

## Considerations on Fiscal Policy in the Space Economy

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**Abstract:** The development of technology has observed a convergence towards economic activities based on highly sophisticated operations from space. Telecommunications, geolocation, logistics, banking operations among other activities, not to mention military activities, are increasingly having components and processes based on space. This exploratory work is a study on space technology in general, with a focus on the design of fiscal policies suitable for economic development, therefore, we do not focus on space applications for technological or scientific developments. We present the considerations to answer the question of how fiscal policy can make it possible for a country, a state, a region or a city, to enter the space economy as an active actor and to boost its economic development on benefit of the population. We recognize that space science and technology have already been beneficial to humanity with cases such as weather predictions, mapping of the earth's crust, etc. However, many socio-economic operations are currently based on processes that depend on space technology (telecommunications, geolocation among others), so that an appropriate policy will have to be defined to be able to conveniently channel economic development. We make an exhibition of the commercial activities in the space, the main suppliers and the dynamics of consumption of the different services that we identify. Faced with a new and little explored economic environment, our conclusions serve as the basis for future research in this field.

**Key words:** space economy; space industry; fiscal policy; economic development

**JEL codes:** E61, E62, F00, O11

### 1. Introduction

In less than 50 years, human activity in space has been growing rapidly and it now represents an industry in which economic, technical, medical, military, scientific, tourism, etc. sectors increasingly converge, making this activity an attractive field for research, investment, production, etc.

Countries with greater technological development have established ambitious plans for the development and presence of their industries in space and this is how we see that it is easy to identify the nations that launch satellites into space, collaborate in the space station, participate with astronauts and their companies carry out research in space, as well as the development of secret projects in the military field and companies that promote trips to space. The question facing this panorama, is to inquire the role that the other countries that are not participating or have a minimum contribution in the development of the industry in the space will play.

This paper presents the previous problem, raises questions in the field of economic development and the fiscal policy criteria that are suggested to be established, in order to incorporate economies into space

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development and future lines of research are proposed.

We start from a very specific research question: how can fiscal policy help a country, a state, a region or a city, be incorporated into the space economy as an active and non-passive actor, which boosts its economic development on benefit of the population?

## **2. Space Economy**

In the last 20 years, we can appreciate an intense economic activity by several countries in the following areas:

- 1) Rocket Construction
- 2) Rocket launching infrastructure
- 3) Satellites launching
- 4) Ground operating systems
- 5) Monitoring and operation of satellites
- 6) Global positioning systems (GPS)
- 7) Telecommunications
- 8) Surface mapping
- 9) Military operations
- 10) Astronomical observatories
- 11) Component supply
- 12) Universities with specialized degrees
- 13) Development of specialized human capital

All of the above, supported by large budgets, regarding which the following questions arise:

- 1) Where do the resources used come from?
- 2) How and when are these investments planned to be recover?
- 3) How will this activity affect the well-being of the population?

The first question can be answered in part by the military budgets of the countries and the geopolitical dynamics that they follow to achieve control of resources in the world.

The second question is difficult to answer with precision, but it is clear that the long-term scenario will be reduced to the extent that the space industry creates the economic activity necessary to move to traditional markets.

The third question will find an answer in the GDP per capita, Gini index, physical infrastructure and services, economic stability, employment levels, education, etc.

In order to size the activity in space (Pixalytics, 2018), Table 1 presents the satellites operating in space in 2018.

**Table 1 Satellites Operating in Space (2018)**

Satellites	Use
792	Communications
661	Earth observation
213	Technology development
121	Navigation and positioning
76	Space science
23	Earth Science
1886	Total satellites in 2018

*Source:* Own elaboration with Pixalytics data.

Table 2 shows the type of satellite users.

**Table 2 Types of Satellite Users in Orbit (2018)**

Satellites	User of the satellites
826	Commercial
523	Governments
399	Military
138	Civil
1886	Total satellites in 2018 (278 satellites with multiple uses)

Source: Own elaboration with Pixalytics data.

The main countries involved in space activity are listed in Table 3.

**Table 3 Satellites Placed in Orbit by Country (2018)**

Satellites	Countries that have placed and operated them
859	U.S
250	China
146	Russia
72	Japan
55	India
52	United Kingdom
452	Other countries
1886	Total satellites in 2018

Source: Own elaboration with Pixalytics data.

The main economic and commercial activities of all of the above affect the current life of nations in aspects such as:

- 1) Banking and financial systems
- 2) Internet and storage in the “cloud”
- 3) Cellular telephony
- 4) GPS location maps
- 5) Weather forecasts
- 6) News systems
- 7) Maritime and air navigation
- 8) Communicate smart devices
- 9) Drone and robot operation
- 10) Replacement of marine cables

We can visualize the space industry as a value chain integrated by the following phases (Magazine, 2018):

- 1) Manufacture of satellites
- 2) Satellites launching
- 3) Satellite operators
- 4) Manufacture of parts and equipment
- 5) Service Providers

All of the above operated by more than 1000 companies worldwide (Figure 1).

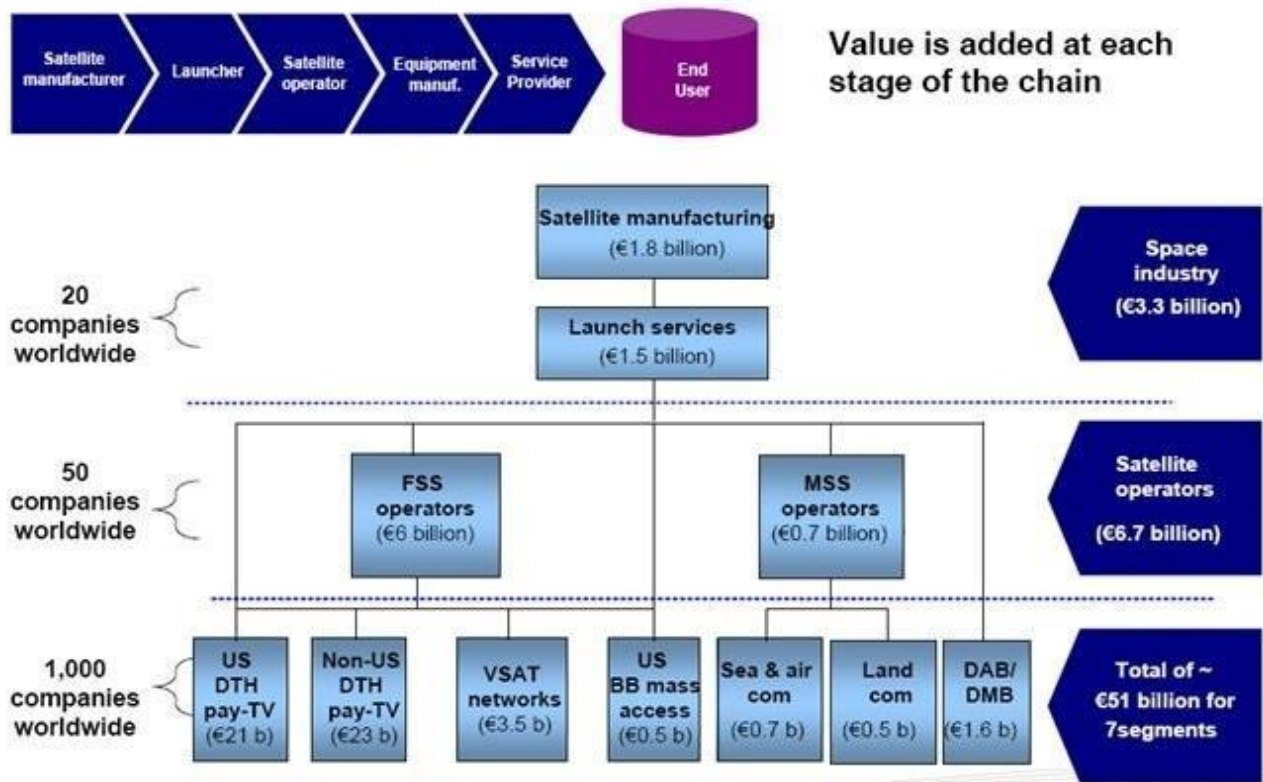


Figure 1 Space Industry

Source: Space Safety Magazine

It is important to state that miniaturization, nanotechnology, robotics, 3D printers and process automation, are making it possible to anticipate the launch of 10 kilogram satellites and the size of a shoe box, which will make it possible to detonate the activity in the space industry and increase competition in this field (News, The low-cost mini satellites bringing mobile to the world, 2018).

As it can be seen in the diagram shown in Table 1, there are clearly three markets in the space economy that are the following:

Table 1 Three Markets in the Space Economy

Sector	Business	Market type	Market segments
Space industry	twenty	Oligopoly	two
Satellite operators	fifty	Oligopoly	two
Service providers	1000	Monopolistic competition	7

From the previous table, it is inferred that the entrance to these markets must be done from the bottom up, that is, starting in some of the service delivery segments and start integrating upwards as a provider and service provider with the large companies in the sector.

The World Economic Forum (Forum, 2018), has integrated a transformation map that intends to represent its vision of different economic phenomena, including the Aerospace Industry (Figure 2) composed by the following components and related information:

Skills of different fields

- Artificial and robotic intelligence
- Employment and skills
- Social innovation
- Education and skills
- Information technology
- Virtual and augmented reality
- The future of mobility

The digital age

- The fourth industrial revolution
- Internet Governance
- Digital economy and society
- The future of mobility
- Cyber security
- Internet of things
- Digital communications

A new era

- Information technology
- Entrepreneurial spirit
- 3D printing
- Space
- The fourth industrial revolution
- Geoeconomics
- Private investors
- Innovation

Air traffic management

- Drones
- Aviation, travel and tourism
- Artificial and robotic intelligence
- International security
- Internet of things

Manufacturing and advanced materials

- Artificial and robotic intelligence
- Innovation
- Information technology
- Advanced materials
- 3D printing
- Chemical and materials industry
- Mining and metals
- The future of mobility

Sustainable production and operation

- Climate change

- Electricity
- Circular economy
- Sustainable development
- Oil and gas

Defense and security

- Biotechnology
- Russian Federation
- The United States
- Space
- International security
- European Union
- China
- Cyber security
- Geoeconomics
- Artificial and robotic intelligence
- Global governance

The above represented in Figure 2, which reflects all the economic activity that space economy entails. It is interesting to appreciate how different activities and fields of knowledge are intertwined in this network and it can be inferred that all of the above has implications for economic development, since intense economic activity is a trigger in the generation of new skills and areas of knowledge, adequate infrastructure, specialized supply, high-logistics production chains, advanced communication systems and a social transformation aimed at guiding society to a new way of visualizing the economic and social environment.

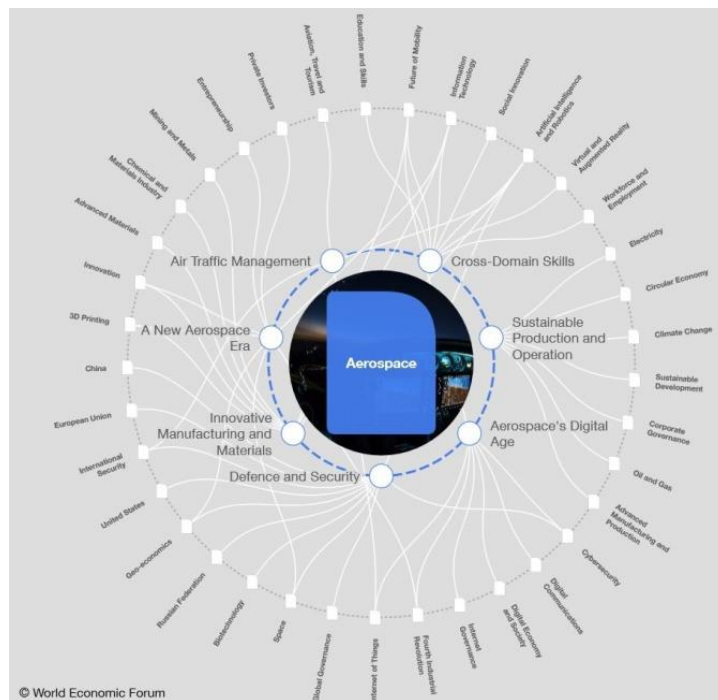


Figure 2 WEF Aerospace Industry

Source: World Economic Forum

### **3. Economic Development**

The improvement in the well-being of the population, aims to be the fundamental purpose of any economy, facilitating the production of goods and services in quantity and quality to meet the needs of the market, providing employment opportunities with better income, which allows physical and intellectual development and creates the necessary conditions so that people have sufficient freedom to choose alternatives that avoid economic and technological dependence (tutor2u, 2018).

Economic development is a broad concept that reflects social and economic progress (Amartya Sen) and refers to creating freedom for people, removing obstacles that prevent this aspect. Greater freedom allows people to choose their destiny. Obstacles to freedom and therefore to development include poverty, lack of economic activities, corruption, poor governance, lack of education and health.

Jeff Finkle, who has been president and CEO of the International Economic Development Council for many years, asserts that “economic development is about creating places where people want to invest, work and live. It's about establishing connections between people, companies, institutions and communities” (Observer, 2018).

Therefore, an economy must plan and organize its activities to achieve economic development and avoid any obstacle for development to be achieved. One of the main obstacles for this purpose is economic and technological dependence, since it reduces the options for progress and in this sense, the technological concentration observed in the development of space activity, clearly limits any economy that does not actively participate in the same.

### **4. Ecological Footprint**

Economic development must respect the environment under a basic premise: we must hand over better living conditions to future generations. In this sense, an ecological concept has been developed that aims to measure the impact of human activity on the environment and is the ecological deficit.

The ecological deficit is determined by subtracting to the ecological footprint, the biocapacity to quantify the capacity of land used by each human being in a society.

The ecological footprint is understood as the total ecologically productive surface, necessary to produce the resources consumed by an average citizen of a given human community, as well as that necessary surface to absorb the waste generated, regardless of the location of these surfaces (Intelligence, 2018). Biocapacity is the biologically productive area (crops, pastures, productive sea or forests) available (Natural, 2018).

In sum, progress in society must observe the utmost respect for the environment and space economy is no exception.

On the other hand, economic development must consider the impact of human activity and the welfare provided by the economy on the environment, maintaining constant monitoring of the ecological footprint, using all possible instruments, including fiscal policy, in a harmonious and sustained growth of society.

### **5. Cultural Heritage**

Cultural heritage is understood as the series of archaeological vestiges, fossil vestiges, architectural vestiges, natural landscape, cultural conditions that are representative of the communities and that make a society distinctive (ILAM, 2018).

To respect the cultural heritage is to respect the memory and effort of those who preceded us, taking care that their legacy can prevail to be appreciated and valued by future generations, in addition to understanding how we reached our present and what conditions and obstacles had to be drawn in order to prepare ourselves better for the future.

Economic development should be conceived as an evolution that incorporates past experiences, new visions and knowledge, respecting the culture of the communities, implementing progress and well-being and taking care of the cultural heritage. This is what is expected of space economy.

In this regard, we must remember that history shows us examples where those societies that failed to integrate their cultural heritage into their economic development, run the risk of a collapse or disintegration (Tainter, 1988).

## 6. Taxation

Every citizen of a country is bound by current legislation to contribute to public spending so that the economy can develop, with the understanding that taxation consists on making contributions required by the State to finance collective needs of public order (Tributos.net, 2018).

For the existence of a constitutional validity of a tax or tribute, the satisfaction of three fundamental requirements is required, first that it is established by law, second that it is proportional and equitable and third that it is destined to the payment of public expenses (Córdova, 2017).

The tribute observes the following elements (eumed.net, 2018):

- 1) The taxable act or fact
- 2) The purpose of the lien
- 3) The subject obligated to pay
- 4) The taxable base
- 5) The tax rate to be applied
- 6) The tax calculation procedure
- 7) The time of the tax payment
- 8) The collection of the tribute

All of the above clearly explain that economic activity and taxation are closely linked and that they feed each other, depending on how they are designed and implemented.

## 7. Fiscal Policy

Fiscal policy is the government action that influences the generation of income and the exercise of public expenditures so that the State can fulfill the functions expected from it.

Fiscal policy is in the hands of the Government of the country, which controls the levels of expenditure and income through instruments such as taxes and public expenditure to maintain a level of stability in the countries (Economipedia, 2018).

Through fiscal policy, governments try to influence the economy of the country, controlling spending and income in different sectors and markets in order to achieve the objectives of macroeconomic policy.

Like any economic activity, the economy in space implies a dynamic of actors (consumers and producers) with economic activities (consumption, production and investment) that must be regulated for a harmonious



development that benefits society as a whole.

That is why the Government activity is fundamental in the development of such an important sector, which invites us to mention the following fiscal considerations:

- 1) No matter how much a country falls behind in its participation in the space economy, it is important to set a long-term plan that states the importance of participating in this economy, the long-term objectives and strategies that are suggested in order to take part in this space as soon as possible.
- 2) Invest in the construction of the necessary infrastructure so the long-term plan drawn up is viable.
- 3) Develop educational plans to prepare sufficient human capital in the areas of knowledge and skills that the new space industry will require.
- 4) Leverage the development of the foregoing, with the least degree of external obligations, since these imply exposure to risks of fluctuations in international markets, encouraging, through fiscal stimuli, the participation of private investment in concrete development projects.
- 5) One aspect that requires special mention is the development of own technology in the country in one or several specialties that make it attractive and competitive, since otherwise the development of economic activities will be characterized by technological dependence that will make it vulnerable to new trends in the space economy.

It is important to point out that all of the above may be possible if and only if, the Government manages to instill and generate positive expectations in the economic environment of the country.

According to the above, if a nation does not actively participate in the space industry and plans its economy to participate actively or partially in it, it will be limited to the consumption of goods and services and the only thing that it can aspire to collect will be the consumption with a value-added tax and will be limited in investment and production with the consequent effects on employment and development, having little chance of being able to influence the development of economic activities. That is, this economy will be limited as explained in the section on economic development.

As an example, we can mention that, actively, some countries are adapting their fiscal policies to boost their activities in technologically advanced sectors such as:

- 1) The United States has created this year (2019) a new branch of its armed forces called “Space Force” that claims to be at the forefront in this area, arguing that space is “a vital national interest” (DW.COM, 2019).
- 2) China developed an economic plan called “Made in China 2025”, allocating strong economic resources to the development of 10 cutting-edge industries in order to position China in a competitive environment in the future (Foreign Policy, 2019).
- 3) Germany launched the “Platform Industry 4.0” initiative, under the auspices of the Federal Ministries of Economics and Research and the competition of the most important business associations, academic and labor of the country in order to advance in 2015 in the scanning industry (Revistacomercio exterior.com, 2019).
- 4) The United States reduced its corporate tax (ISR or income tax) from 35 to 21%, in addition to setting a 10% tax on capital repatriation, in order to make its tax regime competitive and maintain and attract investments.

## **8. From Space to Economic Activity**

In view of the above, it is essential that fiscal policy considers the way in which the economic activity of

countries, regions or cities is incorporated into the space industry (Online, 2018) with a long-term economic vocation in areas such as:

- 1) Satellites or spacecraft launching
- 2) Design, production and maintenance of satellites and space stations
- 3) Provision of new materials, tools and spare parts for the manufacture of spacecrafts
- 4) Communication technology and satellite networks
- 5) Development of solar technology and other energy sources
- 6) Space logistics
- 7) 3D printing
- 8) Biotechnology
- 9) Robotics and drones

Activities driven by fiscal incentives or incentives attract investments that generate production of goods and services, employment and economic activity with a taxation that makes long-term economic development viable.

With the advent of the fourth industrial revolution (News, What is the fourth industrial revolution (and why should we worry, 2018), cutting-edge technology development and the operation of global telecommunications networks, the space industry will set the tone for the economic development and those actors that are not proactive, will observe a marginalization in the dynamics of operations and an atony that will make many economies unfeasible. The transformation process will only benefit those who are able to innovate and adapt.

## 9. Conclusions

In order to fulfill its economic function, a State must implement a tax system that allows it to have sufficient resources and thus exercise the public expenditure necessary to create and develop economic activity.

In this sense, a State must plan and anticipate technological, political, social and economic trends to be able to guide efforts, attract investments, create employment and achieve the well-being of the population.

The economy of space is developing based on the convergence of many technologies (nanotechnology, biotechnology, robotics, 3D printing, drones, GPS, aeronautics, etc.) and it is necessary for nations to detect, select and develop the necessary actions to be incorporated to the economy of space.

Space economy implies progress and evolution taking care that its implementation is not detrimental to the environment and the cultural heritage of nations. Not doing so can have negative consequences on the social order of human society.

It is necessary to plan the fiscal policy to establish the programs to attract investments, development of human capital, own technology and infrastructure that is required to promote employment and economic activity.

Fiscal policy must boost growth to achieve economic development but taking care of preserving the environment and cultural heritage.

It is advisable to monitor the activity that takes place in the space to identify the actors, technologies, uses and trends in this environment, in order to anticipate the probable participation based on a defined long-term economic vocation.

Although space economy is a recent development, its influence and participation in societies is increasingly significant and tends to grow exponentially in terms of value and dynamism.

All nations will try to participate in space economy, but not all of them will be able to count on the resources,

technology and, above all, with the vision to position themselves as relevant actors, being able to foresee active countries with significant influence and another group of nations (most of them unfortunately) with characteristics of technological dependence and backwardness.

The United Nations Organization through UNOOSA mentions that the benefits of human activity in space will be reflected in fields such as: agriculture, global health, environment, sustainable development, disaster management, education, human settlements, research and development, transport, communication, humanitarian assistance and international peace and security (UNOOSA, 2018) which reflects the importance of this sector for the economic development of the countries.

Economic development, which refers to increasing the welfare of the population, can be supported by the economy of space and it is convenient for nations, regions and/or cities to plan how they can join this activity.

## References

- Córdova P. (2017). *Employment Allowance: Worker's Right*, Mexico City: Mexican Institute of Public Accountants.
- DW.COM (2019). "Trump signs the directive to create the United States Space Force", available online at: <https://www.dw.com/es/trump-signature-directive-to-create-the-space-force-of-united-states/a-47594443>.
- Economipedia (2018). Available online at: <http://economipedia.com/definiciones/politica-fiscal.html>.
- Eumed.net (2018). "Essential elements of the tribute in the LISR", available online at: <http://www.eumed.net/tesis-doctorales/2013/jmoa/impuesto-renta-elements.html>.
- Forum W. E. (2018). "Industry Aerospace", available online at: <https://toplink.weforum.org/knowledge/insight/a1Gb0000001kpfOEAQ/explore/summary>.
- Ilam F. (2018). "Cultural heritage — Natural", available online at: <https://ilam.org/index.php/es/patrimonio-cultural-natural/248-cultural-natural-sites>.
- Intelligence E. (2018). "What is the ecological footprint?", available online at: <https://www.ecointeligencia.com/2011/03/que-es-la-huella-ecologica>.
- Magazine S. S. (2018). "Space economy", Space Value Chain: A Breakdown: available online at: <http://www.spacesafetymagazine.com/space-on-earth/space-economy>.
- Naturales S. D. (2018). "What is the ecological footprint", available online at: <https://www.gob.mx/semarnat/articulos/que-es-la-huella-ecologica?Idiom=es>.
- News B. (2018). "What is the fourth industrial revolution and why should we worry", available online at: <https://www.bbc.com/mundo/noticias-37631834>.
- News B. (2018). "The low-cost mini satellites bringing mobile to the world", available online at: <https://www.bbc.com/news/business-43090226>.
- Observer T. P. (2018). "Economic development explained: What it means and why it matters", available online at: <https://placebrandobserver.com/what-is-economic-development>.
- Online T. S. (2018). "Global space activities status boards", available online at: <https://www.thespacereport.org/resources/economy/commercial-infrastructure-support-industries>.
- Pixalytics (2018). "How many satellites are orbiting the Earth in 2018?", *Pixalytics*, available online at: <https://www.pandaxalytics.com/sats-orbiting-the-earth-2018>.
- Foreign Policy (2019). "Made in China 2025", available online at: <https://www.politicaexterior.com/articulos/politica-exterior/made-in-china-2025>.
- Revistacomercioexterior.com. (2019). "Industry 4.0 and factory of the future Aleman", available online at: <https://www.revistacomercioexterior.com/articulo.php?id=407&t=industria-40-and-the-factory-of-the-future-German>.
- Tainter J. (1988). *The Collapse of Complex Societies*, Cambridge University Press.
- Tributos.net (2018). "Taxation, what is it? Why should we pay taxes?", available online at: <https://www.tributos.net/tributacion-337>.
- Tutor2u. (2018). "Economic development", available online at: <https://www.tutor2u.net/economics/reference/economic-development>.
- UNOOSA (2018). "United nations office for outer space affairs", *Benefits of Space for Humankind*, available online at: <http://www.unoosa.org/oosa/en/benefits-of-space/benefits.html>.