

Space Economy and Taxation

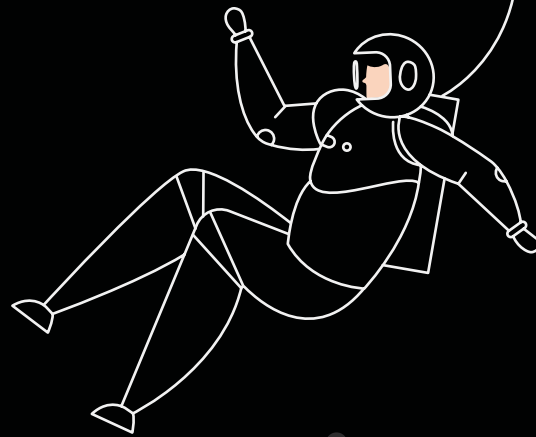


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**To some this may look like a sunset.
But it's a new dawn.**

Chris Hadfield

Never in the history of the world has there been a period of such interest by businesses to engage in space activities before.

We were only celebrating relatively small triumphs, like the first landing on the Moon just 50 years ago; cut to today's world, companies are selling tickets to low-orbit commercial flights and dreaming of colonizing Mars. Even though most of today's space economy includes satellite and R&D activities, sectors such as space tourism, space mining, and logistics are gaining importance by the day. We could never know what the future holds, but it seems that investing in space industry will be a rising trend in the upcoming years as it is expected to generate an overall revenue of more than USD 1 trillion globally by 2040 according to Morgan Stanley.¹ Moreover, it is estimated by UBS that in a decade, high speed travel via outer space will represent an annual market of at least \$20 billion and compete with long-distance airline flights. UBS also predicts that long haul airplane flights that are more than 10 hours in duration will even "be cannibalized" by point-to-point flights on rockets.²

Now, since space economy is still at a relatively early stage, revenue growth remains restricted for now. This means that most of these revenues generated so far were taxed by the relevant states in the relevant jurisdictions. However, we wanted to dive deeper into discovering what might be awaiting us in the future when businesses actually start generating revenues in the space. This article contains insight and evaluation on what might be the implications of rising privatization in space and what it would mean for individuals and businesses. After all, considering how our world and what we call "normal" is changing, faster than ever these days, it might not be long before we find ourselves in a spaceship traveling to Mars to unwind from work.

The future is already here, it is just not evenly distributed yet.

William Gibson

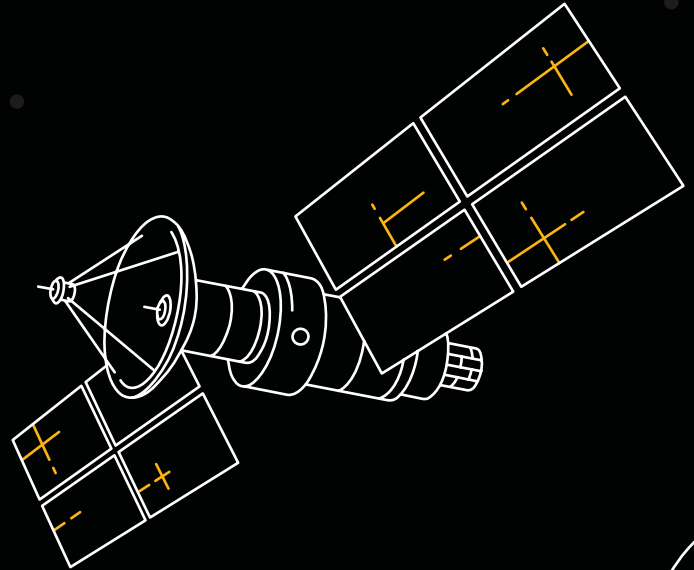
¹ morganstanley.com

² cnbc.com

What is Space Industry and What are Some Emerging Trends in the Industry?

PwC defines the space industry as the industry that includes all public and private entities involved in the development, manufacturing, operation and exploitation of space systems and related infrastructure, from innovative research activities to the supply of products and services to end-users. Space industry, especially due to the rise of the concept of “**New Space**” has been growing exponentially in the past years. PwC estimates that the overall market value of the industry reached USD 371 billion in 2020. While a big portion of this value (USD 226 billion) is attributed to downstream **space activities** which includes consumer equipment and space services, the next biggest share belongs to institutional budgets related to research and development, space exploration and military.³

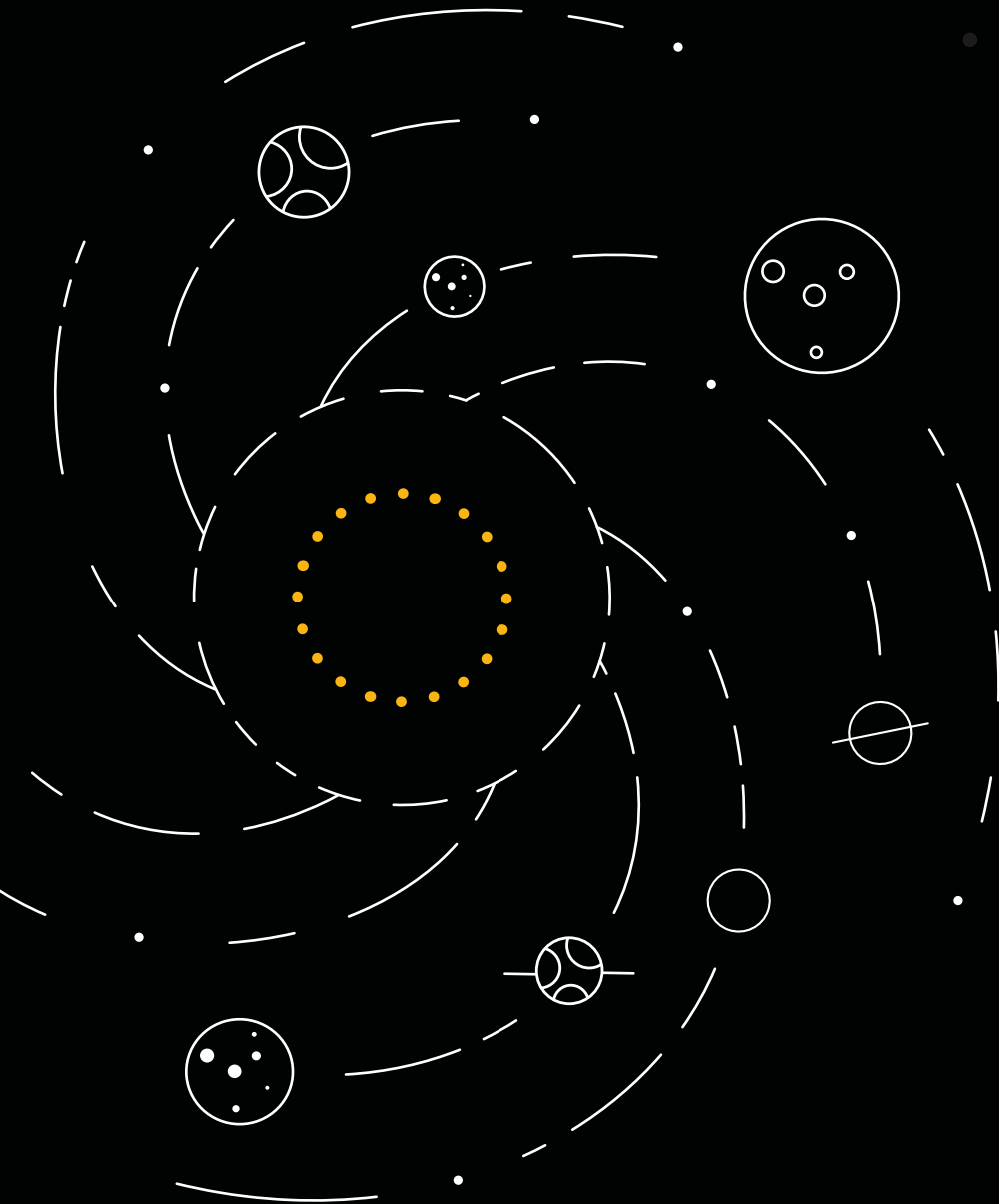
The space industry consists of several sub-areas such as satellite communication, Earth observation, navigation, launchers, exploration and more.



³ PwC France, Main Trends and Challenges in the Space Sector, 2nd Edition, December 2020

I don't think the human race will survive the next 1,000 years, unless we spread into space. There are too many accidents that can befall life on a single planet. But I'm an optimist. We will reach out to the stars.

Stephen Hawking





Earth Observation

Earth observation (EO) is a growing sector with many applications across different sectors from precision farming, civil protection, insurance, natural resource monitoring, oil and gas exploration and meteorology. The value of the market was estimated as USD 5.3 billion in 2020 and average annual growth rate of EO value-added services was 15% over the course of 2014-2019.

The dynamics of the EO market has been changing recently. For example, we see that many players in the EO market have started to switch to vertically integrated business models in order to take advantage of synergies arising from economies of scale. Plus, there is a rising awareness in the sector for EO based products and services. Combined with this, there is a downward pressure on prices thanks to the increased demand and supply side shifts.⁴



Satellite Communication Industry

Satellites are used in fields such as streaming, communication, navigation, weather forecast, safety, climate and environment monitoring and many more. The satellite industry is the most lucrative domain of the space sector and it is at the heart of proper functioning of our everyday personal, financial and social lives. The estimated value of the global market for satcom services was USD 153 billion in 2020 and as of November 2019, there are more than 900 satellites in orbit sent by SpaceX and OneWeb.

The competition in the sector is fierce as players such as SpaceX, OneWeb, Amazon and Telestat are expected to launch thousands of more satellites in the future.

It is also noteworthy that the satcom domain is moving away from traditional Geostationary Orbit (GEO) Large satellite constellations towards Low-Earth Orbit (LEO) small satellites constellations. This shift is eventually resulting in lower CAPEX and thus enables an increased number of satellites to be launched. However, the growth of the industry is not only defined by the increased number of satellites in space. There is demand from new market segments including mobility, IoT and M2M and this is transforming the satcom domain. On the supply side, one of the rising trends appears to be distribution partnerships. This changes the way businesses deliver their outcomes as distributor partnerships require operators in the sector to partner up with local distributors in order to gain access to niche regional markets and increase sales in developing markets.⁵



Access to Space & Space Exploration

Access to space is a concept that binds together all sub-sectors of the space industry since the absence of access renders trivial all efforts of the humankind towards becoming a space-faring race. The R&D behind launchers start at the design of the launch system and finally includes launch operations such as management, monitoring and the launch mission itself. The launch market is segmented into institutional services which include the use of local vehicles for local institutional players and the commercial segment which is currently a duopoly between SpaceX and Ariespace.

Having the technology to carry out independent launches has the utmost importance both for private companies and governments all around the world because it is the key to becoming independent in the space race. Launchers appear as strategic assets for spacefaring nations and the dynamic nature of the sector requires all private and institutional players to constantly adopt to the local and international practices. PwC argues that despite being subsidized by governments due to its strategic importance, the launch sector is expected to face stable or declining government financing for flagship space programs in the future. As a consequence, launch companies will have to evolve accordingly and will have to examine new markets.

⁴ PwC France, Main Trends and Challenges in the Space Sector, 2nd Edition, December 2020

⁵ PwC France, Main Trends and Challenges in the Space Sector, 2nd Edition, December 2020

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- Even though not many nations have independent access to space, increasing number of private companies in the sector are spicing up the competition and pushing players to reduce development, manufacturing and operating costs. Companies are increasingly opting for micro launcher systems or modular launch systems that can be reused and this in return creates the need of developing spaceports to host operations for such vehicles.⁶



Space Tourism

Enhanced operations of access to space means space tourism will also emerge as a developing sub-sector. Space tourism is a niche segment of the aviation industry that seeks to give tourists the ability to become astronauts and experience space travel for recreational, leisure, or business purposes.⁷ There are different kinds of space travel such as high altitude jet fighter flights, atmospheric zero-gravity flights, short-duration suborbital flights, and longer duration orbital trips into space. Companies like Blue Origin, SpaceX and Virgin Galactic are expected to be among the top players in the industry. NSR's Space Tourism and Travel Markets report forecasts suborbital and orbital tourist services beginning in 2020 and 2021, respectively, generating USD 14 billion in cumulative revenues by 2028.⁸

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Space Mining

Lastly, space mining appears as one of the other sectors with high economic potential that will co-develop with the space exploration practices. It refers to the exploitation of raw materials from asteroids and other minor planets, including near-Earth objects. It has great economic potential because metals such as iron and nickel, and rare metals like platinum, gold, iridium, palladium, osmium, ruthenium and rhodium can be found in asteroids at a concentration level several times higher than what is found on Earth.⁹ The global market value of the asteroid mining industry reached 712 million U.S. dollars in 2017. This figure is forecasted to increase by 2025 to some 3.87 billion U.S. dollars.¹⁰ The success of space mining will also be the potential big leap for electronics in Earth especially in manufacturing of processors, energy cells and ultimately the ambition of quantum computers.

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When the United States Senate passed the US Commercial Space Launch Competitiveness Act (Space Act) in 2015, it did not only grant U.S. companies time until 2023 without any concrete regulatory oversight over the industry, but it also gave them the right to “possess, own, transport, use, and sell” the resources they mined in space. This was especially good news for asteroid mining companies like Planetary Resources and Deep Space Industries. Some even argue that the Act marked the beginning of a golden era in privatization of space industry as “it allows the industry to grow, to test, and to develop without this overshadow of the regulatory hammer coming down on them,” said Eric Stallmer, president of the Commercial Spaceflight Federation.¹¹ However, there are some like Fabio Tronchetti, a lawyer at the Harbin Institute of Technology in China,¹² who argue that the Space Act of 2015 would violate the Outer Space Treaty as it prohibits states from asserting propriety rights over celestial bodies. The legal and economic implications of the Act are debatable on an international scale and they might become a heated topic in the future as more and more companies and states venture into the space business.

⁶ PwC France, Main Trends and Challenges in the Space Sector, 2nd Edition, December 2020

⁷ sciencedirect.com

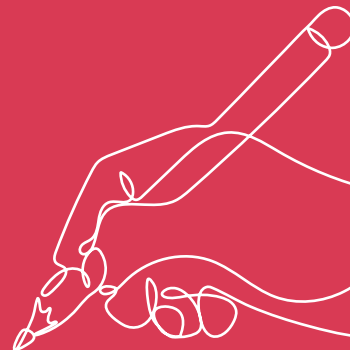
⁸ nsr.com

⁹ manufacturing.net

¹⁰ statista.com

¹¹ theverge.com

¹² popsci.com



Rising Privatization in Space Economy

Even though current regulatory environment started favoring privatization of space activities, origins of the first concrete efforts of humankind towards space exploration dates back to October 4, 1957 when the Soviet Union first launched its Sputnik 1 satellite into the space. As many may know, first space missions were completely funded by the government, but a lot has changed before some were able to run space-mining or space tourism companies like SpaceX, Virgin Galactic, Deep Space Industries and many more. Indeed, PwC estimates that the space activities conducted by commercial players in the field of space exploration focused mainly on sustainable long-staying, space transportation and infrastructure development.¹³ During the course of accomplishing such high-profile tasks and while shifting from exploration to commercialization of space, the industry started to emerge as a field where privatization started to prevail as a predominant force behind the development of many commercial, scientific and even military activities.

One of the biggest reasons behind increasing privatization of space industries appears as the consistent policy pursued by governments over decades towards outsourcing space services from private companies which eventually helped such enterprises gain the relevant know-how, insight and technological expertise to develop space systems independently.¹⁴ The high cost of building space infrastructure and the hardships encountered in executing space operations has further alienated the governments from the industry.

In fact, the 2004 Report of the President's Commission on Implementation of U.S. Space Exploration Policy (Recommendation 3-1), states that **“the Commission recommends NASA recognize and implement a far larger presence of private industry in space operations with the specific goal of allowing private industry to assume the primary role of providing services to NASA, and most immediately in accessing Low-Earth Orbit. In NASA decisions, the preferred choice for operational activities must be completely awarded contracts with private sector and non-profit organizations and that NASA's role must be limited to only those areas where there is irrefutable demonstration that only government can perform the proposed activity.”** He also points out that NASA's role in U.S. GDP declined over the years as it garnered more than 0.7 percent of GDP in the mid-1960s, but that level fell precipitously in the late 1960s and then gradually but persistently over the next 40 years to around 0.1 percent of GDP today.¹⁵

The decline of NASA's share in U.S. GDP is only one indicator of rise of privatization in space economies, though an important one. Other leading countries in the sector such as India and China are also marching towards a more privately dominated space economy. In fact, India announced in June 2020 the establishment of Indian National Space Promotion and Authorisation Centre (IN-SPACe) which is expected to facilitate the relations between Indian Space Research Organisation (ISRO) and private sector companies. The centre will evaluate demands of private sector companies — including educational institutes — and will find ways to attune their demands, in consultation with ISRO.¹⁶



Earth is a small town with many neighborhoods in a very big universe.

Ron Garan

¹³ PwC France—Main trends and challenges in the space sector, pg 22

¹⁴ ESPI, Commercialization of Space and Its Evolution. 2007. Pg 8.

¹⁵ Journal of Economic Perspectives. Space, The Final Frontier by Matthew Weinzerl. 2018. Pg. 173-174

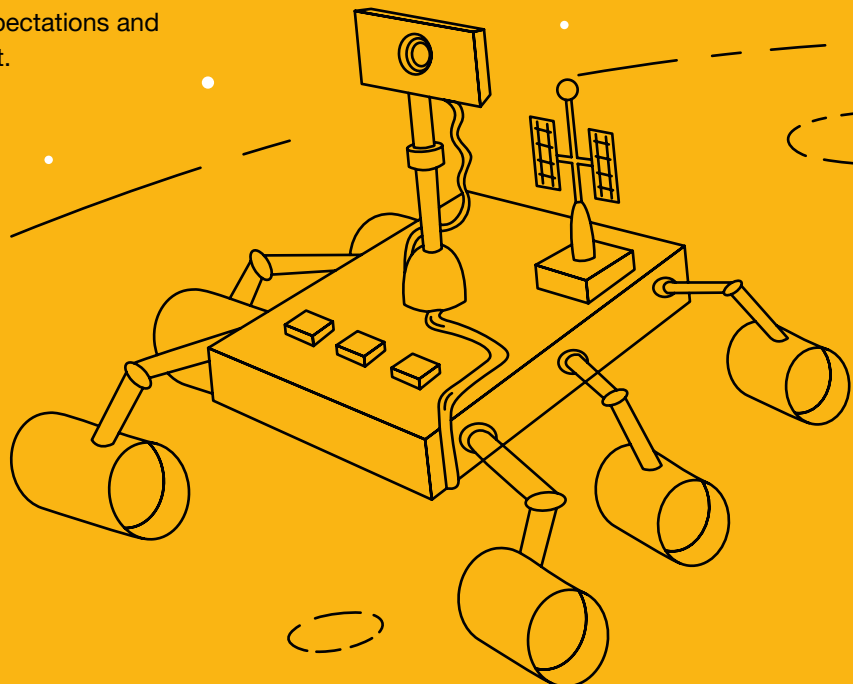
¹⁶ indianexpress.com

Moreover, in China the investment in commercial space sector was around \$600 million to \$900 million in the years 2014–18, with the bulk of that coming in the last two years, according to the U.S. government-funded IDA Science and Technology Policy Institute. Besides funds steered by local-level governments, IDA found that most of investment in the sector came from private venture-capital funds and from individuals.¹⁷

This also demonstrates that, start-ups are emerging as pioneers of privatization in space. The industry is even going beyond being dominated by giants such as Space X, Blue Origins, Virgin Galactic and Planetary Resources and “space unicorns” are starting to attract huge amounts of capital inflow. It is stated in a recent Morgan Stanley article that hundreds of startups have formed in the past several years to explore opportunities in space infrastructure—satellite manufacturing, launch capabilities, IT hardware—and adjacent areas, such as space tourism, satellite broadband, media and even asteroid mining.¹⁸ Furthermore, start-up space ventures attracted \$5.7 billion in financing of all types during 2019, shattering the \$3.5 billion record set the previous year. This was largely driven by investors continuing to pour large amounts of capital into a handful of the industry’s largest companies and 71% of funding received by start-ups came from venture capitals,¹⁹ demonstrating the positive expectations and trust towards this newly emerging market.



While this article is being finalized, Turkish government has announced a detailed space campaign with the ambition of building up its national space industry. The program includes moon landing (capsule only), national launching stations, space observatory, new satellite launches and even sending a personnel to space. Our article was finalized when the program was announced and therefore no detailed analysis has been included in this paper. The second edition of this work will include more insight on the local space program of Turkey in the context of economy and taxation areas.



¹⁷ marketwatch.com

¹⁸ morganstanley.com

¹⁹ Bryce Space and Technology- Start Up Space. Update On Investment in Commercial Space Ventures.

Okay...so now what happens?

Putting aside the numerical outlook of the industry, it seems that this promising economic potential and the vast amount of capital inflow for privately held companies is also likely to facilitate relatively fast technological developments in space. Such developments are likely to cause certain positive spillover effects to emerge in space economy such as the contribution to the global GDP and employment level, R&D advancements, increase in access to internet and even discovering potential natural resources such as water, thanks to Space Resource Utilization activities.

However, on the flip-side of the coin, there are also certain negative spillovers that humanity will be struggling with in the near future. Space debris, for example is one of the most serious negative consequences of increased space activities and it refers to man-made objects in space that have lost their functionality. Especially the rising trend of small satellite constellations in EO and Satellite Communication sectors creates a greater risk of sustainability of the space environment and emphasizes the need for wider implementation of Space Traffic Management applications to reduce the debris problem. Space Resource Utilization, on the other hand, may cause problems with property rights, property rights and determining safe zones for SRU activities to be carried out and therefore it requires the establishment of internationally accepted regulations and procedures.²⁰ Possible violations of privacy due to advanced satellite technology and costs associated with possible market failures due to misallocation of common goods also pose a threat against proper development of the legal, economic and social growth of the industry.

It turns out that space economy demonstrates market failures similar to those we see on typical planet Earth economies. The inherent high-barriers to entry to the industry mean that profits will likely be concentrated in the hands of a few and lack of standardization in outputs of space economy might imply higher switching costs for consumers.²¹ Of the companies with a bigger slice of the cake, one might even arise as a monopoly which would hinder competition and increase the price of goods and services provided.

In an increasingly privatized environment with such fallouts, it becomes almost inevitable to speculate on the role of the governments in fixing these potential market failures. Is a policy change in property rights and labor market regulations necessary? Should governments be subsidizing the space commerce to lower costs and barriers to entry to balance out the negative externalities arising from lack of competition? Should pollution permits be available to avert space debris problem? In the light of these questions, we can consider the example of asteroid mining from Weinzerl to better understand how space economies cause a conflict with regards to public interest and why the above questions need answers. Weinzerl mentions that the heart of the economic issue is who has the right to mine and profit from the resources to be found in asteroids.

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In order for us to have a future that's exciting and inspiring, it has to be one where we're a space-bearing civilization.

Elon Musk

²⁰ PwC France, Main Trends and Challenges in the Space Sector, 2nd Edition, December 2020

²¹ oxera.com

He also asks “if commercial interest in asteroids conflicts with the public’s interest in them for scientific exploration or space settlement—for example, because mining destroys material of interest to scientists while extracting material that is useful to settlers—how are such conflicts to be sorted out?”²²

What the asteroid mining example above demonstrates is that the baseline of the conflicts created by space economy comes from the fact that space, as a common resource that belongs to all humankind, has only been exploited so far by an exclusive minority. It would, of course, not be feasible to expect the otherwise due to the inherently high need in the industry for advanced technology and large amounts of capital. However, the restricted nature of space-related material and non-material profits creates a non-negligible social and even ethical dilemma with regards to how the harvested benefits from this common resource should be allocated. As long as this dilemma is not adequately addressed, it does not only pose a risk in terms of achieving a proper regulatory environment in the industry but also creates a “flag of convenience” problem according to PwC, just like in maritime law, where one country is favored over the others for regulatory reasons, which could create potential safety hazards for passengers, other spacecraft and the environment.²³

Considering the large-scale impact of the issue, it becomes important to see that where private sector falls short in providing what is needed by all, government intervention becomes a vital element and an international approach is crucial for a resolution. Even though there may be various ways of regulating the commercial activities in space through means such as incentives, law enforcement or price controls,

this article evaluates taxation as a tool of addressing the market failures in space economy and problems that might arise in this respect. Taxation has always been a means by which companies and individuals contribute to the governance and functioning of societies and the current situation shows that it raised over the years as an integral part of a just regulatory system for space economies that could address the aforementioned dilemma. However, **if private space activities will be taxed, then we need to justify by whom, how much and on what basis.**



²² Journal of Economic Perspectives. Space, The Final Frontier by Matthew Weinzerl. 2018. Pg. 188

²³ PwC France-Main trends and challenges in the space sector, pg 25

Possible Concerns with Space Taxation & Troubleshooting

The first set of issues that arise in terms of taxing private space operations comprise uncertainty over international treaties, reluctance of governments to act and absence of international awareness, collaboration and a legit authority. A brief look at space law reveals that there are currently five main international treaties in space law and each of the treaties stresses the notion that outer space, the activities carried out in outer space and whatever benefits might be accrued from outer space should be devoted to enhancing the well-being of all countries and humankind, with an emphasis on promoting international cooperation.²⁴ Of these treaties, Formed in 1967, at a time when space exploration was just beginning, Outer Space Treaty is still the most commonly acknowledged one with over a hundred signatories. It aimed to set the basics of space law and it imposed that “outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”, that “the Moon and other celestial bodies shall be used exclusively for peaceful purposes;” and “Outer space shall be free for exploration and use by all States”.

The rest of the treaties except Moon Treaty mainly serve to further elaborate on the provisions of Outer Space Treaty, proposing nothing concrete on the regulatory issues we face today. Because despite laying the groundwork in creating the general principles for regulating space activities, neither of the international treaties elaborate on the commercial use of space. This is exactly is where space law fails to answer even the most basic questions that a tax lawyer would need to ask to evaluate if outer space activities can be taxed and how.²⁵

Furthermore, space law is not only bounded by these five international treaties, but it also includes various legal elements. In one of the recent articles of PwC, it is pointed out that states that have enacted national space legislations have taken highly divergent approaches and that some countries only have a national space law, others have several laws or a number of regulations under the law. It is also mentioned that most states have defined their legal/regulatory framework according to the state of national space industry, actual commercial space activities, or national governance.²⁶ Given the diversity of existing national and international framework, another main problem with space related taxation issues appear as lack of international consensus in regulatory framework and most importantly, reluctance of space-advanced nations to step up to the plate to create such consensus. The rivalry between universal and local interests in space sector creates economic and legal conflicts, because too much is economically at stake. The fact that Moon Treaty has only 11 signatories demonstrate the existence of this international reluctance perfectly as it was the only treaty that intended to regulate the issues such as appropriation of resources, ownership, responsible exploitation and national sovereignty.



²⁴ unoosa.org

²⁵ financierworldwide.com

²⁶ PwC France-Main trends and challenges in the space sector, pg 24

Besides, it is also important to realize that, at the time when Outer Space Treaty was created, the level of advancement in space and what humankind was able to accomplish in the next 10 years after the treaty was signed have changed drastically. On top of this, considering that space law was heavily influenced by maritime law²⁷ at the time it was created, a more dynamic approach might be necessary to adjust the regulatory system in accordance with more complex issues of current advancement level of space activities. An efficient system should shed light onto property rights including whether space resources will be apportioned with a first-come-first-serve approach or with an approach that takes into account the gap between countries in terms of space know-how. Labor market regulations need to be addressed including setting a sufficient minimum wage and providing social security for space workers and taxation issues such as how much and where companies/individuals will pay their corporate/ income taxes need to be discussed.

Moreover, logistics issues need to be evaluated, for example problems with transporting the workforce- e.g. if there will be habitats on the moon, who will be doing the housekeeping? We need to create resources in the long run financially and logistically for qualified personnel (e.g. scientists) as well for blue-collar workers. We even need to regulate whether astronauts returning to the Earth really need to go through customs or not, as they do now. Can we find a more efficient way of carrying out “customs declaration” procedures for astronauts instead of preserving our current way of making them declare moon rocks, moon dust and other lunar samples like we did before for Apollo 11 astronauts after they landed on Earth?²⁸

Lastly, another aspect that current regulatory system falls short to conceive -and therefore further reinforces the need to reform the outdated aspects of space law- is defining the boundary between space and Earth. Even if we set aside all the other issues presented above, taxation by nature requires a clear understanding of jurisdiction in terms of boundaries. This especially becomes important in taxing satellite and sub-orbital flight activities, which wasn't such a critical issue before.²⁹ In fact, PwC forecasts that in the coming years, a large volume of satellites below 500 kg will be launched, with a large majority coming from constellations programmes. 80% of the satellite demand will be driven by the commercial market stimulated by the demand from commercial Earth Observation and communications constellations.³⁰ Although space law and airspace law overlap on many issues, they also have many conflicting points including defining where outer space begins and no integrated aerospace law regime has been formed as of today that could shed a light onto the issue of delimitation of space.



²⁷ financierworldwide.com

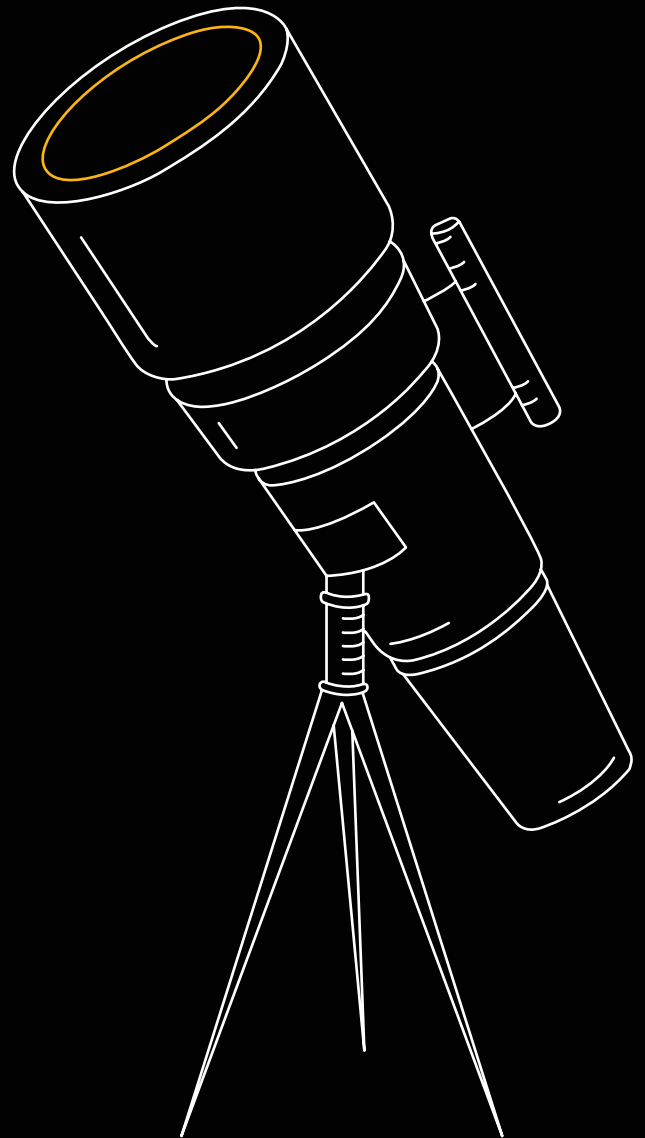
²⁸ space.com

²⁹ financierworldwide.com * by “satellite activities” what we mean here is not the satellites placed in the Geostationary Orbit or Low Earth Orbit, but satellites with much lower altitudes, around the 100-200kms from the Earth's surface.

³⁰ PwC France-Main trends and challenges in the space sector, pg 19

We Say Sky is the Limit - Where Does this Limit Start?

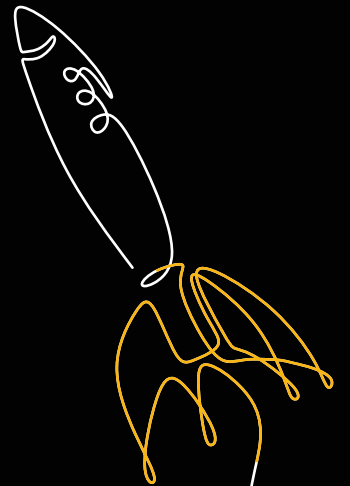
While Air law rules that “states can enjoy complete and exclusive sovereignty over their territorial air space”, space law states “state sovereignty over outer space is prohibited”. Further, while on one hand Article 3 and 6 of Chicago Convention respectively state that “no State aircraft may fly over the territory of another State without its permission” and “no commercial service may be operated over or into the territory of another State without its permission”, Outer Space Treaty Article 2 states “outer space is not subject to national appropriation by claim of sovereignty”. Even though some countries recognized the Kármán line as a boundary of outer space which is estimated to be at an altitude of 100 kms above the sea level, international consensus still lacks on where outer space begins. Especially considering that sub-orbital space tourism vehicles and certain satellite activities* has a corresponding altitude of around 100 kms, how will these activities be taxed without a consensus on where outer space begins and air space ends? This is important because where we set this line will determine whether such space activities will be considered within the “territorial air space” of a state and therefore be subject to taxation within that jurisdiction, or outer space where they are not subject to national claims of any state. Therefore, defining the boundary between space and earth appears as one of the most fundamental issues that needs to be clarified before achieving successful take-off in bringing a solid international legal and economic framework for regulating and taxing space activities.



I know the sky is not the limit because there are footprints on the Moon — and I made some of them!

Buzz Aldrin

In conclusion, the current circumstances show that in regulating space industries, there are a set of intertwined legal and economic uncertainties that needs to be handled before we can come up with an internationally acknowledged tax regime. It appears that the rise of privatization in space will inevitably augment the urgency of addressing market failures in the space economy. Even an established, efficient space marketplace offers no guarantee that the pursuit of private priorities in space will serve the public or respect the public's ethical judgments. But if we fail to exert oversight over the space economy, its legitimacy—and thus its success—will be undermined.³¹ In creating a functional and efficient regulatory framework and an operational taxation system, we need to alleviate the problems arising from conceptual uncertainty as well as those related to lack of international awareness, collaboration and legit authority. Meanwhile, we also need to bear in mind that solutions brought by short-termism intended address to any space-related socioeconomic or legal issues will not be functional and won't yield permanent outcomes that will last in the future. We need to remember that actions we take today will determine the aftermath of space industries which might help humankind become a multi-planetary race and create its next home.



³¹ Journal of Economic Perspectives. Space, The Final Frontier by Matthew Weinzerl. 2018. Pg. 188



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2021-0060