

INVESTMENT IN THE SPACE INDUSTRY: A COMPARATIVE ANALYSIS OF UKRAINE AND THE EU

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Abstract. The identity and institutional capabilities of the European Union (EU) have changed over the years. As a global player in international politics, the EU has recognized the need to develop a comprehensive space policy perspective. This perspective is shaped by changes in the dynamics of the space ecosystem, the "New Space", and this phenomenon consists of new business models, new technologies, new markets, new value chains and new actors. New space actors (private investors) have fundamentally changed the dynamics of space activities. The *subject* of the research is the peculiarities of the influence of investment processes of the EU and Ukraine on the development of space industries. The *methodological basis* consisted of general scientific and special methods of knowledge, based on a systematic approach to the consideration of economic processes. The article aims to examine investment in the context of space management in the EU and Ukraine, and to examine in detail the trends in such funding of space companies. In order to better understand the European space system. The article concludes that, recognizing the indisputable importance of space applications and safety of space systems, the EU attaches great importance to taking into account the trend of "New Space" in its governance structure and stimulating changes in this sector. Unfortunately, Ukraine lags far behind in this respect. In the EU, in the initial stages of space research and use, space programs are financed from the general budget, and as individual activities reach a level of profitability, their public funding is reduced. Therefore, the sphere of commercial space activities and the share of private investments in their total financing are rapidly growing. The reduction of state expenditures is compensated by investments of private business in commercial projects. Thus, the article emphasizes the particular importance of private investments in the development of the Ukrainian space industry and points to the need to develop the commercialization of space activities, especially given the potential in the absence of budget financing. It is impossible to compare the sufficiently powerful and effective investment system of the EU and the lack of even state financing of the space industry in Ukraine. Against the backdrop of hostilities in Ukraine, there is a significant need to reconsider investments in this area on the basis of public-private and international partnerships. *Conclusion.* The main tasks for Ukraine are revision and change of the state policy, right accents on investments into the space industry, qualitative overcoming of bureaucratic obstacles, approval of a new Strategy of Space Industry Development. As an example, one could use the experience of the EU and refer to its previous experience in this sphere to have an opportunity to stay among the world space powers.

Key words: investment, space industry, financing, commercialization of space activities, public-private and international partnerships, Ukraine-EU.

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1. Introduction

Space has always been a source of inspiration for explorers and scientists. From physics to chemistry, from materials science to engineering, the pursuit of space has created revolutionary technologies and greatly expanded humanity's scientific knowledge. It has also greatly improved people's daily lives – according to the European Space Agency (ESA), every euro spent in this sector brings six euros to society.

Until recently, space was synonymous with government spending: the huge costs and risks made the sector inaccessible to private players. However, huge technological advances and a new entrepreneurial spirit are rapidly shaping the new space economy. This industry, according to Elon Musk's experience in the United States, requires the emergence of new private players who create effective commercial opportunities in space exploration through advanced technology and the data revolution.

Attracting private capital into space activities increases the investment attractiveness of the industry. The development of commercial space through startups and space companies is one of the most notable trends in space. Influenced by early initiatives related to space tourism, access to space, and the growing use of small satellites, space activities are attracting new entrepreneurs, both startups and large network players with significant investment potential. However, investing in the space industry is still a pressing issue for countries around the world today.

2. Analysis of recent research and publications

Many articles consider the "New Space" in a particular area of space activities (Earth observations, launchers, etc.). O. V. Anisenko and D. O. Babina point out that it is more profitable to attract funds from investors and partner countries who themselves use the achievements of space development and are interested in their implementation (Anisenko et al., 2018).

They argue that the implementation of promising large-scale space projects depends directly on the participation of private aerospace companies and corporations.

The unrealistic funding provided in the space programs in Ukraine was, as noted in a study by G. V. Dmitrenko (Dmitrenko, 2010).

The mechanism of stimulating investment activity of 'Space Industry enterprises' through the attraction of financial assets under state guarantees is proposed by A. B. Ogurtsov, O. V. Polishchuk (Ogurtsov et al., 2014).

In the Space Industry, important aspects are the corporatization of enterprises in this area, which will help attract private capital (Bukhun, 2015).

The monographic study by S. P. Koshova analyzes statistical data for the period of 2011–2021

of investments of developed countries in the space industry, according to which the conclusion about the stable high level of investment activity in space and the predominance of private investments in finance is made (Koshova et al., 2021).

An assessment, of the current state, of financing for the, development, of the Space Industry in Ukraine was made by Yu. V. Bukhun (Bukhun, 2013).

However, one of the problems researchers face is the scattering of data on the launch capacity of individual countries, as well as the lack of a unified statistics and methodology of private investment in the space industry.

3. Methodology

The aim of the article is to compare the investment processes of the EU and Ukraine in the space industry. During the study the theoretical and methodological basis was made by general scientific and special methods of knowledge, based on a systematic approach to the consideration of economic processes. To solve these problems we used the following methods: methods of analysis and synthesis – to study the economic essence of the space industry; system approach – to determine the methodological foundations for the formation of the enterprise management system; general methods of analysis and others. In addition, a set of additional methods of scientific research of economic processes and phenomena using statistical and analytical materials, as well as the results of their own research.

4. Investing in the space industry: advantages and disadvantages

Investing in space is no different than investing in other industries, and now that space activities have expanded, there are many space companies open for investment. Space activities should not be seen as isolated from the global ecosystem by other solutions (such as terrestrial communications). The so-called "New Space" covers five main components:

- 1) market and customers;
- 2) space Industry, including major enterprises and supply chain, and start-ups;
- 3) service operators;
- 4) sources of funding, five (5) countries, defense agencies, and International organizations (ITU, IADC).

Investments in a complex field, which the space industry is, as in any other business, are associated with relatively high risk. Since the space business is new, and investors are interested in investing in companies that have been on the market for ten years, there are few issuers.

There are no companies in the space sector that are considered "Blue Chips"; small volumes of securities

trading, the latter are not hedging assets and such high-risk investments; low investor awareness of the activities of space companies. Investors come to the industry following the exploits of famous people such as Elon Musk, Richard Branson and others.

With the exception of the space communications market, space activities are usually associated with government customers or government activities with long-term projects. The basic assumption of New Space is that there is untapped potential for commercial space activity (To Infinity and Beyond, 2018).

The so-called "democratization of space" implies that commercial interests play a leading role, or at least that the resources of governments and commercial enterprises must be combined to improve efficiency. The main driving forces behind the new appetite for space activities are new needs: Global Communications, Digital Transformation of Society, and so on.

Other markets, including ISRU (In Situ Resource Utilization), are brand new with long term return on investment and high uncertainty about market size and availability.

In contrast to the Cold War space race and the not-so-distant stage of increased commercial competition in space, venture-backed startups are emerging, activating a new wave of affordable space products and services.

A relatively new phenomenon is the growing entrepreneurship in space, also called New Space. More and more start-ups, backed by private venture capital funds, are developing very small satellites or groups of small satellites for operational missions. The big players in the web industry are increasingly interested in space and can invest enough money either directly or through new companies.

When it comes to launch vehicles, the new space trend is to make access to space more affordable. Elon Musk of Space X and the success of his

Falcon 9 with several first stages certainly is a major symbol of the entrepreneurial space.

The most significant change is the growing role of private investors and venture capital in the space industry. New space investors have different profiles, and the investment objectives are very different if they are created by business angels, venture capitalists, large industrial groups (corporate ventures), young Internet billionaires or space enthusiasts.

Business angels are more likely to support a startup's space activities over the medium to long term, while venture capitalists are looking for quick financial returns (e.g., exit opportunities).

Investors in the space industry are usually venture capital funds as the largest group, followed by business angels. Table 1 shows the main forms of interaction between investors and startups in the space industry.

In practice, investments in space startups are also realized through private companies and corporations (stock purchases, full buyouts, takeovers), crowdfunding and altruistic activities, and IPO public offerings.

The general difficulty in finding investors for such a specialized field as space entrepreneurship is exacerbated by the underdeveloped mechanisms of the Ukrainian financial market compared to the EU.

5. Peculiarities of investment in space in the EU

New Space is primarily a U.S. trend, since it was there that space activities, the propensity to innovate and invest in innovative projects, and the culture of risk began to play an important role in public policy. Even if the development of New Space and startups started later and remains relatively low compared to what happened in the U.S., the New Space phenomenon now affects other countries involved in space.

Table 1

Categories of investors in the space industry

Types of investors	Characteristics	Range of investments in space activities	Form of investment
Investor Angel (Business Angel)	Research or accredited investors investing in young growth companies	50,000 – 1 million dollars	Equity
Venture company	The company is an intermediary that raises capital at the expense of investors by investing in high-risk projects	2 – 75 million dollars	Preferred tranche shares
Private investment company (investment fund)	A private organization whose main task is to form a pool (fund) of material, financial and intellectual resources for their further investment in assets that can bring profit by increasing their value	100 million – 1 billion dollars	Equity
Corporations	Corporations that use CAPEX both to implement new projects and to invest in existing ones	100 million – 1 billion dollars	Equity
Banks	Private and public banks providing debt financing in excess of equity	100 million – 1 billion dollars	Debt converts into shares
Capital markets	Raising capital through Initial Public Offering (IPO)	100 million – 1 billion dollars	Equity

Source: compiled according to (Start-Up Space, 2019)

The European Space Agency (ESA) was historically established in Europe to develop and manage space science programs. The emergence of new industrial competition in the United States prompted ESA member states to reorganize the European landscape, placing more responsibility on industry (which led to the creation of the Ariane Group). The European Union (EU) also has an ambitious space policy.

Focusing on space applications, the EU now has two main systems, namely Galileo, the European navigation program, and Copernicus, a group of optical and radar satellites designed to provide information for environmental monitoring. Initially, EU space programs were aimed at supporting public policy, but now they are aimed at economic development and the private sector.

There are several innovation financing schemes in the EU, which include special tools or elements of financing for the space sector. The initiators of the funding schemes are public institutions and their institutes. Through its executive bodies, the European Commission manages the EU Framework Program for Research and Innovation (Horizon 2020) and the Competitiveness of Enterprises and Small and Medium-Sized Enterprises (COSME) program, and oversees the implementation of the European Structural and Investment Funds (ESIF) through national and regional authorities across Europe.

The European Investment Bank (EIB) Group consists of the EIB itself and the European Investment Fund (EIF). Among other things, the EIB Group implements the European Strategic Investment Fund (ESFI), which is the basis of the investment plan for Europe and a joint initiative of the European Commission and the EIB Group to stimulate the European economy by mobilizing private financing for strategic investments.

National ministries and regional/local authorities and their agencies provide additional funding for research and development in Europe. There are many different funding schemes, some based solely on national funds and others supported by European institutions.

The European Space Agency (ESA) is another major player when it comes to investments in space research and development in Europe. ESA funds a wide variety of research programs aimed at developing a high level of competence in the European space sector. Some of these programs are mandatory for member states and financed from the general ESA budget, while others are optional and financed from additional financial resources provided by member states.

Next The Multiannual Financial Framework of the EU (MFF) proposes to simplify the landscape of financial instruments under the single umbrella of InvestEU. InvestEU was expected to mobilize more than €650 billion of additional investment in Europe

thanks to a €15.2 billion contribution from the proposed EU budget (The Future of the European Space Sector).

The EU's flagship research and innovation program, Horizon 2020, is the largest program of its kind, with €75 billion allocated to innovation projects over seven years (2014–2020).

In just three years (2018–2020), Horizon 2020 has invested about €30 billion in research and innovation. Horizon 2020 funding comes mainly in the form of grants, but also through purchases and bonuses, as well as financial instruments such as loans, shares, quasi-shares, and guarantees. Specifically, as part of the InnovFin – EU funding for innovators, which is part of the Horizon 2020 program, the Commission, in cooperation with the EIB group, has allocated about €2.7 billion from the Horizon 2020 budget.

InnovFin tools include loans, guarantees and equity financing that can be tailored to innovators, whether an SME, a large company or a research institution. Specialized financial products are provided either directly to the recipient or through financial intermediaries such as development banks, private banks and investment funds.

One tool is the InnovFin thematic investment platforms, which catalyze third-party financing for thematic areas and provide access to financing through debt or equity products through financial intermediaries and asset managers (InnovFin).

The tool that the EIF will introduce to support space small and medium-sized enterprises (SMEs) and medium-sized companies is the InnovFin Space Equity Pilot (ISEP) under the EU Single Financial Instrument. The ISEP will provide access to risk financing for innovative enterprises in the space sector through a special financial instrument aimed at attracting a contribution of €50 million from the 2018–2020 EU budget.

The €410 million VentureEU Venture Capital Program was recently launched and debuted on April 10, 2018. As a pan-European venture capital funds program, it aims to ensure rapid innovation growth by increasing the amount of venture capital available to promising European companies. The six venture capital funds will participate in up to €410 million in initial EU funding, which they will use to launch their mission to raise €2.1 billion in private investment.

Using €2.1 billion to attract up to €6.5 billion in investments from institutional investors, such as pension funds, intend to significantly increase the amount of venture capital funding available to European startups and large companies. Each of the six funds will have 12 months to raise €2.1 billion. The cornerstone fund they will share consists of €200 Million from the Horizon 2020 InnovFin Equity

initiative, €105 Million from COSME and €105 Million from the Juncker Plan European Fund for Strategic Investments.

Horizon 2020 also finances projects through special SME instruments, which are designed for activities close to the market. The SME instrument has €1.4 billion available for financing from 2018 to 2020 and is divided into three phases, each with different forms of financing and mentoring support.

The Ninth Framework Program, which replaces Horizon 2020 Horizon Europe and began in January 2021 with a proposed budget of €97.9 billion, is the largest research and innovation funding program. It evolves around three pillars: open science, global challenges, and open innovation (Horizon Europe).

In addition to Horizon 2020, the EU has a special financing program for SMEs. The COSME scheme aims to support SMEs to improve access to finance as well as market access and business support (COSME – European program).

With a budget of €2.3 billion, COSME uses two main financial instruments to provide access to funding through intermediaries. The Loan Guarantee Fund (LGF) guarantees financial institutions that they can provide more loans and leases to SMEs, and the Equity Facility for Growth (EFG) provides venture capital to equity funds investing in SMEs.

The use of both instruments greatly increases the number of SMEs that can receive funding. COSME also participates in the recently created VentureEU program. The COSME macro tools are used both by the EIF itself and through intermediaries such as banks or fund managers.

In November 2014, the EU announced the Investment Plan for Europe as an innovative response to the ongoing economic downturn caused by low demand across the EU. The plan is designed by the Commission as a method of removing barriers to investment and making better use of financial resources.

Its main instrument is the European Strategic Investment Fund, which is implemented in cooperation between the European Commission and the EIB Group.

First launched in 2015, the EFSI was initially a €16 Billion guarantee from the EU budget, complemented by a €5 Billion EIB equity allocation.

In September 2017, the EFSI was strengthened and extended until 2020. Total funding of €43 Billion was available from 2015 to 2020 through the EFSI Infrastructure and Innovation Window and its window for SMEs, mobilizing at least €500 Billion in additional investment in the economy by mid-2020.

In September 2017, the EU published its latest policy strategy outlining the EU's economic strategy. It was called "Investing in Smart, Innovative and Sustainable Industries: An Updated EU Industrial Policy Strategy", and focused on building a holistic package to strengthen and make the EU industry more

competitive. The EU has redefined investment in innovative SMEs as a critical vector for achieving the EU's main goal of growth and jobs.

Besides the EU, ESA offers funding instruments to support space research and development companies in addition to the purchase of satellite missions. Much of the EU and ESA space funding is related to three European space programs: Galileo, Copernicus and EGNOS; funds for research and innovation activities are provided to support them. The combined funding of the three programs 67 was more than €11 Billion between 2014 and 2020.

6. The importance of national, local grants and venture capital for investment in space research

National and local grants, as well as country- and sector-specific initiatives in EU member states, complete the picture of the funding available in Europe. For example, ESA 68 estimates that national European space programs allocate about €180 million annually in grants and subsidies for research and development in space technology, with Germany accounting for more than half of that budget.

The €320 million European Angel Fund (EAF) is an initiative recommended by the EIF with national funds. The EAF provides capital to business angels and other non-institutional investors to co-invest in innovative companies.

The two main players in the field of space research and space technology funding are the EU and ESA.

They are complemented by private financiers who provide financing in the form of equity, debt or hybrid products. There are many public and private funding instruments available in Europe. For example, the Copernicus incubation program supports the market entry of the most promising business applications based on Copernicus data. The program provides €50,000 annually to twenty (20) European startups to fund up to 85% of the total incubation costs of their chosen organizational support program (ESA BIC or any other incubation or acceleration program). There are currently eighteen (18) ESA BICs in fifteen (15) European countries that support an average of one hundred forty (140) startups per year. There are no debt financing instruments in the EU to finance companies in the space sector.

However, in the private capital markets, space companies obtain business loans from commercial banks and project financing satellites from commercial lenders or institutional investors, and borrow money in the capital markets through bond issues.

In 2020, the European Commission formally approved the Union Security Strategy, which aims to protect every EU citizen and identifies four (4) key strategic priorities, including space and infrastructure (Commission Communication).

In 2016, the European Commission launched a "Space Strategy for Europe". This strategy document focused on "strengthening Europe's autonomy to access and use space in a safe and secure environment." To ensure Europe's autonomous, reliable and cost-effective access to space, the European Commission needs to work with ESA, member states and a number of stakeholders, including the private sector.

Another important factor in making the EU a great space power is an understanding of the dynamics of new space and the role of the United States and China. Given that the EU Parliament's first resolution on European space policy was adopted on September 17, 1981, the EU has long made space a priority.

Traditionally, European space management has a tripartite structure. It consists of the EU, ESA and the national space agencies of member states (including the national agencies of Germany, France, Italy and the UK). The new space has spawned new actors. The most critical developments for European space management occurred in the 21st century. In 2003, the Commission issued the White Paper on Space, a document that clearly articulated the main directions of EU space policy and emphasized the need for cooperation with other actors (Christensen, 2019).

Today, the Directorate-General for Defense Industry and Space (DEFIS) is the EU's leading agency for the space sector and defense industry. DEFIS is responsible for the EU's space program, which consists of Copernicus (European Earth Observation Program), Galileo and EGNOS (European Geostationary Navigation Overlay Service).

For the period 2021-2027, the Commission proposed a budget of €16 billion in current prices, equivalent to €14.2 billion in constant 2018 prices, broken down as follows: €9.7 billion for Galileo and EGNOS; €5.8 billion for Copernicus; and €0.5 billion for SSA and GOVSATCOM (EU Space Program).

To take into account the dynamics of New Space, the European Commission – in cooperation with the European Investment Bank and the European Investment Fund – provides investment in start-ups, early and mature space companies through InnovFin – Space Equity Pilot (2014–2020) InvestEU (2021–2027), European Council Innovation and Competitive Space Start-ups for Innovation Initiative (CASSINI) programs. In addition, under the new multi-annual financial program for the period 2021–2027, Horizon Europe, the European Defence Fund and Invest EU are also, designed to support companies and space research (ESPI Report).

In addition, the ESA implements many support programs that have benefited three hundred and forty (340) new companies. These companies specialize in various categories, such as, Material and New Manufacturing, Electronics, Information and

Communication Technology, Aeronautics, Automotive, Marine Transportation, etc.

Along with EU and ESA initiatives, there are national programs that support investment and entrepreneurship in space activities. In recent years, Germany, France, Italy, Spain, and the UK have implemented significant initiatives to encourage private efforts in the new space ecosystem (ESPI Report). However, the European space ecosystem lacks entrepreneurs with knowledge of space and knowledge of how to invest in space (The Future of the European Space Sector).

According to the European Commission's report on the space sector, investments in New Space accounted for two-thirds of all space-related investments between 2011 and 2017. Thanks to the New Space approach, production costs have been reduced and new business models have emerged.

From 2000 to 2017, space companies attracted more than €14.8 billion in investments (The Future of the European Space Sector).

In 2019, initial investment reached \$5.7 billion. In 2020, that figure was \$3.5 billion, the highest level of investment prior to that year (Bryce Start-up Space).

In addition, investments in new space companies are estimated at \$7.6 billion. According to the Commission, the amount of venture capital companies and angel investors is two-thirds of the investment in space companies.

Venture capital firms account for 46% of start-ups in space companies, and angel investors – 25% (The future of the European space sector).

A European Council document published in 2021 clearly states that the EU supports development and the entrepreneurial ecosystem in space (Regulation (EU) 2021/696).

ESA's activities are, divided into two categories – "Mandatory" and "Optional". Programs implemented within the general budget and space.

The budget of the scientific program is "Mandatory"; they include the main activities of the agency (research of future projects, technological research, joint technical investments, information systems and training programs).

All Member States contribute to these programs on a scale based on their gross national product (GNP). Other programs, known as "optional", are of interest only to some Member States, which have the right to decide the level of their participation.

The most common source of future funding in the EU space sector is venture capital/private equity, due to the fact that these funding instruments are available, flexible and fast.

In 2022, the EIF will raise €300 million to support the innovation and growth of Europe's small and medium-sized space technology companies through the InnovFin Space Equity Pilot project into two

space-focused funds, Orbital Ventures and Primo Space.

The European Commission has also launched a new program to provide investment to European startups to keep these companies on the continent. Specifically, the European Investment Bank and the European Investment Fund are allocating at least €1 billion (\$1.12 billion) over five years to the Cassini program, which will provide early-stage funding for European space companies.

Thus, the EU has a very powerful and developed toolkit for investment in the space industry, especially at the supranational level. This should become a driver of reforms in the space industry of Ukraine, which until recently was a space state with great scientific and technical potential in this sphere. After all, in recent years, what was there before has been practically destroyed.

7. The consequences of investment in the space industry for the development of Ukraine

The level of funding determines the state of the technological base of the space industry, and innovations in this area ensure the efficiency of production, product quality during expanded reproduction, which in turn affects its competitiveness.

High capital intensity and long payback periods of the space industry result in low profitability and inefficiency of space activities. It is for this reason that powerful scientific research in this area has not been conducted in Ukraine for quite a long time. In addition, the problem of assessing the efficiency of such budget programs remains. The plight of the space industry in Ukraine was also alleviated by the fact that commercialization of space activities was impossible for a long time, and corporatization began only recently. Russia's aggression against Ukraine in 2014, when in fact the main consumer of this industry was lost, had a significant impact.

Therefore, increasing the market value of space industry assets and increasing its competitiveness in world markets, counteracting the moral and physical deterioration of fixed assets, as well as improving the technical level of production in the space industry; improving the quality of space industry products as the main function of investment should be activated in Ukraine.

Government investment in the space industry can promote scientific and technological progress, create new jobs, and thereby reduce unemployment (Buhun, 2015; Buhun, 2013; Horbulin et al., 2008).

Article 11 of the Law of Ukraine "On Space Activities" of 15.11.1996 № 502-96-VR stipulates that foreign loans and investments in Space Activities related to the implementation of the National Targeted Scientific and Technical Space Program of Ukraine are

guaranteed by the state in accordance with current legislation of Ukraine.

In 2014–2017, Ukraine's space activities were carried out under difficult economic and political conditions in relations with the Russian Federation, as the share of industry products for Russian customers ranged from 60 to 80% of the total volume. The National Targeted Space Program has not become an effective and efficient instrument of state aid, because there is a mismatch between the degree of actual funding and the planned indicators of the program, which does not allow to achieve the goals set.

As can be seen from Table 2, financing of space programs has not been carried out in the necessary amounts, and the modern program project will remain a project also because of Russia's aggression against Ukraine due to the catastrophic state of the state budget.

Currently, the main investor in the Space Industry in Ukraine, unlike the EU, is the State. Due to the financing of budget, programs of the main administrator of budget funds (SCA of Ukraine) from the State budget funds are, also allocated, including for the support and operation of enterprises and institutions of the Space Industry (Table 3).

For comparison, the ESA budget in 2018 was \$6.5 billion, already in 2021 – \$7.78 billion (according to a report Euroconsult – Government Space Programs 2021), in 2020 the EU government spending on space programs was \$2.43 billion, in 2021 – \$2.57 billion (according to the State Statistics Service of Ukraine).

In early 2018, the head of the SCA of Ukraine announced the preparation of a bill that would allow private companies to do business in the rocket and space industry.

In the long term, the commercialization of the space sector can attract the necessary investments to unite innovation and intellectual capital of Ukraine.

It was only in 2019 that a bill was passed removing restrictions on private capital participation. This is despite the fact that the development of space entrepreneurship has been a significant trend in the International Space Sector since the early 2000s.

Since 2020, Ukraine has allowed private business to work in the field of space technology, forming the basis for private investment in space.

Thus, a comparison of budgetary investments of the EU and Ukraine in the space industry according to their GDP shows that Europe spends at least \$5 billion (0.03% of GDP), Ukraine has stopped financing the space program since 2017.

Polyakov, a Ukrainian who is the third largest investor in the U.S. space sector, was forced to sell his stake to meet national security requirements. Ukraine did not join the five-year ERA-Planet project in 2016 because of noncompliance with Horizon 2020 funding conditions. Therefore, Ukraine needs

to reconsider its approaches to investing not only digitally, but also organizationally.

The general situation in the Ukrainian economy, the lack of confidence in its stability and the absence of official regulation of various operations leads to the fact that private investment is almost non-existent. Venture financing and the institute of business angels are still not easily involved in projects that do not belong to the traditional IT sector or the consumer goods sector.

However, it is very important to take into account and provide conditions for participation, the presence of representatives in the international trend of New Space. Forecasting the future development and the role of space startups (especially in the upstream segment) is a very multifaceted task.

At present, if the state authorities of Ukraine do not plan to purposefully and actively develop private space entrepreneurship in the country by investing and concluding long-term contracts with private companies, another measure to support private initiatives may be the organization of modernization of national legislation regulating the sector of space activity.

Most domestic businessmen – potential space entrepreneurs and investors – consider investments in the space industry risky not only because of the peculiarities of space activities, high entry threshold and long payback period, but they are also hindered by gaps and unresolved regulatory issues or existing legislation that limits the development of entrepreneurial activity in the industry.

Foreign investors, when deciding to finance a private space project, also take into account the regulatory

framework in the space industry of the country where the startup is located.

8. Conclusions

The conditions for space investment in Europe and Ukraine are not so comparable. In the new space ecosystem, traditional European space authorities have adapted their programs to support and encourage European space companies. Much depends on national policies.

At present, Ukraine is gradually losing its place among the space powers of the world. According to this study, this is the result of bureaucratic obstacles, corruption and weak state policy in this area, including investment.

There is no legislation that would stimulate the development of private space exploration. This leads to a lack of commercial programs and projects involving Ukrainian private companies and/or launched space startups.

The projected economic downturn as a result of military actions in Ukraine will significantly affect the direct allocation of planned funding for the space program in the state budget, which has not even been approved yet.

Therefore, it is advisable for Ukraine to intensify investment in the space industry in the framework of public-private and international partnership.

Prospects for further scientific research include the intensification of entrepreneurial activity in the space industry, attracting private investment, etc. based on the study of trends in space and the study of experience in this aspect of space countries.

References:

- Anisenko, O. V., & Babina, D. O. (2018). Development of the Space Industry in Ukraine. *Ahrosvit*, vol. 11, pp. 55–59. Available at: <http://www.agrosvit.info/?op=1&z=2657&i=10> (accessed May 06, 2022).
- Dmitrenko, G. V. (2010). Mechanisms of Public Financial Audit in the context of the component of financial control over the effectiveness of the use of state budget funds on the example of the National Space Agency of Ukraine. *Investytsiyni: praktyka ta dosvid*, vol. 6, pp. 66–69. Available at: http://nbuv.gov.ua/UJRN/ipd_2010_6_17 (accessed May 07, 2022).
- Ogurtsov, A. B., & Polishchuk, O. V. (2014). Attracting Financial Assets under State Guarantees – a mechanism for stimulating investment activities of enterprises in the Space Industry. *Ekonomika ta derzhava*, 4, 114–117. Available at: <http://www.economy.in.ua/?op=1&z=2748&i=22> (accessed May 07, 2022).
- Bukhun, Yu. V. (2015). Investment aspects of corporatization of Space Industry enterprises of Ukraine Scientific works of Kirovograd National Technical University. *Ekonomichni nauky*, vol. 28, pp. 228–238. Available at: http://nbuv.gov.ua/UJRN/Npkntu_e_2015_28_28 (accessed May 07, 2022).
- Koshova, S. P., & Hbur, Z. V. (2021). *National security through the prism of Space Industry development: a textbook*. Vinnytsia: HO "Yevropeys'ka naukova platforma", 100 p.
- Bukhun, Yu. V. (2013). Features of Space Industry Financing in Ukraine. *Visnyk ekonomiky transportu i promyslovosti*, vol. 42, pp. 206–210. Available at: http://nbuv.gov.ua/UJRN/Vetp_2013_42_20 (accessed May 08, 2022).
- To Infinity and Beyond – Global Space Primer, Bank of America Merrill Lynch, Thematic Research, Oct. 2017 Accessed Sept. 2018. Available at: <https://go.guidants.com/q/db/a2/1e1ffc185c1d44bd.pdf> (accessed May 08, 2022).
- Start-Up Space, Update on Investment in Commercial Space Ventures, Bryce Space and Technology (2019). Available at: https://brycetech.com/downloads/Bryce_Start_Up_Space_2019.pdf (accessed May 08, 2022).

The future of the European space sector How to leverage Europe's technological leadership and boost investments for space ventures Available at: <https://www.eib.org/en/publications/the-future-of-the-european-space-sector-report> (accessed May 08, 2022).

InnovFin – EU Finance for Innovators Available at: <http://www.eib.org/products/blending/innovfin/products/thematic-investment-platforms.htm> (accessed May 08, 2022).

Horizon Europe. Available at: https://ec.europa.eu/commission/sites/beta-political/files/budget-proposals-research-innovation-may2018_en.pdf (accessed May 08, 2022).

COSME – Europe's program for small and medium-sized enterprises. Available at: https://ec.europa.eu/growth/smes/cosme_en (accessed May 08, 2022).

Communication from the Commission on the EU Security Union Strategy, COM (2020). 605, Brussels, 24.07.2020.

The White Paper on Space: A New European Frontier for an Expanding Union, SEC (2003). 1249, Brussels, 11.11.2003, 37–38.

Christensen C. Space Economy and Investment Trends. Available at: <https://apscsat.com/wp-content/uploads/2019/09/Bryce-APSCC-Presentation.pdf> (accessed May 08, 2022).

EU Space Program In "A Europe Fit for the Digital Age". Available at: <https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-mff-eu-space-program> (accessed May 08, 2022).

ESPI Report 78 – Space Venture Europe 2020. 2–5. Available at: <https://espi.or.at/news/espi-report-78-space-venture-europe-2020> (accessed May 09, 2022).

Creating the right opportunities for start-ups. Available at: <https://spacesolutions.esa.int/business-incubation/our-start-ups> (accessed May 09, 2022).

Bryce Start-up Space: Update on Investment in Commercial Space Ventures, 2020. Available at: https://isulibrary.isunet.edu/index.php?lvl=notice_display&id=10984 (accessed May 09, 2022).

ESPI Insights, Vienna, August 2021, p. 8. Available at: <https://espi.or.at/news/espi-insights-for-august-2021-is-out> (accessed June 09, 2022).

Regulation (EU) 2021/696 of the European Parliament and of the Council establishing the Union Space Program and the European Union Agency for the Space Program and repealing Regulations, Brussels, 28.04.2021.

Buhun, Yu. V. (2015). Ways of forming the mechanism of investment support of reproduction processes in the space industry. *Ekonomichnyy visnyk Natsional'noho tekhnichnoho universytetu Ukrayiny "Kyivskyy politekhnichnyy instytut"*, vol. 12, pp. 121–128.

Buhun, Yu. V. (2013). Features of financing the space industry in Ukraine. *Visnyk ekonomiky transportu i promyslovosti*, vol. 42, pp. 206–210.

Horbulin, V. P., & Shevtsov, A. I. (2008). Preserving the status of a rocket and space state is a national task of Ukraine. *Stratehichni priorityty*, vol. 7(6), pp. 144–152.

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