PURDUE UNIVERSITY | Purdue Policy Research Institute

Right Relationship Between Government and Industry

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I. Introduction

Space exploration has traditionally been the domain of state-owned agencies, especially big international players such as the likes of NASA, Roscosmos, ESA, and ISRO. However, the past two decades have seen a significant shift with increased involvement from private industry. Companies like SpaceX, Blue Origin, and others have entered the field, driven by technological advancements, cost efficiencies, entrepreneurial ambitions, and political influence. This new dynamic has led to the development of public-private partnerships (PPPs), where governments leverage private sector innovation, resources, and expertise while maintaining oversight and strategic control to meet the expectations of the "Neo Gold Rush" of the moon. Public-private partnerships set a strong foundation of cohesiveness between private-sector firms and state-run agencies. A dynamic, synergistic relationship between private corporations and the government will encourage a nation to achieve its long-term space exploration goals. This paper examines the appropriate relationship between government entities and private industry in space exploration, focusing on resource allocation, intellectual property rights, aligning goals, and potential policy implications.

II. Funding and Investment

The rise of private industry in space exploration has significantly altered the funding landscape. Traditionally, space missions were funded solely by government budgets. However, the entry of private companies has introduced new funding streams [Fig. 1]. A striking example is SpaceX. SpaceX's partnership with NASA for the Artemis mission demonstrates how government agencies can leverage private investment to meet their ambitious goals. Venture capital (VC) firms increasingly invest in space exploration, particularly in high-stakes areas like space mining. With VC revenue initially falling to the small-stage companies, these companies will be able to focus on the R&D of their respective projects thoroughly. With the advent of private sector space in the past two decades, almost 2000 firms have received investments of around $300 billion from private equity entities and VCs (Mckinsey and Co, 2022).

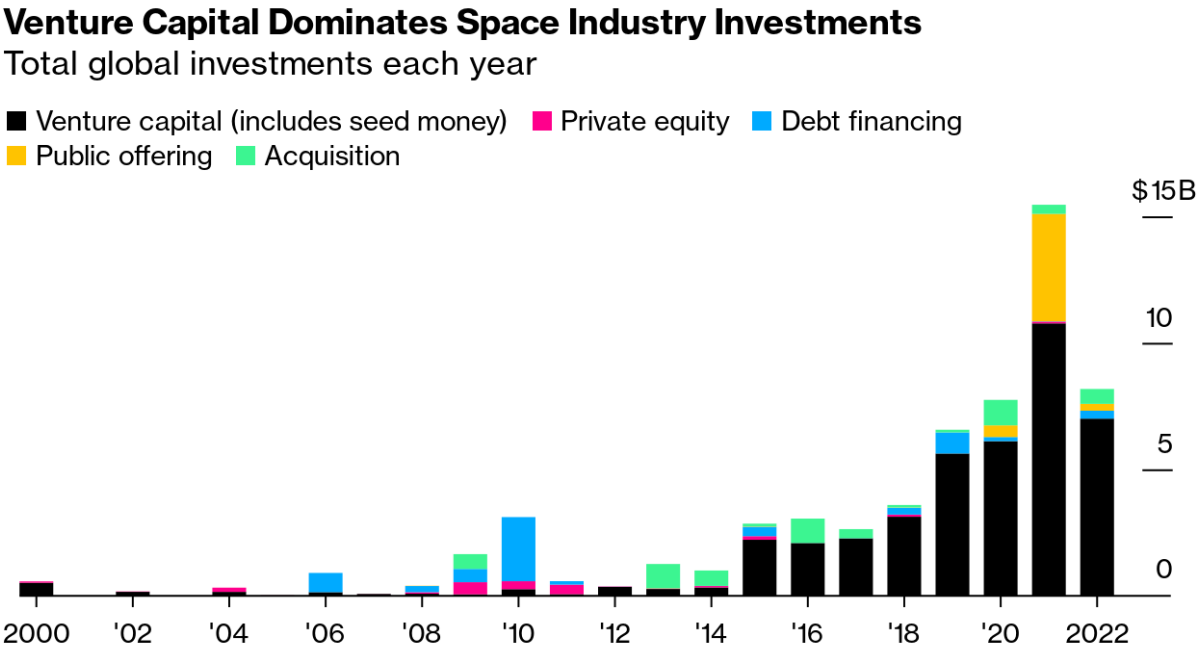

Fig. 1: Venture Capital Cash Fuels Space Startup Dreams: Bloomberg Business of Space (Bloomberg, 2022).

With more investment comes ambitious projects with lofty valuations. Smaller private sector space startups, such as Astranis Space Technologies and ABL Space Systems, “had equity valuations between $1.2 billion and $2.5 billion, while their projects, Series C satellites, and low-cost launch vehicles cost around $200 million and $250 million respectively” (McKinsey and Co, 2022). Such projects are of utmost significance, as this shows a promising field of development such as space is attracting VC to firms and encouraging a “new space race” where

the international community and their respective private sector firms acting under their policies compete with each other to establish streams of revenue through the extraction of moon resources. Bloomberg notes that space mining is expected to draw more VC money than traditional sectors, highlighting the growing interest from the private sector in space-related industries. Aside from VC, through Public-Private partnerships (PPPs) research and development grants. the private sector and government will have access to vast sources of investment that will help ensure that they seamlessly reach their goals. PPPs are of utmost importance, as they act as the main liaison for governments and the private sector for many processes such as technology transfer and data sharing. This influx of private investment allows for more extensive and rapid development of space technologies, benefiting both public and private entities.

III. Infrastructure and Expertise

Government agencies possess significant infrastructure and expertise, built over decades of space exploration and the necessity to meet modern standards. However, private companies bring innovation and efficiency to the table. This drive for innovation has fostered new advancements in physical and human capital, ensuring bright prospects for the space industry. Historically, innovation, complexity, and reliability have been prioritized when developing and manufacturing space technology. This trend continues, but the demand to meet modern standards for tech is critical for state-owned agencies and private entities alike. Software and Hardware must meet modern standards to facilitate new missions and efficiently synergize with the long-term goals of a nation. SpaceX's reusable rocket development has revolutionized space missions' cost dynamics. Public-private partnerships enable the sharing of infrastructure and expertise, optimizing resource utilization. NASA's collaboration with SpaceX and Blue Origin for the Artemis mission is a prime example of how government agencies can benefit from private-sector advancements. These two space private-sector giants have been assigned contracts NextStep Appendix H (SpaceX) and NextStep Appendix P (Blue Origin) to design cargo variants of existing landers (National Aeronautics and Space Administration, 2022). NASA and other space agencies are not only targeting landing humans on the moon but landing advanced technological equipment and infrastructure to help further their research objectives.space industry.

IV. NASA, SpaceX, and Blue Origin: A Model Partnership

NASA's partnership with SpaceX and Blue Origin specifically for the Artemis Projects is cited as a key model for public-private collaboration in space exploration. With the Obama administration signing the NASA Authorization Act of 2010, the development of aeronautical technology was effectively privatized. This partnership has enabled NASA to achieve significant milestones, such as the first commercial crewed mission to the International Space Station (ISS). SpaceX's reusable rocket technology has drastically reduced launch costs, making space exploration more sustainable and accessible, paving the way for NASA to implement their "cargo lander" idea (NASA.gov), which they have also given a contract to Blue Origin for manufacturing and development. NASA has announced that it will target sending human and commercial landers to the moon for the Artemis V mission, which is projected to take place in March 2030 (NASA.gov) This pivotal breakthrough exemplifies the magnitude of growth of the space industry. Such technological breakthroughs have led to NASA becoming more of a customer, not a producer of space goods. Through the transfer of technology, NASA and private firms can integrate each other's technologies into their hardware in a cohesive manner that ensures proper operational procedures. The prioritization of efficiency over quantity, has improved the prospects of current and future space exploration projects.

V. Ownership and Rights

Intellectual property (IP) rights in space exploration are complex, given the collaborative nature of many projects. The ownership and commercialization of IP resulting from joint efforts between government and private industry need clear frameworks and must comply with cybersecurity regulations. Developing new technologies through NASA's partnerships with private companies like SpaceX and Boeing involves significant IP considerations. Ensuring that both parties can benefit from the commercialization of these technologies is crucial for fostering innovation. However, there have been instances where IP sharing between state-owned agencies and private sector corporations has been compromised and in direct violation of government regulations. In 2023, NASA filed a lawsuit against Boeing for IP Theft and hardware development theft from Colorado-based firm Wilson Aerospace. "Not only did Boeing take NASA IP and exclusive reserved private sector technology for its own, but it implemented faulty

versions that put the lives of the astronauts at a high risk (National Aeronautics and Space Administration, 2023). To prevent companies from usurping each other's confidential data and developmental schemes, international governments must create stringent laws concerning IP rights and technology ownership to establish a fine line between collaboration and downright theft. Government policies must balance the need to incentivize private investment and innovation with the public's interest in space exploration benefits. This includes setting clear guidelines on IP ownership and revenue sharing from commercialized technologies. However, any technological undertaking that concerns high-profile data such as IP needs to be in regulations set within international law, specifically the Moon Agreement (1984), the Registration Convention (1972), and the Outer Space Treaty (1967) (United Nations Office of Outer Space Affairs, 2024).

VI. Government and Industry Interests

Aligning the goals of government agencies and private industry is essential for successful space exploration partnerships. Government agencies focus on scientific discovery, national security, and international cooperation. At the same time, profit motives and market opportunities drive private companies to invest in developing and manufacturing state-of-the-art technology. While the interests of the government and the private sector tend to be somewhat non-aligned in a way, the verdict is that for the success of high-profile missions such as moon resource mining, space exploration, and militarization, interests must be aligned through well-structured partnerships. Aside from the up-and-coming Artemis program, a key example of where government and industry partnerships are at its paramount was NASA's Apollo program. The Apollo Program achieved its mission to land on the moon in 1969 with Neil Armstrong’s world-famous landing. Even in the 20th century, there was heavy involvement from the private sector in the Apollo program. Private companies like Boeing, North American Rockwell, formerly North American Aviation, IBM, and the Douglas Aircraft Company were heavily involved in the development of the hardware and the software of training facilities and the space shuttles themselves (NASA, 2014). Eventually, private sector companies started to see opportunities in lunar and Mars missions for commercial activities such as mining and tourism. Currently, Boeing serves as the main contractor for the development of NASA’s Space Launch System (SLS), the rocket that is responsible for carrying astronauts and cargo to the moon. It is

estimated to cost $2 billion per launch. By aligning their goals with NASA's, these companies contribute to the broader objectives of space exploration while pursuing their business interests.

VII. Lunar Commercialization

The commercialization of lunar resources is a significant area of interest for both government and private entities. The moon's abundant resources, such as platinum and other precious metals, present substantial economic opportunities. Governments and private companies are investing in the technology and infrastructure needed to exploit these resources. To make lunar commercialization viable, there must be a sustainable way to transport materials, build structures, and support human activity on the moon. Both governments and private companies are investing in technologies like reusable rockets, lunar habitats, and in-situ resource utilization (ISRU). Collaboration on these projects is essential, as the costs and risks are too high for one sector to manage alone. By working together, governments and industries can spread the risks, reduce costs, and accelerate the timeline for lunar commercialization. Leading by example, Boeing's plans for lunar commercialization highlight the potential for new industries to emerge, driven by both public and private investment (Space News). With the lunar economy projected to reach $100 billion in the span of two decades, exploration and commercialization are of especially high demand and consideration between state-owned entities and the private sector (KPMG International, 2022).

VIII. Regulatory Framework

Developing a regulatory framework that balances security concerns with fostering innovation is critical. Space exploration involves significant risks, including militarization, environmental impacts, and the ethical considerations of space resource utilization. Governments must establish regulations that address these concerns while encouraging private sector participation. A prime example of a regulation implemented is the U.S. Commercial Space Launch Competitiveness Act (CSLCA) of 2015, which allows American companies to mine and own space resources, encouraging private investment in space mining (UC Berkeley Rausser College, 2021). However, it also requires companies to adhere to international treaties like the Outer Space Treaty, which mandates that space activities benefit all humankind.

IX. Security Concerns

Security concerns in space exploration include protecting critical infrastructure from overt attacks, preventing the weaponization of space, and ensuring the safe and peaceful use of space resources. In 2020, the number of cyberattacks targeting space assets, primarily those of the United States, increased by 25% compared to previous years (Chatham House, 2021), and 60% of federal agencies utilizing interstellar technology experienced cyber threats (United States GAO, 2022). Of more concern, China and Russia have focused on the development of anti-satellite (ASAT) weapons and have tested 16 of these highly potent systems from 2015-2020 (Secure World Foundation, 2021). If space technology is compromised by cyberattacks or missile strikes, this could pose a serious national threat to the United States or any allied nation. There must be standard protocols that promote the non-proliferation of space and prevent the use of a celestial body for sinister purposes. Governments must work with private companies to develop security protocols and standards. NASA's collaborations with private companies include stringent security measures to protect technology and data from cyber threats and espionage.

X. Conclusion

The relationship between government and industry in space exploration is evolving, driven by the need for innovation, efficiency, and resource optimization. Public-private partnerships offer a viable model for leveraging the strengths of both sectors. Clear policies on resource allocation, intellectual property rights, and regulatory frameworks are essential for fostering these collaborations. By aligning their goals, government agencies and private companies can achieve significant milestones in space exploration, from lunar bases to Mars missions. The right relationship between government and industry in space exploration is characterized by collaborative resource allocation, balanced intellectual property rights, aligned long-term goals, and a regulatory framework that addresses security concerns while encouraging innovation. As we venture further into space, these partnerships will ensure sustainable and successful exploration. Some long-term goals in space exploration include the development of sustainable technology, commercialization of space resources, and the protection and utilization of intellectual property. Achieving these goals requires a collaborative approach where government and private entities contribute their strengths collectively. Governments provide strategic direction, regulatory frameworks, and initial funding, while private companies can drive technological innovation and operational efficiencies. The combination of investment, policy regulations, and innovation working together in tandem with each other ensure bright future prospects for international space exploration.

References

Johnson, J. C. (2022). Understanding the economic worth of precious lunar metals. USRA.

Maidenburg, M., & Woodward, A. (2024, January 7). NASA bets on private companies for Moon landings in 2024. The Wall Street Journal.

Lorinc, J. (2023, December 6). Space mining will likely draw more venture capital money than Asteroid Metals. Bloomberg.com. https://www.bloomberg.com/news/articles/2023-12-06/space-mining-will-likely-draw-more-venture-capital-money-than-asteroid-metals

Mahler, C. (2021, June 11). Lunar Commercialization is on the horizon. Boeing.

Abdalati, W. (2020, November 19). *Public-Private Partnerships in Space*. ISS National Laboratory. https://www.issnationallab.org/research-on-the-iss/public-private-partnerships-in-space/

Jones, K. L. (2021, September 19). *Public Private Partnerships - Considerations for the New Space Age*. Perry World House. https://global.upenn.edu/sites/default/files/perry-world-house/Jones_SpaceWorkshop.pdf

Jones, K. (2018, April 18). *Public-private partnerships in Space*. Public-Private Partnerships In Space | Aerospace Center for Space Policy and Strategy. https://csps.aerospace.org/papers/public-private-partnerships-space

Rausser, G. (2023, October 16). *The role of public–private partnerships in Fostering Outer Space Innovations*. UC Berkeley Rausser College of Natural Resources. https://nature.berkeley.edu/news/2023/10/role-public-private-partnerships-fostering-outer-space-innovations

Hicklin-Coorey, O. (2022a, April 11). *The economic benefits of Space Exploration: Why we should invest more in space*. EMORY ECONOMICS REVIEW. https://emoryeconomicsreview.org/articles/2022/4/11/the-economic-benefits-of-space-exploration-why-we-should-invest-more-in-space

International Space Exploration Coordination Group. (2022, February 19). *Benefits stemming from Space Exploration - NASA*. National Aeronautics and Space Administration. https://www.nasa.gov/wp-content/uploads/2015/01/benefits-stemming-from-space-exploration-2013-tagged.pdf?emrc=ca90d1

Bayen, A., Choi, E., & Rausser, G. (2023, May 17). *Space Exploration: The Role for Public-Private Research and Development Partnerships*. escholarship.org. https://escholarship.org/content/qt5bf3441q/qt5bf3441q_noSplash_87aa470a88efdf69d97f53bda0516a5c.pdf?t=ro3fy8

U.S. Government Accountability Office. (2021). Space acquisitions: DOD continues to face challenges of delayed delivery of critical space capabilities (GAO-21-330). https://www.gao.gov/products/gao-21-330

Secure World Foundation. (2023). Global counterspace capabilities: An open-source assessment. https://swfound.org/counterspace/

KPMG. (2023). Space 2040: The commercial space race has begun. KPMG Ireland. https://kpmg.com/ie/en/home/insights/2023/11/space-2040-deal-adv.html