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Transforming Space

The New Space Era: Expansion of the Space Economy

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Key takeaways

- As with many novel concepts in their early stages, the term "commercial space economy" has been used frequently without a clear definition of its boundaries, yet this multifaceted industry is more than just space tourism and is only expanding.
- In 2021, the total global space economy was estimated at $469 billion – up over 60% from estimates just a decade prior – and in BofA Global Research's view, it will likely continue to grow to ~$1.1 trillion by 2030.
- What's propelling this growth? While it's clear that governments across the globe no longer have a monopoly over space, they do remain a driver of investment. In fact, the European Union (EU) announced in early 2022 that it will be investing ~$15 billion through the next five years in space exploration, earth monitoring, and satellite launch programs.
- And in the United States, the National Aeronautics and Space Administration (NASA) has become a major proponent for advances in commercial space. NASA contracts awarded to public and private companies are often offered to broaden technological boundaries in space for applications such as communications, security and climate monitoring.

Over 30 years of commercial space

As with many novel concepts in their early stages, the term "commercial space economy" has been used frequently without a clear definition of its boundaries. If one were to search the phrase on the internet, several sources referencing space tourism would likely appear first. While space tourism is a feature of commercial space economy, it's only one part of a multifaceted and growing industry.

Differing definitions: is government spending included?

It is understandable that there is some debate over what falls into the category of commercial space economy. Even within the US government there appears to be a lack of consensus regarding what defines the sector. Some US governmental organizations, such as the Bureau of Industry and Security, the Congressional Research Service, the Department of Commerce and the White House, refer to any economic activity involving space as a feature of the larger commercial space economy.

However, the Federal Aviation Administration (FAA) defined a commercial launch as one that is "privately financed without government support." Nevertheless, government spending remains a key driver for space investment and agencies have increasingly become the consumers of space-related products and services.

The BofA Global Research definition includes public and private sectors

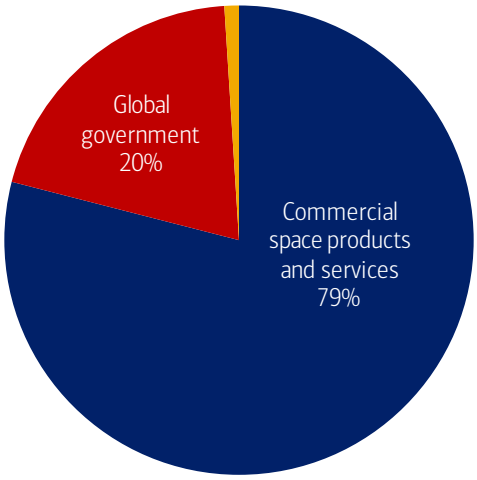
BofA Global Research has defined the total space economy as a full range of activities and the use of resources that create and provide value and benefits to human beings in the realm of exploring, understanding, managing and utilizing space.

It includes all public and private actors involved in developing, providing and using space-related products and services, ranging from research and development and the manufacturing and use of space infrastructure (ground stations, launch vehicles and satellites) to space-enabled applications (navigation equipment, satellite phones, meteorological services, etc.) and the scientific research generated by such activities.

The space economy was estimated at $469 billion in 2021

In 2021, the total space economy was estimated at $469 billion, up 62.8% from the 2011 estimate of $288 billion, according to Statista. Approximately 79% of this total market value is attributed to commercial space products and services (Exhibit 1). Global government spending on space was estimated to be $87.35 billion in the same time period, accounting for a sizeable 20% share of the market (Exhibit 1). In the United States alone, defense spending has been steadily rising for the past 15 years, and the beneficiaries are mostly publicly traded and private companies. However, these relatively free market dynamics were not always a feature of the space economy.

Exhibit 1: Share of total global space economy by market value (%)
Commercial space products and services account for most of the total space economy market value.



Source: Statista, Space economy: global turnover 2009-2021 | Statista, Space economy - global breakdown by sector 2021 | Statista

Commercial space launch – a history

Until the early 1980s, all launches in the United States were conducted under the supervision of a federal agency, such as the National Aeronautics and Space Administration (NASA) or the United States Air Force (USAF), without any commercial alternatives. While expendable launch vehicles (ELVs) were manufactured by non-government corporations, there was no regulation or funding present that enabled these companies to conduct their own launches. As a result, ELVs were purchased and operated by NASA, effectively giving the US a monopoly over all space launches in the western world. If a foreign government or commercial entity wished to place a satellite into orbit, they generally had to do so using one of four NASA-operated ELV families.

In 1979, the European Space Agency (ESA) launched Ariane, the first launcher intended to deliver commercial payloads into orbit, but by 1980, there was still no non-governmental way of reaching orbit in the US. Then, in 1981, NASA unveiled its Space Shuttle program and, after discontinuing most of its ELV programs around the same time, made it the primary launch vehicle for both civil and commercial payloads. However, demand outpaced the launch capability of the Space Shuttle, therefore creating demand for alternative launch options. The Space Shuttle's inability to meet demand was exacerbated by the Challenger disaster in early 1986, in which seven American astronauts were killed after their launch vehicle disintegrated moments after liftoff.

Later that year, former President Ronald Reagan signed the National Security Decision Directive (NSDD) 254, titled "United States Space Launch Strategy." The directive's intention was to prevent the Space Shuttle from carrying any commercial or foreign payload that did not require human assistance or pertain to national affairs (Source: Aerospace Security, Center for Strategic and International Studies). Consequently, the commercial space launch industry was born, paving the way for the first United States-licensed commercial launches in 1989 (Source: Federal Aviation Administration).

Politics continue to influence the space economy

The SPACE Act of 2015 was a key step in commercializing space

The Commercial Space Launch Competitiveness Act (a.k.a. Spurring Private Aerospace Competitiveness and Entrepreneurship or SPACE Act of 2015) was a legislative measure that intended to provide greater incentive for private companies to engage in space exploratory activities. The greatest takeaway from the legislation was the ability of US actors to benefit from the exploitation of resources beyond Earth (i.e. minerals, water). The act also extended the indemnification of American launch providers from unusual and unexpected third-party losses in the case of a crash, further limiting the risks involved with space exploration (Source: United States Congress).

Fostering commercial space activities is a priority for the Department of Commerce (DOC)

The Department of Space Commerce (the principal unit for space commerce policy activities within the Department of Commerce (DOC)) led by the current Secretary of Commerce, Gina M. Raimondo, is highly focused on fostering conditions for the economic growth and technological advancement of the U.S. commercial space economy with a vision of the US as a world leader in this area (Source: Department of Space Commerce).

In 2018, the DOC released a strategic plan for 2018-2022, which detailed the Department's priorities. The report was titled "Helping the American Economy Grow[1]" and included Strategic Objective 1.1 titled: "Expand Commercial Space Activities." The objective outlined the strategies for expanding commercial space activities including expanding the Office of Space Commerce, actively participating in the National Security Council, and supporting Americans companies operating in space.

Additionally, the Secretary has been vocal about maintaining a free and open space (similar to the "free and open seas" strategy of today's naval commerce). In BofA Global Research's view, the language in the report demonstrates growing political support for investment into and protection of the US space economy.

Governments no longer have a monopoly over space

Shift from government contracts to partnerships

In addition to increased government spending from agencies such as the Department of Defense (DoD), NASA has become a major proponent for advances in commercial space. According to NASA's Chief Technologist, "a robust and competitive commercial space sector is vital to continued progress in space. The United States is committed to encouraging and facilitating the growth of a US commercial space sector that supports US needs, is globally competitive, and advances US leadership in the generation of new markets and innovation-driven entrepreneurship[2]." The agency's sights have been set on developing the fields of satellite manufacturing, satellite-based services, space launch, and terrestrial applications.

To achieve its goal of a competitive and commercial market for space products and services, NASA has established three themes that highlight the transition to a commercial space economy, including:

- Private sector role as partner rather than contractor
- Government purchase of services instead of hardware
- Creating broader opportunities for innovation

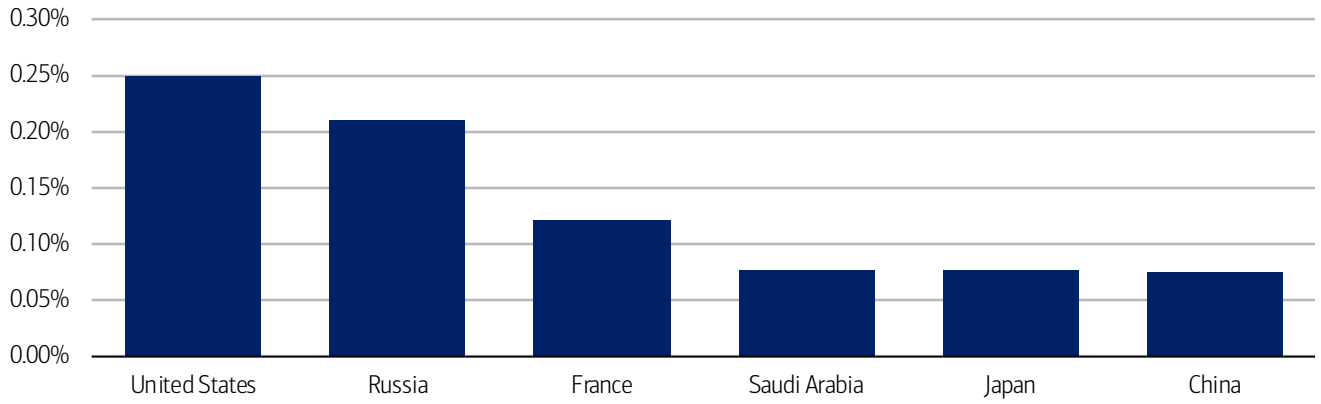
These themes complement the increasingly tolerant regulatory environment for commercial space operations in the United States. Commercial launches require virtually little regulatory oversight aside from a launch license issued through the FAA, opening up the industry to non-governmental competition and ending the NASA monopoly over space launches (Source: Space Foundation).

Government spending still a driver of investment both in US and abroad

Proportionally, NASA funding is far from its heights during the space race of the 1960s. Nevertheless, nominal spending has been steadily increasing since the beginning of the century. Since 2000, NASA spending has grown on average 0.24% annually when adjusted for inflation (Sources: NASA, Bloomberg). In 2017, government programs accounted for 59% of total European space industry sales. Though the United States still leads in budget allocation as of 2020 as a share of GDP compared to other G20 governments (Exhibit 2), the European Union (EU) announced in early 2022 that it will be investing ~$15 billion through the next five years in space exploration, earth monitoring, and satellite launch programs. The same can be said for recent government investments in the indigenous space industries of both China and the United Kingdom (Source: Organization for Economic Cooperation and Development).

[1] U.S. Department of Commerce 2018–2022 Strategic Plan
[2] NASA - NASA and Commercial Space

Exhibit 2: G20 government space budgets (2020) as a share of GDP
United States and Russia lead G20 governments.



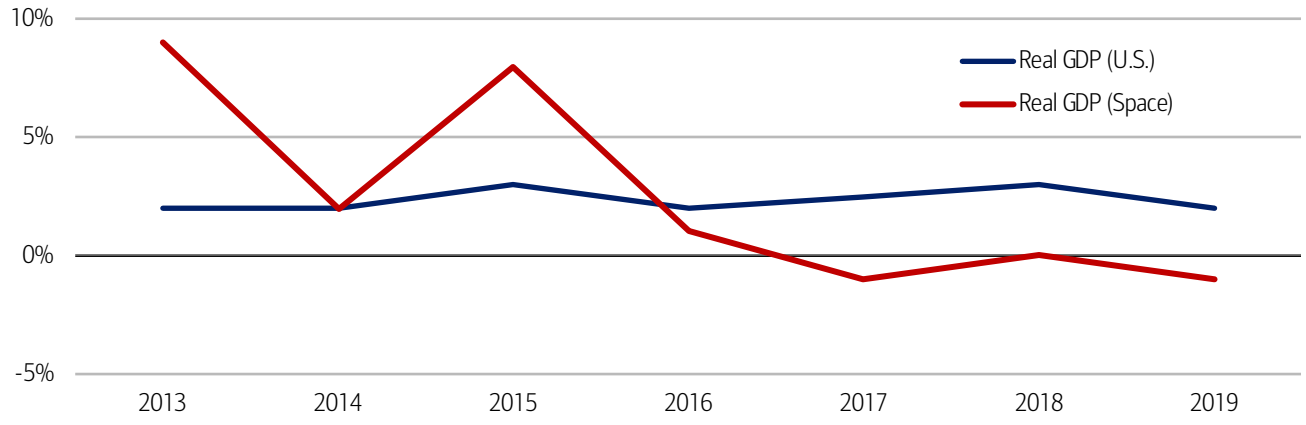
Source: Organization for Economic Cooperation and Development, Space Economy for People, Planet and Prosperity (oecd.org)
Note: Budgets include data for civil and defense programs, when available. The figure does not include the aggregate budget for the European Union.

Public-private partnerships are becoming the new standard

Despite NASA's dwindling share of budget, launches continue to increase

According to the Bureau of Economic Analysis, the average annual growth of real value added for the US total space economy over the 2012–2019 period was 2.7%, higher than the 2.3% growth in the overall US economy (Exhibit 3). And while nominal spending on space has continued to grow since the turn of the century, governmental agencies such as NASA have been consuming less and less of the United States federal budget each year. Funding for NASA accounted for 0.5% of the federal budget in 2021. This figure is well below the Apollo era high of 4.44% in 1965. The United States space program of the 1960s and early 1970s accounts for approximately 27% of all federal funding of NASA. However, space has taken a backseat on the national agenda and has not consumed more than one percent of national spending since 1992 (Source: Aeronautics and Space Report of the President).

Exhibit 3: Change from Preceding Period in Real Value Added for the U.S. Total Space Economy and Overall U.S. Economy (%)
The average annual growth of real value added for the U.S. total space economy for the 2012-2019 period was higher than the overall US economy.



Source: Bureau of Economic Analysis, Space-Economy-2012-2019.pdf (bea.gov)

Private ownership of equipment, the new norm

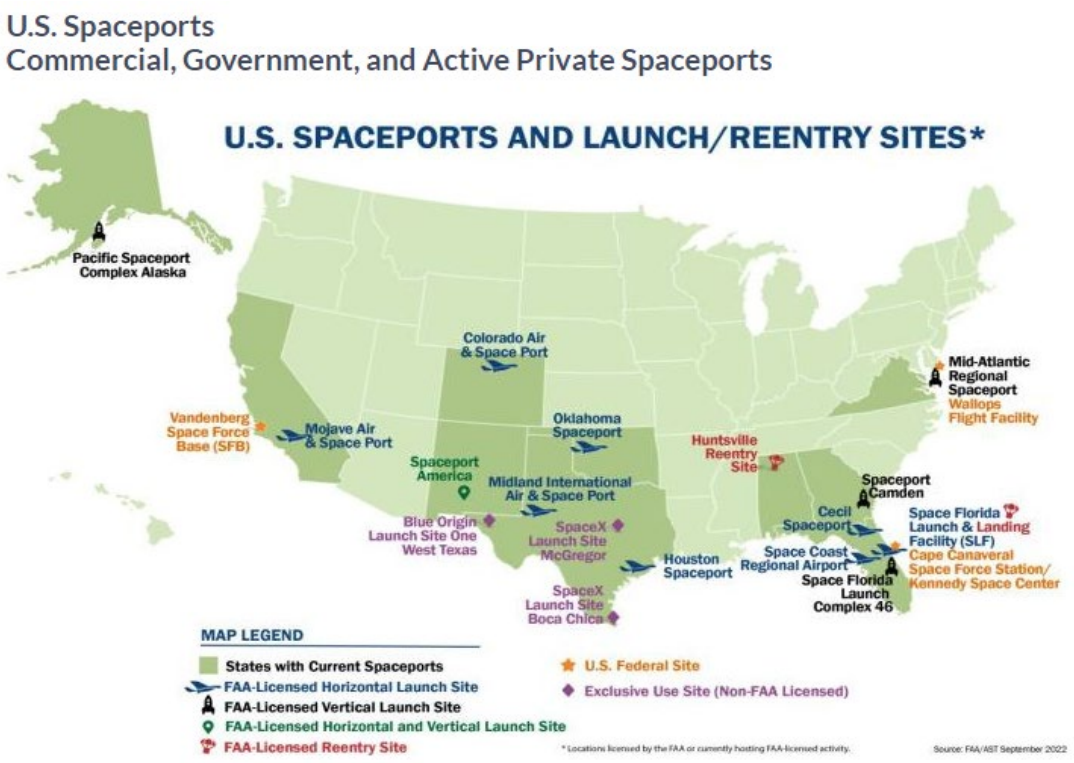
Most contracts offered by NASA are awarded to private and public companies with substantial space exposure. This new commercial space age diverges from the federally orchestrated space programs of the 20th century. NASA traditionally owned and operated its own spacecraft and related machinery. The watershed moment that ended this practice was the Space Shuttle program's end in 2011, after which the United States had to rely on third-party contractors in order to travel to space (Source: Federal Procurement Data System).

Increase in commercial spaceports

Since Sputnik 1 was launched into orbit from Baikonur Cosmodrome in 1957, spacecraft have been launched from 33 different spaceports around the world. In 1996, the Federal Aviation Administration (FAA) licensed its first spaceport for Harris Corporation at Vandenberg Air Force Base.

Since then, the number of FAA-licensed spaceports has risen steadily to 14 as of this year (Source: Federal Aviation Administration). These registered launch sites are available to both commercial and government customers and are generally located in the southern United States (Exhibit 4). There are an additional 19 spaceports around the world, adding up to a global total of 33 spaceports (Source: Aerospace Security, Center for Strategic and international Studies). Lower latitude launch sites are optimal because higher horizontal velocities are present closer to the equator, a result of the Earth's rotation. The increased horizontal velocity can then be utilized, thus requiring less energy for the spacecraft to accelerate into space.

Exhibit 4: U.S. Spaceports and Launch/Reentry Sites
In the U.S., most spaceports are concentrated in southern states.



Source: FAA, Office of Spaceports | Federal Aviation Administration (faa.gov)

Incentives in commercial space

Beyond government contracts, there have been a number of private incentive programs that have attempted to broaden technological boundaries in space. In a fashion that harkens back to the early ages of aviation, several companies have announced cash awards for achieving particular milestones in space launch and exploration.

Commercial Crew Program relies on the private sector

Since the Space Shuttle program ended, NASA has been looking to end its reliance on Russian launch vehicles and shift to an American commercial option. In 2010, NASA announced its Commercial Crew program, a two-pronged approach to tackling the absence of affordable access to space. The program focused on ensuring that companies operated their own spacecraft and infrastructure, which represented an interesting departure from previous NASA policy. NASA would award participating companies Space Act Agreements and contracts to design and develop supporting technology for a crew transportation system. The program had multiple stages and eventually awarded Commercial Crew Transportation Capability (CCtCap) contracts for the design and development of spacecraft capable of delivering astronauts to the International Space Station (ISS).

Current market landscape

End goals have evolved beyond commercial launch to an entire space economy

Initially, the commercial space industry was focused on the launch of satellites, whether they be commercial or foreign-owned, or resupplying the ISS. However, the industry has evolved substantially since its beginning in the 1980s, to include a plethora of satellite technologies and applications.

Beyond the use of satellites, space tourism has also become a highly touted facet of the industry in recent years. Several companies have emerged with the promise to ferry "space tourists" beyond the Karman line, the edge of space 62 miles above

Earth. Even as companies iron out the details of delivering tourists to space, many experts have already begun formulating more complex applications of space technology such as the extraction of space resources (e.g. water, minerals) and in-space manufacturing.

Satellites and related technology

Substantial innovation and lower costs have made the use of satellites more widespread and, consequentially, more profitable. Approximately 87.8% of space industry revenues are derived from satellites and related products and services. Furthermore, 45.6% of total revenues are attributed to commercial satellite usage (Sources: Bryce Space and Technology, Organization for Economic Cooperation and Development). End applications vary significantly, however the most common are:

1. Communications/Telecom: Connotes satellites used for relaying of audio, television, and telephone signals around Earth.
2. Remote sensing/Earth Observation (EO): Designed for Earth observation from orbit. Common uses include meteorology, cartography, and environment monitoring.
3. Navigation/GPS: Network of artificial satellites that transmit continuous microwave radio signals to calculate precise geographical positions.
4. Machine to Machine (M2M)/Internet of Things (IoT): Refers to data transmission between remote machines through satellite networks.
5. Big Data: Space-borne monitoring satellites used to process and extrapolate patterns from collected Earth imagery data.
6. Security: Used for reconnaissance, monitoring and operational military activities.
7. Space Situational Awareness: Used to keep track of elements in Earth's orbit. Monitors objects such as asteroids, comets, and space debris (i.e. inactive satellites).

Environmental, Social, and Governance (ESG) in space

ESG focus on Earth will drive demand for space activities

A rising number of companies have begun adding ESG scorecards to their annual report, which detail the progress they have made toward environmental, social, and corporate governance goals. BofA Global Research expects the space industry to become an increasingly critical part of how every company operates, as a significant amount of environmental data about the Earth can only be gained from the vantage point of satellites. In addition to companies monitoring how their operations affect the environment, companies must also monitor how the changing environment may affect their operations.

The climate crisis will be a key driver of satellite technology and data demand

According to BofA Global Research, space technology is likely to have the biggest role in the environmental side of ESG, which includes climate change, an area where space technologies may be most beneficial and necessary. Increased governmental regulation of how business activities may affect the environment are becoming more common and widespread. In order to effectively comply with these regulations, data points such as greenhouse or carbon gas emissions and energy usage must be tracked, likely through the use of in-space satellites. As the world trends to a more ESG-conscious place, BofA Global Research expects demand for satellite services, data, analytics, and monitoring to increase.

Future growth drivers

Government spending and minimal consumer exposure continue to support

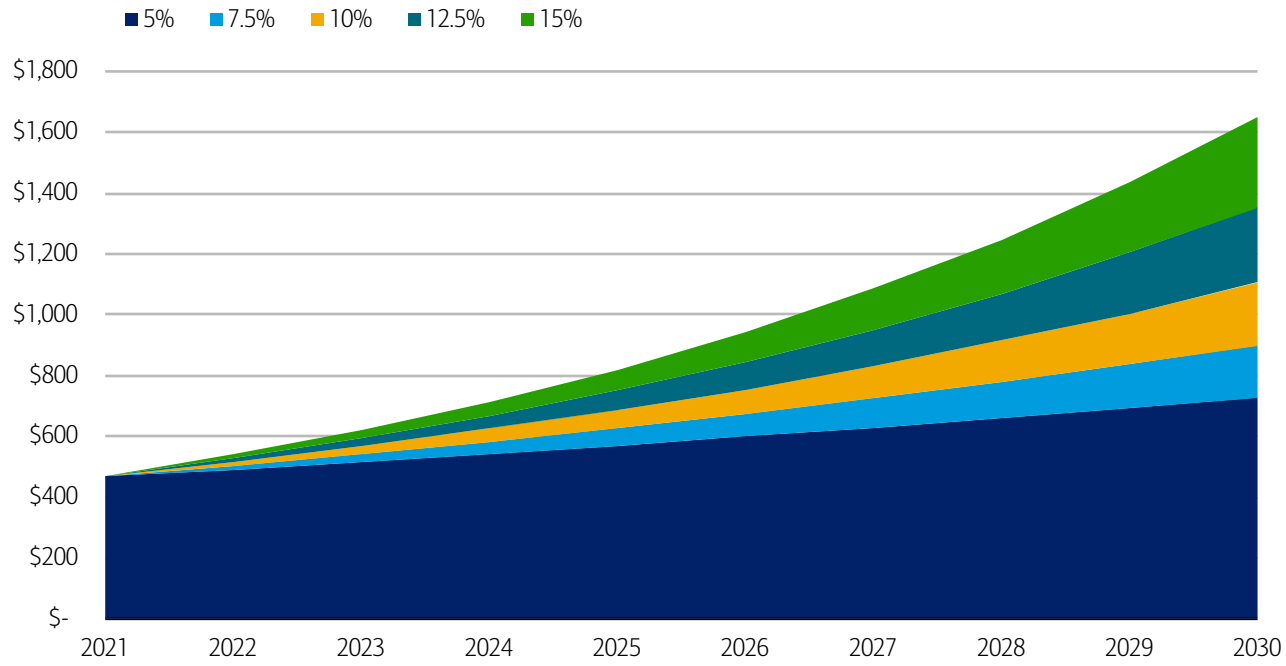
Using a historical compound annual growth rate (CAGR) of 10.6% (last two-year average) to forecast the base case for future space industry growth and with ~10% growth, BofA Global Research expects that the space economy will likely grow by over $1 trillion in the next decade alone. While the COVID-19 has led to delays in some public and private programs, the challenges of the pandemic have not appeared detrimental to overall investment. This may largely be because most spending in space is business-to-business/government (B2B/G), which generally recovers faster than business-to-consumer (B2C) spending. Furthermore, government spending on space is poised to increase over the next few years.

Exhibit 5 provides a scenario analysis of different growth trajectories over the next decade, including a 15% growth bull case scenario (green), 10% base case scenario (amber), and a 5% bear case scenario by BofA Global Research.

Enablers to reach the 15% bull case scenario of BofA Global Research's projections include a reduction in launch costs (allowing for companies to develop and test technology in space), an increase in space militarization (driving larger Space Force budgets), and companies developing more commercial solutions, including private space stations, in-space manufacturing, and asteroid mining. BofA Global Research also expects that the sustained loss of Russian lift could drive further commercial space growth to these levels.

Downside risks, which limit growth and support the below 5% bear case projections according to BofA Global Research, include high inflation and interest rates, which may prevent recent de-SPACs (special-purpose acquisition companies) from being able to access additional funding and aerospace & defense (A&D) primes slowing investment in space development. In the 5% scenario, BofA Global Research sees space growing with the economy overall and a potential recession deterring investors from heavily investing in nascent, long-cycle businesses.

Exhibit 5: Different scenarios for the total space economy over the next decade by growth trajectory ($)
BofA Global Research expects that, if current growth rates are sustained, the industry could reach ~$1.1tn by 2030.



Source: BofA Global Research

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