The Rise and Effects of Private Space Companies

Wilson Harper

Washington Aerospace Scholars
28 February 2024

On February 22nd, 2024, the lander Odysseus touched down on the Moon. A week earlier, it rode a SpaceX Falcon 9 rocket to space. It created history for a surprising reason: The Odysseus landing was the first American moon landing in fifty years—and the machine was built and flown entirely by private companies, also a first of its kind (Wall, 2024). In fact, the private space industry has been growing at a rapid rate—exponential, even. In 2011, the value of the global space economy was $288 billion, and it has skyrocketed to nearly $450 billion in the last decade (Space Foundation Editorial Team, 2022).

But what developments made this rapid growth possible, and why is private industry only now taking the spotlight? Overall, a change in risk, policy changes, economic opportunities, and technological advances enables private space companies to prosper. However, capitalism can take a toll, because there are increasing concerns over the safety and regulation, sustainability, and monopolization of private industry. Still, the future of private space is incredibly exciting.

The Beginning

In the early days, NASA contracted out expendable launch vehicles, or ELVs, to companies, and that was the only way that manufacturers could get involved. This practice continued until 1982, and, during that period, satellites owned by companies and foreign governments could only be launched through NASA rockets. The U.S had a monopoly on space launches until 1986, at least in the Western Hemisphere.

Recognizing this, the European Space Agency designed its own expendable launch vehicle, called Ariane. The rocket's first launch was in 1979. Later, in 1984, Arianespace, a company founded in 1980, began operating the Ariane rocket. That made it the first commercial launch service provider. In 1983, the United States began endorsing private space, and, in 1986, Regan signed a directive that prevented NASA from launching commercial satellites, barring special circumstances that required the shuttle's capabilities (Federal Aviation Administration, 2020).

In the wake of this change, the company Orbital ATK created Pegasus, the first air-launched rocket that traveled to orbit, as well as the first winged vehicle to go Mach 8. Those aren't its most significant firsts, though: In 1990, Pegasus was the first spacecraft completely developed by a private company to leave Earth (OrbitalATK, 2016).

A New Era

There were a few factors that made commercial space finally take off. The Ansari X Prize was one of the first of these factors. This award was inspired by early aviation prizes, specifically the Orteig Prize, which was the thing that persuaded Lindbergh to fly across the Atlantic in 1927. The X Prize was first announced in 1995. Contestants would have to fly someone to an altitude

of 100 km, which is considered to be the edge of space. If they were successful, they would receive $10 million. Nine years later, in 2004, SpaceShipOne achieved that goal (X Prize Foundation, 2010). Prizes like these spurred early development before even venture capitalists were interested.

Just two years later in 2006, NASA announced the Commercial Orbital Transportation Services initiative, or COTS. This initiative's goal was for private industry to carry cargo to orbit and to the ISS—and to carry crew, one day. SpaceX and Rocketplane Kistler were given contracts worth over $200 million each as a result of this. The program ended in 2013 after several cargo demonstrations, although humans were not flown (Moskowitz, 2012; Washington Aerospace Scholars, 2023). COTS had a major influence on SpaceX's early days. The company first launched its Falcon 1 in 2008, which was the first privately developed liquid fueled rocket to leave Earth (Clark, 2008).

Additionally, legal requirements changed over time. In 2004, the Commercial Space Launch Amendments Act legalized private spaceflight. This document created a "learning period." This period reduced FAA regulations for private spaceflights, at least in terms of occupant safety. The governmental organization was still heavily involved in any aspects that could affect the general population's safety. Proponents of this act say that anyone on board these new rockets would be made aware of the risks. Still, opponents say that every aspect of spaceflight should be regulated to some extent. Regardless, this act has stayed in effect for twenty years (Boyle, 2004). In fact, it was set to expire in October of last year. Congress extended the act for three more months, and they are deciding whether to continue to extend it as this is written. If it lapses, the FAA will have to step up and create more regulations (Clark, 2023a).

The Space Act Agreements are agreements that also help private space companies. There are a few types of SAAs: Reimbursable agreements are where a company uses NASA resources—personnel, expertise, or facilities—and then pays them back. Nonreimbursable agreements happen where the company and NASA work together for mutual benefit, without the exchange of money. Another type, funded agreements, are where NASA pays a company to accomplish the goals of the Administration. The last type, international agreements, happen when NASA collaborates with other countries (ContractsCounsel, 2024). These agreements—especially the first three—allow NASA to work with private companies to a much greater extent. For example, the SpaceX crewed missions to the ISS, Crew Dragon, were made possible by the Space Acts Agreements (National Aeronautics and Space Administration, 2020).

The Technological Revolution

Additionally, there are several innovations that made private spaceflight more feasible. One big change is computers: they have become exponentially faster and cheaper over the last several decades. Furthermore, the term *computer* no longer refers to people hand-calculating problems (British Broadcasting Corporation, 2016). Also, material science, miniaturization, standardization and automation have rapidly progressed, further lowering the barrier to enter spaceflight. As an example, CubeSats have made it easier for non-space companies to get satellites outside Earth. These are small satellites that follow standardized measurements: A 1U (or unit) CubeSat measures 10 cm by 10 cm, and larger standards exist, all the way up to 12U. Think of them like shipping containers—keeping them the same size lets them be cheaper and easier to manage. These satellites are used by the government, academia, and companies (National Aeronautics and Space Administration, 2023).

Manufacturing methods have also simplified the construction of rockets and other space components. Additive manufacturing, or 3D printing, is the big one. Mitsubishi recently demonstrated a novel idea in which satellite antennas are printed once in space. This concept could greatly save costs (Coykendall & Hardin, 2023). In addition, NASA has printed hard-to-create rocket parts such as engines, injectors and combustion chambers. 3D printing isn't just useful for small-scale structures, though, because companies have even been using it to create entire rockets. Using metal 3D printers, Relativity Space is manufacturing the first 3D printed, reusable rocket (Washington Aerospace Scholars, 2023). Eventually, it may be possible for them to create a rocket using these methods in as little as sixty days, which, again, cuts down dramatically on costs (Relativity Space, 2023). Lastly, Fleet Space hopes to launch a "constellation" of satellites that have all been 3D printed (Coykendall & Hardin, 2023).

Financial Forces

There are several monetary factors that have influenced the meteoric rise of commercial space. As SpaceX has shown that private space is feasible, other companies—and investors—have naturally wanted a piece of the pie, because rocket companies are in heavy demand. In the last two years alone, the number of Earth-orbiting satellites has almost doubled, and those satellites have to get into orbit somehow (Guttman, 2022). As discussed earlier, this is partly caused by the convenience of CubeSats. Also, satellites are just being used for more and more. For example, SpaceX operates a satellite system called StarLink. This fleet can provide high-speed internet to nearly anywhere in the world. Those satellites launch using what's called a "train" or "constellation" of satellites. These trains are often mistaken for UFOs and are projected to have as many as 40,000 satellites, eventually (Iemole, 2021). Once in orbit, satellite

trains maneuver into their final position. This technique allows for fewer launches, saving time and money (Wolfe, 2024).

Aside from internet access, satellites provide an array of other useful services. Global navigation systems like GPS rely on satellites. The U.S. government has put about 25 satellites into orbit for GPS. These satellites broadcast a signal to a device, and, using the exact timing of the signal, that device can determine its exact location. Once the device knows its location, it is trivial for it to determine its speed, bearing, elevation, and more. GPS is crucial in a variety of applications, including phones, navigation systems, aviation, and even one of its original purposes: missile guidance systems (The Aerospace Corporation, 2021). In fact, civilian GPS units disable themselves if they go faster than 600 m/s or 1,350 miles per hour or if their altitude is above 18,000 meters or 60,000 feet so that they cannot be used in weapons (Torrone, 2011).

Additionally, satellites can be used to take pictures and collect data about Earth. Governments use satellites for intelligence purposes to gather information on the location of enemy troops, their supplies and infrastructure, and more. Satellites can, of course, be used for peaceful causes, too, such as weather tracking and forecasting (Riskaware, 2021).

SpaceX: A Pioneer in Spaceflight

Next, let's take a closer look at one of these private companies: SpaceX. The company was founded in 2002, and their first rocket was the Falcon 1, revealed just a year later. SpaceX used heavy vertical integration to drive costs down, leading to a price of only $6 million per Falcon 1 launch—very cheap, for its time (SpaceRef Editor, 2003). Eventually, SpaceX set its sights on creating reusable rockets. In 2015, it succeeded in landing a rocket booster for the first time, and on April 8th, 2016, a booster landed on droneship for the first time. These landings can

decrease costs and increase launch frequency—the company launched ten rockets within just a thirty-day period in 2023 (Clark, 2023b).

In May of 2022, SpaceX launched its Crew Dragon spacecraft to orbit, with NASA astronauts on board. The spacecraft eventually docked with the International Space Station, making SpaceX the first private company to send humans to the station (Washington Aerospace Scholars, 2023). The launch was also the first crewed orbital launch in almost a decade that was from the United States (Chang, 2020). Since then, SpaceX has sent humans to the ISS over twenty times (SpaceX, 2024). In 2019, SpaceX announced the StarShip project. This will eventually be a fully reusable rocket. It is the tallest rocket and the largest by mass, and it produces twice the thrust of the Saturn V rockets that sent men to the Moon. Its final goal is to send humans to Mars. One interesting characteristic of it is that it is designed for in-flight refueling: One StarShip can be launched into orbit, carrying cargo. Another is launched afterwards carrying solely fuel, and it will transfer that fuel to the first spacecraft. This theoretically allows for shorter flight times to other planets, because the rocket will have more fuel to accelerate along the journey (Sauers, 2024). SpaceX's work in decreasing launch costs and increasing reliability has been crucial for the United States.

There are a number of other, smaller private space companies. United Launch Alliance, or ULA, is a joint venture between Lockheed Martin and Boeing founded in 2006. It has launched over 155 rockets, with an impressive 100% mission success rate (United Launch Alliance, 2019). Blue Origin—founded by Jeff Bezos, the CEO of Amazon. It was the first company to return a rocket to Earth in 2015 (Washington Aerospace Scholars, 2023). Now, it provides engines for United Launch Alliance and will be partially responsible for the Artemis lunar landers (O'Shea, 2023).

Possibilities and Ramifications

The private space industry, unsurprisingly, presents several advantages and disadvantages. The clearest benefit of these private companies is their ability to decrease launch prices. NASA's Space Shuttles, when in service, cost around one and a half billion dollars per flight, which equates to $30,000 per pound of payload. On the other hand, SpaceX launches cost about $60 million per launch, which is just $1200 per pound of payload (Chow, 2022). This lower price allows other companies to launch their own satellites much more easily. Also, NASA has partnered with SpaceX and Orbital ATK to send cargo to the International Space Station, and, as mentioned earlier, SpaceX has even sent humans to the ISS (Monaghan, 2023).

Both Virgin Galactic and Blue Origin have launched civilian flights to space. This is the first time in the world that humans can travel to space without being a part of NASA or other governmental organizations—albeit at a cost of up to half a million dollars (Gendron, 2023).

Finally, private companies can be more willing to embrace risk—both economically and in terms of human lives. Because private companies are not beholden to the government, investors can dump more money into them and hope for a return on investment. Additionally, there are fewer regulations regarding human safety, as discussed earlier. Astronauts for these private companies may not be made sufficiently aware of the risks they face (Ligor & Becker, 2023). It is important to note that the lack of regulations may end or change in the coming months, as outlined earlier (Weinzierl & Sarang, 2021).

In fact, increased human risk is not the only potential downside to commercial space. Space junk has been an issue since the early days, but it is becoming even more of a crisis. It is not economically feasible to remove junk from orbit, and littering in space is extraordinarily

common. It may be necessary for laws to limit this from happening even more (Goldstein, 2021). Another problem is the effect of spacecraft on the environment, specifically in the form of climate change. One astronaut on board a rocket creates as much pollution as 100 airline passengers (Kluger, 2023). Lastly, it is crucial to make sure that monopolies do not develop more than they already have. Vikram Nidamaluri, the managing director of telecom, media, and entertainment at Lazard, is concerned about this especially in the context of SpaceX. He explained, “Having such a dominant launch provider is probably not healthy just in general for the commercial prospects of the industry. No one wants a monopoly choking out one point of the value chain. There are obviously other players that are ramping up capacity, but I think the timeline hasn’t moved forward rapidly enough” (Sheetz, 2023).

New Horizons

The long-term future of private space is still partially unknown. The chairman of Virgin Galactic speculates that point-to-point travel to two different locations on Earth may be more profitable than tourism, saying, “You would never think that you could go to Hong Kong for the weekend… But if you could get there in 90 minutes, it's no different than driving from one tip of San Francisco to the other in traffic. So, that’s completely transformational to the world of travel and tourism and transportation” (Berger, 2019). Still, the infrastructure and technology required for that goal are a long way off.

Asteroid mining is another potential goal. Asterank, an asteroid database, has speculated that mining just ten asteroids that are relatively close to Earth could result in one and half trillion dollars of profit. These asteroids are rich in materials like gold, platinum, and nickel (Yarlagadda, 2022). The long-term effects of space mining are partially unknown, but it is very

possible that asteroid mining could be an alternative to mining here on Earth—which clearly has negative effects (Tomorrow Bio, 2023).

Finally, it seems inevitable that humanity will eventually construct colonies on the Moon and Mars—and private companies will certainly be involved in that process.

The private space industry has experienced tremendous growth and advancement in recent years, thanks to changes in risk assessment and policy, economic opportunities, and technological innovations. In contrast to the early days of space exploration, private companies are at the forefront of many developments and launches—not NASA.

Specifically, companies like SpaceX have pushed the boundaries of what is possible, making space cheaper than ever. However, the rise of private space companies presents issues regarding safety, regulation, sustainability, and monopolization. Regardless, commercial spaceflight's future is very thrilling. Clearly, it is crucial that the implications of this evolving industry are carefully considered. The private space sector has the potential to transform our world in ways we can hardly imagine.

References

Berger, E. (2019, November 26). *Virgin Galactic's real goal may be point-to-point travel around Earth*. Ars Technica. https://arstechnica.com/science/2019/11/virgin-galactics-real-goal-may-be-point-to-point-travel-around-earth/

Boyle, A. (2004). *Private-spaceflight bill signed into law*. NBC News. https://www.nbcnews.com/id/wbna6682611

British Broadcasting Corporation. (2016, February 2). The Vocabularist: What's the root of the word computer? *BBC News*. https://www.bbc.com/news/blogs-magazine-monitor-35428300

Chang, K. (2020, May 30). SpaceX Lifts NASA Astronauts to Orbit, Launching New Era of Spaceflight. *The New York Times*. https://www.nytimes.com/2020/05/30/science/spacex-nasa-astronauts.html

Chow, D. (2022, April 8). *To cheaply go: How falling launch costs fueled a thriving economy in orbit*. NBC News. https://www.nbcnews.com/science/space/space-launch-costs-growing-business-industry-rcna23488

Clark, S. (2008). *Spaceflight Now | Falcon Launch Report | Successful launch for Falcon 1 rocket*. Spaceflightnow.com. https://spaceflightnow.com/falcon/004/

Clark, S. (2023a). *SpaceX nails 200th rocket landing after launch with 72 small satellites – Spaceflight Now*. Spaceflight Now Inc . https://spaceflightnow.com/2023/06/12/spacex-nails-200th-rocket-landing-after-launch-with-72-small-satellites/

Clark, S. (2023b, July 27). *A nearly 20-year ban on human spaceflight regulations is set to expire*. Ars Technica. https://arstechnica.com/space/2023/07/a-nearly-20-year-ban-on-human-spaceflight-regulations-is-set-to-expire/

Clark, S. (2023c, September 7). *SpaceX broke its record for number of launches in a year*. Ars Technica. https://arstechnica.com/space/2023/09/spacex-broke-its-record-for-number-of-launches-in-a-year/

ContractsCounsel. (2024). *Space Act Agreement: Definition*. Www.contractscounsel.com. https://www.contractscounsel.com/t/us/space-act-agreement

Coykendall, J., & Hardin, K. (2023). *Riding the exponential growth in space*. Deloitte Insights. https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/future-of-space-economy.html/#endnote-24

Federal Aviation Administration. (2020, August 13). *Origins of the Commercial Space Industry*. Cleared for Takeoff. https://medium.com/faa/origins-of-the-commercial-space-industry-1098d5153e59

Gendron, W. (2023). *Virgin Galactic's first space tourism flight took off this week. Here are the players taking civilians to space.* Business Insider. https://www.businessinsider.com/virgin-galactic-blue-origin-spacex-commercial-space-flights-tourism-cost-2023-7

Goldstein, L. (2021, November 8). *Why Are We Letting Monopolists Corner Space?* Washington Monthly.

https://washingtonmonthly.com/2021/11/07/why-are-we-letting-monopolists-corner-space/

Guttman, C. (2022). *Surge in Satellites Speeds Space Race for Data*. The Forecast by Nutanix. https://www.nutanix.com/theforecastbynutanix/industry/satellite-market-trends

Iemole, A. (2021, January 20). *SpaceX launches first Starlink mission of 2021*. NASASpaceFlight.com. https://www.nasaspaceflight.com/2021/01/spacex-launch-first-starlink-mission-2021/

Kluger, J. (2023, April 19). *There's No Way to Make Space Travel Good for Planet Earth Right Now*. Time. https://time.com/6273065/space-travel-climate-impact/

Ligor , D., & Becker, J. (2023). *Enter Outer Space at Your Own Risk?* RAND. https://www.rand.org/pubs/commentary/2023/05/enter-outer-space-at-your-own-risk.html

Monaghan, H. (2023). *Commercial Cargo Spacecraft - NASA*. NASA. https://www.nasa.gov/humans-in-space/spaceships-and-rockets/commercial-cargo-spacecraft/

Moskowitz, C. (2012, June 1). *SpaceX Dragon Capsule Splashes Down in Pacific, Ending Historic Test Flight | Space.com*. Web.archive.org. https://web.archive.org/web/20120601034043/http://www.space.com/15939-spacex-dragon-capsule-landing-pacific.html

National Aeronautics and Space Administration. (2020). *SPACE ACT AGREEM_ENT BETWEEN NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND SPACE EXPLORATION TECHNOLOGIES CORP. FOR CO_CIAL ORBITAL TRANSPORTATION SERVICES DEMONSTRATION (COTS) BACKGROUND*. https://www.nasa.gov/wp-content/uploads/2015/04/189228main_setc_nnj06ta26a.pdf

National Aeronautics and Space Administration. (2023). *What are SmallSats and CubeSats? - NASA*. NASA. https://www.nasa.gov/what-are-smallsats-and-cubesats/#:~:text=CubeSats%20are%20a%20class%20of

O'Shea, C. (2023). *NASA Selects Blue Origin as Second Artemis Lunar Lander Provider - NASA*. NASA. https://www.nasa.gov/news-release/nasa-selects-blue-origin-as-second-artemis-lunar-lander-provider/

OrbitalATK. (2016, April 5). *Pegasus*. Web.archive.org. https://web.archive.org/web/20160405005453/http://www.orbitalatk.com/flight-systems/space-launch-vehicles/pegasus

Relativity Space. (2023). *Relativity Space - Additive*. Relativity Space. https://www.relativityspace.com/additive

Riskaware. (2021, June 10). *What are satellites used for? (and why they matter)*. Riskaware. https://www.riskaware.co.uk/insight/what-are-satellites-used-for-why-satellites-matter/

Sauers, E. (2024, January 13). *SpaceX says refueling its Starship in space won't be scary*. Mashable. https://mashable.com/article/spacex-starship-propellant-transfer

Sheetz, M. (2023, September 12). *SpaceX's near monopoly on rocket launches is a "huge concern," Lazard banker warns*. CNBC. https://www.cnbc.com/2023/09/12/spacex-near-rocket-market-monopoly-is-huge-concern-lazard-banker.html

Space Foundation Editorial Team. (2022, March 8). *Is the Space Industry Growing?* Center for Innovation and Education. https://cie.spacefoundation.org/is-the-space-industry-growing/

SpaceRef Editor. (2003, March 19). *SpaceX Performs First Rocket Engine Firing*. SpaceRef. https://spaceref.com/press-release/spacex-performs-first-rocket-engine-firing/

SpaceX. (2024). *SpaceX*. SpaceX. https://www.spacex.com/humanspaceflight/iss/

The Aerospace Corporation. (2021, February 2). *Brief History of GPS | The Aerospace Corporation*. Aerospace Corporation. https://aerospace.org/article/brief-history-gps

Tomorrow Bio. (2023). *Challenges and Opportunities in Space Mining*. Www.tomorrow.bio. https://www.tomorrow.bio/post/challenges-and-opportunities-in-space-mining-2023-06-4603020911-space

Torrone, P. (2011, July 26). *GPS Units Disable Themselves If They Go Faster Than 1,200 MPH*. Make: DIY Projects and Ideas for Makers. https://makezine.com/article/technology/gps-units-disable-themselves-if-they-go-faster-than-1200-mph/

United Launch Alliance. (2019). *ULA | United Launch Alliance*. Ulalaunch.com. https://www.ulalaunch.com/

Wall, M. (2024, February 24). *Intuitive Machines' Odysseus lander tipped over on the moon during "spicy" lunar landing*. Space.com. https://www.space.com/intuitive-machines-odysseus-moon-lander-tipped-over

Washington Aerospace Scholars. (2023). *The Museum of Flight Education*. Was.museumofflight.org. https://was.museumofflight.org/mod/book/tool/print/index.php?id=2630#ch3899

Weinzierl, M., & Sarang, M. (2021, February 12). *The Commercial Space Age Is Here*. Harvard Business Review. https://hbr.org/2021/02/the-commercial-space-age-is-here

Wolfe, D. (2024). *Starlink satellite trains: Is this the future of the night sky?* Washington Post. https://www.washingtonpost.com/business/interactive/2023/starlink-satellite-train-spacex-visibility/

X Prize Foundation. (2010, September 23). *Ansari X PRIZE | X PRIZE Foundation*. Web.archive.org. https://web.archive.org/web/20100923001722/http://space.xprize.org/ansari-x-prize

Yarlagadda, S. (2022, April 8). *Economics of the Stars: The Future of Asteroid Mining and the Global Economy*. Harvard International Review. https://hir.harvard.edu/economics-of-the-stars/