26									
Jun-67		4	27									
Jul-67		6	28									
Sep-67												
Oct-67		20										
Nov-67		21										
Dec-67	123	22										
Jan-68		24										
Feb-68		26										
Mar-68		28										
Apr-68	124	31			14							
May-68		32			16							
Jun-68		34			19							

Jul-68		36		2	23							
Aug-68		37		3	25							
Sep-68	125	40										
Oct-68		41		4								
Nov-68	126	44										
Dec-68		45		10								
Jan-69		46		14								
Feb-69				19								
Mar-69		50		23								
Apr-69		51		28								
May-69				31								
Jun-69				33						3	3	
Jul-69		52		35								
Sep-69				36								
Oct-69		53										
Dec-69		54		39								
Feb-70				41								
Mar-70		56		42								
Apr-70				44								
May-70				45								
Jul-70		57										
Aug-70				46								
Sep-70		60		47								
Oct-70	127											
Nov-70				48								
Dec-70				50								

Jan-71		61										
Feb-71		62		51								
Jun-71		63		52								
Jul-71				53								
Sep-71	130											
Oct-71	131											
Dec-71	132											
Feb-72				54								
Mar-72						1	14					
Apr-72							15					
May-72		64				2	17					
Jun-72		65		55		4	19			4		
Jul-72		67		56			20					
Aug-72						6	21					
Sep-72						8						
Oct-72						10						
Nov-72		68		57								
Dec-72						11						
Jan-73						12						
Feb-73				58		14						
Mar-73		69		59		16						
Apr-73						19						
May-73						21						
Aug-73		70		60		22						
Sep-73	135											
Oct-73				61		26						

Dec-73												37
Jan-74						28				5		
Feb-74						29						
Mar-74						30						
Apr-74						31				6		
Jun-74						32						
Sep-74	138											
Oct-74						33						
Jan-75						34						
Feb-75				62		35						
Mar-75						36						
Apr-75						37						
May-75							22		2			
Jul-75				63								
Aug-75						38						
Sep-75	141					39						
Oct-75	142					40						
Nov-75	143								3			
Dec-75	144			64		41		1				
Apr-76						42						
May-76								2				
Jun-76						43		3				
Aug-76		72		65		44		4	4			
Sep-76	145	73		66				5				
Dec-76	147	74				46		6				
Jan-77						47						

Feb-77		75				48		7		7		
Mar-77								8				
Apr-77				67		50		9		9		
Jun-77		76				51						
Aug-77								10				
Sep-77	149							11				
Oct-77								12				
Dec-77								13				47
Jan-78		77		68		53		15				
Feb-78								16				
Mar-78				69				17				
Apr-78								18				
Jul-78								19				
Aug-78						54						
Sep-78	150											
Nov-78								20				
Dec-78	151							21				
Feb-79		78										
Mar-79				70				22				
Jun-79		79										
Jul-79				71		55						
Sep-79	152											
Oct-79								23				
Dec-79						56						
Jan-80						59						
Feb-80						61						

[illegible]

[illegible]

May-93	183							37				
Jun-93										17	8	
Jul-93	184											
Aug-93										18	9	
Feb-94										19	10	
May-94				82		76						
Aug-94				83		77						
Dec-94	185											61
Feb-95						78				20	11	
Apr-95												
Jun-95								38				
Jul-95										21	12	
May-96		94				79						
Jun-96												
Nov-96										22	13	
Jun-97										23		
Jul-97								39				
Jun-98		95		84		80						
Dec-98										25	15	
Feb-99								40				
Apr-99								41				
May-99		96		85		81						
Jun-99				86								
Sep-99	188											
Sep-00	189											
Oct-00		97				82						

Nov-00	189							42				
Jan-01								43				
Feb-01				87						26	16	
Mar-01								44				
Jul-01										27	17	
Dec-01												64
Jun-02		98										
Sep-02	191											
Nov-02						83						
Dec-02												65
Mar-03								45				
Jun-04												
Dec-04												67
Jun-05										28	18	
Sep-05										29	19	
Nov-05												
Dec-05						84		46		30	20	
Jan-06		99										
Mar-06								47				
Apr-06						85		48				
Jun-06	192			89		86		49		31	21	
Jul-06						87				32	22	
Oct-06								50				
Dec-06				90								
Jan-07										33	23	
Feb-07						88						

Mar-07								51				
Oct-07										34	24	
Nov-07										35	25	
Dec-07												69
Jun-08										36	26	
Mar-09		100						52				
Jul-09								53				
Nov-09				91		89						
Jan-10								54				
Apr-10		101										
Aug-10										37	27	
Oct-10								55				
Dec-10												70
Jul-11	193											
Oct-11												
Dec-11				90						38	28	71
Jan-12								56		39	29	
Feb-12												
Mar-12		102		92				57				
Jul-12								58				
Sep-12								59				
Dec-12												74
Mar-13		103		93		91		60				
Dec-13												76
Jan-14								61				

Apr-14								62				
Jul-14						92						
Dec-14												77
Jun-15												
Oct-15		104										83

iii. COPUOS Membership

Table 6: COPUOS Membership

<u>States</u>	<u>Date</u>	<u>Count</u>
Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia (now Czech Republic), France, India, Iran, Italy, Japan, Mexico, Poland, Sweden, the Union of Soviet Socialist Republics (now Russian Federation), the United Arab Republic (now Egypt), the United Kingdom of Great Britain and Northern Ireland & the United States of America	Dec-58	18
Albania , Argentina, Australia, Austria , Belgium, Brazil, Bulgaria , Canada, Czechoslovakia (<i>now Czech Republic</i>), France, Hungary , India, Iran, Italy, Japan, Lebanon , Mexico, Poland, Romania , Sweden, the Union of Soviet Socialist Republics (<i>now Russian Federation</i>), the United Arab Republic (<i>now Egypt</i>), the United Kingdom of Great Britain and Northern Ireland & the United States of America	Dec-59	24
Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chad , Czechoslovakia (<i>now Czech Republic</i>), France, Hungary, India, Iran, Italy, Japan, Lebanon, Mexico, Mongolia , Morocco , Poland, Romania, Sierra Leone , Sweden, the Union of Soviet Socialist Republics (<i>now Russian Federation</i>), the United Arab Republic (<i>now Egypt</i>), the United	Dec-61	28

Kingdom of Great Britain and Northern Ireland & the United States of America		
Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chad, Chile , Czechoslovakia (<i>now Czech Republic</i>), Federal Republic of Germany , Egypt, France, German Democratic Republic , Hungary, India, Indonesia , Iran, Italy, Japan, Kenya , Lebanon, Mexico, Mongolia, Morocco, Nigeria , Pakistan , Poland, Romania, Sierra Leone, Sudan , Sweden, the Union of Soviet Socialist Republics (<i>now Russian Federation</i>), the United Kingdom of Great Britain and Northern Ireland, the United States of America, & Venezuela	Dec-73	37
Albania, Argentina, Australia, Austria, Belgium, Benin , Brazil, Bulgaria, Cameroon , Canada, Chad, Chile, Colombia , Czechoslovakia (<i>now Czech Republic</i>), Ecuador , Egypt, Federal Republic of Germany, France, German Democratic Republic, Hungary, India, Indonesia, Iran, Iraq , Italy, Japan, Kenya, Lebanon, Mexico, Mongolia, Morocco, Netherlands , Niger , Nigeria, Pakistan, Philippines , Poland, Romania, Sierra Leone, Sudan, Sweden, Turkey , the Union of Soviet Socialist Republics (<i>now Russian Federation</i>), the United Kingdom of Great Britain and Northern Ireland, the United States of America, Venezuela & Yugoslavia	Dec-77	47

Albania, Argentina, Australia, Austria, Belgium, Benin, Brazil, Bulgaria, Canada, Chad, Chile, China , Colombia, Czechoslovakia (<i>now Czech Republic</i>), Ecuador, Egypt, Federal Republic of Germany, France, German Democratic Republic, Greece ¹ , Hungary, India, Indonesia, Iran, Iraq, Italy, Japan, Kenya, Lebanon, Mexico, Mongolia, Morocco, Netherlands, Niger, Nigeria, Pakistan, Philippines, Poland, Romania, Sierra Leone, Spain , Sudan, Sweden, Syrian Arab Republic , Turkey , ¹ the Union of Soviet Socialist Republics (<i>now Russian Federation</i>), the United Kingdom of Great Britain and Northern Ireland, the United Republic of Cameroon, the United States of America, Upper Volta (<i>now Burkina Faso</i>) , Uruguay , Venezuela, Viet Nam & Yugoslavia	Nov-80	53
Albania, Argentina, Australia, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba ² , Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece ³ , India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan , Kenya, Lebanon, Malaysia ² , Mexico, Mongolia, Morocco, Netherlands, Nicaragua , Niger, Nigeria, Pakistan, Peru ² , Philippines, Poland, Portugal ³ , Republic of Korea ² , Romania, the Russian Federation, Senegal , Sierra Leone, South Africa , Spain ³ , Sudan, Sweden, Syrian Arab Republic, Turkey, ³ the United Kingdom of Great Britain and	Dec-94	61

Northern Ireland, the United States of America, Ukraine 4 , Uruguay, Venezuela, Viet Nam & Yugoslavia		
Albania, Argentina, Australia, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba 5 , Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Malaysia 5 , Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru 5 , Philippines, Poland, Portugal, Republic of Korea 5 , Romania, the Russian Federation, Saudi Arabia , Senegal, Sierra Leone, Slovakia , South Africa, Spain, Sudan, Sweden, Syrian Arab Republic, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam	Dec-01	64
Albania, Algeria , Argentina, Australia, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Syrian Arab Republic, Turkey,	Dec-02	65

the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam		
Albania, Algeria, Argentina, Australia, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Libyan Arab Jamahiriya (now Libya) , Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Syrian Arab Republic, Thailand , Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam	Dec-04	67
Albania, Algeria, Argentina, Australia, Austria, Belgium, Benin, Bolivia , Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Libyan Arab Jamahiriya (now Libya), Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South	Dec-07	69

Africa, Spain, Sudan, Sweden, Switzerland , Syrian Arab Republic, Thailand, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam		
Albania, Algeria, Argentina, Australia, Austria, Belgium, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Libyan Arab Jamahiriya (<i>now Libya</i>), Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia , Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam	Dec-10	70
Albania, Algeria, Argentina, Australia, Austria, Azerbaijan , Belgium, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Kenya, Lebanon, Libya, Malaysia, Mexico, Mongolia, Morocco, Netherlands,	Dec-11	71

Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam		
Albania, Algeria, Argentina, Armenia , Australia, Austria, Azerbaijan, Belgium, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica , Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Jordan , Kazakhstan, Kenya, Lebanon, Libya, Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam	Dec-12	74

Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Belgium, Belarus , Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Ghana , Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Jordan, Kazakhstan, Kenya, Lebanon, Libya, Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam	Dec-13	76
Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Belgium, Belarus, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Cuba, Czech Republic, Ecuador, Egypt, France, Hungary, Germany, Ghana, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Jordan, Kazakhstan, Kenya, Lebanon, Libya, Luxembourg , Malaysia, Mexico, Mongolia, Morocco, Netherlands, Nicaragua, Niger, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, the Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Slovakia, South	Dec-14	77

Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Venezuela & Viet Nam		
UAE, Sri Lanka, Israel, Qatar, Oman, El Salvador	Oct-15	83

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