

Space Economics and Law

Henry Hertzfeld, Research Professor, Space Policy Institute, George Washington University

The Space Economy

The estimates for the “space economy” that are being quoted endlessly by advocates have to be carefully dissected. There is no one definition of what the space economy really is; some are referring to the value of activity in space and on-orbit, others to the full range of possible monetary activity related to space, and still others refer to revenues and expenditures of terrestrial companies and governments’ space activities. It is the latter concept that has seen the \$1 trillion estimate for space activities in 2040.

But, when evaluated, it is really nothing to get very excited about. Most estimates of the amount of revenue associated with space are today somewhere between \$350 B and \$450 B annually. That is divided into about \$125 B (35%) for satellite services (TV, telecom, radio, etc.), about the same amount for all ground equipment sales, \$90 to \$100 B (29%) are government expenditures on space and about \$10 B (3%) is satellite manufacturing and launching. (Note that there is likely double counting in these totals because it is very difficult to parse government expenditures from commercial sales and there are many other accounting and disclosure issues with all of the economic surveys of space activities.)

If one calculates the compound annual interest growth for \$350 billion over a 19-year period from today, a \$1 trillion total is reached at a 6% annual growth rate. (If we begin with the higher estimates of today’s space economy, the growth rate will be lower.) Although 6% is a reasonable rate of

growth, it is not spectacular or even so large as to be particularly notable, especially when it is likely that the purchasing power of a dollar today will be less as time goes on due to inflation and unpredictable changes.

That being said, what is extremely important to understand is the remarkable change in space technology over the past 15 to 20 years. Many space applications have progressed from a largely R&D and product demonstration phase to a mature technology with systems designed, operated, and relied upon by virtually all nations as well as companies and individuals. Turn off the space spigot and we will create a serious problem: space capabilities have become critical infrastructure.

Although there are estimates, some as high as \$10 to 15 billion annually, of a very fast-growing trend in venture capital and related investments in space companies, those too, must be evaluated very carefully. First, about a third of that number is from the very special class of angel investors who have goals that go beyond near-term profits. (And those investments are largely in launch vehicles—a sector that rarely makes any profits, but is very important to space business.) Another large amount of that total is in mergers and acquisitions and in valuing IPOs and SPACs. For the most part those investments are measured by discounted expected future returns, with values that often reflect very speculative expectations.

Finally, there is somewhere between \$1 billion and \$2 billion of true new investment

in R&D and product development from terrestrial companies with cash-generating other businesses that see opportunities in space. Those are the interesting investments and they range from AI and robotics to big data analysis and life sciences.

Private sector involvement in space was evident from the beginning of the space age. Since NASA was formed in 1958, about 80% of NASA's outlays have gone to private companies. Forms of government contracting have changed and there are more recent incentives to promote the purchase of services from industry. But in the United States much of the success of the space programs has always had continues to support a strong private involvement that directly reflects the amount, needs, and goals of the public sector.

Thus, regardless of whether this near-term rapid escalation of interest in space companies is an investment "bubble" or whether it represents a solid long-term trend in non-government sponsored private sector activity is still unclear. One factor, often not realized is that governments are still responsible for a major share of the space market. And without that well-funded sovereign "anchor tenant," many of the new companies could not succeed. Private space investment has not seen a smooth progression over time; but the long-term trend is clearly upward.

Space Law

Space law has not progressed as fast as space technology. International space law is based on the 1967 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) along with three other supplemental treaties: the Rescue and Return Convention, and the Liability Convention, the Registration Convention, all coming into force in the late 1960s and early 1970s. (The Moon Agreement, a fifth space treaty, came into force in 1982 but only has 18 States Party and is considered by many a failed treaty. Nonetheless, it still generates quite a bit of discussion, particularly related to private sector resource use on the Moon.)

The treaties are primarily a set of overall principles to be applied to space. The major principles are:

- Space is to be used for peaceful purposes and to be considered the province of mankind; it should be used for the benefits and interests of all countries, and there is to be the freedom of scientific investigation,
- Freedom of access to all areas of space to all nations without discrimination,
- International cooperation in space explorations is encouraged,
- There is to be no appropriation of space or celestial bodies by any nation or by any claim of sovereignty or by occupation, use, or any other means,
- There are to be no weapons of mass destruction placed in orbit or on any celestial body,
- States are internationally responsible and internationally liable for their national activities in space and are required to authorize and continuously supervise their activities and those of non-government entities.

These treaties are, it must be emphasized, agreements among nations. Reflecting the

time period in which they were drafted, they are a post WWII, Cold War product primarily focused on the geopolitics between the United States and the U.S.S.R., the two superpowers of the time and the only states that could then access space.

The treaties are not particularly business friendly, but it is noteworthy that they do not exclude or preclude private actors and activities in outer space.

Today, technology has outpaced the law. There are capabilities to do things in space that could not have been done in the 1960s such as satellite servicing and using resources obtained in space. Even satellite telecommunications were experimental then (although for U.S. companies, performed by private actors under heavy regulation). Also today, at least 11 nations have launch capabilities and essentially anyone can purchase a launch, assuming it is for peaceful purposes and passes safety and financial responsibility reviews. Almost every nation in the world now uses satellite telecommunications and/or operates their own satellites from their own territory.

Furthermore, space is becoming crowded in certain orbits. Debris from a variety of sources is accumulating in space and creating environmental and sustainability issues. Although it appears to be a manageable risk for the near term, a huge potential problem could develop in the future. Nations are fast developing methods to attempt to manage and minimize the probability of a major space debris incident.

Compounding this are the dual-use aspects of space. There have always been national security uses allowed in space,

such as using space for military communications and monitoring the Earth with remote sensing imagery from satellites.

Until recently satellites put into orbit have generally been safe from harmful interference. That is no longer the case. Various incidents have occurred that are of concern to defense and security establishments. Thus, as we move forward, the safety and protection of national assets in space, whether they are commercial or governmental, will be a factor. An actual war in space is unlikely, but certainly space assets, given their critical importance to both the civil economy and national security, will be involved in any future terrestrial conflict between or among nations.

No new international space law treaty is feasible today. The current treaties are sufficient for moving forward, even in these radically different times. Nations will, however, have to be flexible and willing to renegotiate, even informally, new norms, standards, regulations, and procedures. This is a difficult matter for traditional international lawyers who have been trained in precedent and rigidity when it comes to reviewing the language of treaties, no matter if the treaty itself is vague and contains numerous lacunae. The Outer Space Treaty is a treaty of principles, not primarily one of absolute rules and regulations.

Future space law appears to be hinged on developing norms, standards, regulations and management tools. Since there is unlikely to be an internationally recognized governing body for space, it will be up to nations to develop coordinated legal approaches and to have national laws that can be enforced. There have been attempts

at doing this such as proposed formal codes of conduct, but none so far have taken hold.

Space has unique properties therefore it is not possible to easily transpose any specific analogous terrestrial legal regime onto space. The major differences in existing treaty regimes include:

- The High Seas: maritime law has a long history and the high seas are considered to be non-sovereign international areas. Historically ships have been treated differently from cargo, particularly with respect to liability limits and insurance; salvage is possible on sunken and abandoned ships, but not for government vessels; there are parallels in resources and navigation at sea, but enforcement is often weak. And the sea bed mining provisions of the UNCLOS were somewhat similar to the Moon Agreement's Art. XI concept for mining resources on the Moon. The failure of this part of the UNCLOS led to a more commercially acceptable amendment in the 1990s, yet there still is no commercially successful Sea Bed mining. It is also interesting to note that the 200-mile EEZ coastal provisions extend the long held right of innocent passage of the seas. These rules are generally observed by all nations. (The South China Sea and Japan Islands issues are exceptions and pose some difficult current international political issues.) However, the freedom to fish in the high seas and the technology now available to overfish creates another set of international issues that are likely to be mirrored in space issues concerning resources in space and on celestial bodies. Nations have been arguing about deep sea fishing rights for hundreds of years without resolution; can the world afford

those types of arguments in space? There is, of course, no answer to this question.

- Heritage sites: all UNESCO heritage sites are on sovereign territory; they are protected and managed by national governments; there is an underwater heritage treaty, but it has been ratified by fewer than 50 nations, and not by the United States, Russia, or China.
- Antarctica: Although Antarctica is currently non-sovereign territory, the Antarctica system of treaties provides that sovereignty is only temporarily ceded; some nations with previously claimed territory are grandfathered; the question of resources required a separate agreement that prohibits any resource mining for 50 years (from the late 1990s; tourism in Antarctica is growing and there are agreements among private tour group operators on environmental protection matters that are adhered to.

However, the major legal difference with respect to space and other sectors in international law is that:

“Space is the only sector/economic activity where, through treaty obligations, nations are internationally responsible and internationally liable for not only their own activities but also activities of non-governmental entities under their jurisdiction” (Articles VI and VII of the OST).

Note that this has a very positive effect of discouraging “flags of choice” for registry (as in maritime domain) because a nation or company cannot avoid liability (or other strict regulations) by registering spacecraft in states with liberal laws and regulatory standards.

Also, the treaty definition of a launching state is the state or states that launch or procure a launch or launch from their territory or facility (Liability Convention, Art. 1). The word, procure, is not defined in the treaty and as commercial space activities accelerate, a working definition may become controversial. Other future problems may occur in recognizing the ownership of space assets, which is terrestrial (OST Art. VIII), but registration may be with a different nation if, for instance, a space asset is sold to a company in a different nation than that of the original registration. There are other associated future issues that are yet to be well defined. They include unlimited 3rd party liability (in both time and amount) assigned to the launching state(s) and associated issues of national authorization, supervision, jurisdiction and control of space objects.

Artemis Accords

Very briefly, the Artemis Accords are a United States-led effort toward international partnerships in the ongoing and soon to expand Gateway/Artemis Moon Program. The Accords have been signed by 12 nations. Subsequent agreements with each nation will detail the partnership and the responsibilities that each nation will have for equipment and specific tasks.

The Accords do not provide new space law. In fact, there is little that is new from a legal perspective. They affirm the principles of the Outer Space Treaty. They build on the international partnership agreement for the International Space Station. They rely on the U.N. Registry that derives from the obligations of the Registration Convention.

The Accords are clearly defined as non-binding, soft law. In one sense, they are an effort to develop some norms and standards of behavior among partner nations. Specifically, they add a focus on resource use in space, but carefully do not define public/private relationship on that topic. They recognize the need to preserve historic sites on the Moon. They provide for a regime of safety zones on operations on the Moon, taking into account due regard for other nations activities. They, following the ISS Agreement, provide for cross-waivers of liability among the partners in their operations but do not change the obligations of liability to others (3rd Party liability) under the Liability Convention.

It will be interesting to observe and follow subsequent partnership agreements in this program, particularly as nations begin to implement their own interpretations and nuances to these Accords and other norms and standards into their practices and national regulations.

This article was drafted for a workshop at Perry World House, the University of Pennsylvania's global affairs hub. The workshop was made possible in part by the generous support of Carnegie Corporation of New York. The statements made and views expressed are solely the responsibility of the author.