

# START-UP SPACE

UPDATE ON INVESTMENT  
IN COMMERCIAL SPACE  
VENTURES

2019

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space and technology





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# Executive Summary

The *Start-Up Space* series examines space investment in the 21<sup>st</sup> century and analyzes investment trends, focusing on investors in new companies that have acquired private financing. Start-up space companies had a record year of funding in 2018, newly attracting investment from entities like Boeing, Rolls Royce, and Morgan Stanley. Additionally, for the first time, the number of investors outside the United States nearly equals the number of investors within the United States. Some maturing ventures are now generating revenue, but many start-up space companies have not yet definitively demonstrated business case success. The overall viability of the start-up space ecosystem will be a critical topic in the next several years.

*Start-Up Space* reports on investment in **start-up space ventures**, defined as space companies that began as angel- and venture capital-backed start-ups. The report tracks seed, venture, and private equity investment in start-up space ventures as they grow and mature, from 2000 through the end of 2018. The report includes debt financing for these companies where applicable to provide a complete picture of the capital available to them, and also highlights start-up space venture merger and acquisition (M&A) and initial public offering (IPO) activity.

**Record \$3B+ invested  
in start-up space  
companies in 2018.**

**Significant Investment in Start-up Space.** Since 2000, start-up space ventures have attracted around \$21.8 billion of investment, including \$8.4 billion in early and late stage venture capital, \$3.1 billion in seed financing, and \$4.7 billion in debt financing. More than 220 angel- and venture-backed space companies have been founded and funded since 2000. Twenty-four of these companies have been acquired, at a total value of about \$3.7 billion. Most investment activity has occurred recently, and since 2015, annual investment has consistently reached at least \$2 billion. In 2018, investment reached \$3.2 billion, a record amount.

Investment Type	2000-2006 (millions)	2007-2012 (millions)	2013-2018 (millions)	Total 2000-2018 (millions)
Seed/Prize/Grant	\$742.0	\$201.9	\$2,170.3	\$3,114.2
Venture Capital	\$327.9	\$519.6	\$7,543.5	\$8,390.9
Private Equity	\$234.2	\$1,300.8	\$301.0	\$1,835.9
Acquisition	\$0.0	\$584.0	\$3,098.3	\$3,682.3
Public Offering	\$0.0	\$0.0	\$23.4	\$23.4
<b>Total Investment</b>	<b>\$1,304.1</b>	<b>\$2,606.3</b>	<b>\$13,136.4</b>	<b>\$17,046.8</b>
Debt Financing	\$710.0	\$3,388.4	\$637.8	\$4,736.2
<b>Total with Debt</b>	<b>\$2,014.1</b>	<b>\$5,994.6</b>	<b>\$13,774.2</b>	<b>\$21,782.9</b>

**Table E-1. The magnitude of investments varies based on investment type and time period.**

In the early 2000s, an average of four funded space companies were started per year; today the figure is five times higher. (In the last six years, the number of funded new companies has averaged 21 per year.)

- This research has identified 701 investors in start-up space companies; however, since all investors are not always disclosed, the total number of

investors is higher. Several high-profile billionaires such as Jeff Bezos, Richard Branson, and Elon Musk, are space investors.

- Looking at investment only (excluding debt financing), more than two-thirds of investment in start-up space since 2000 has been in the last four years.
- Since 2000, three start-up space companies have attracted investment in excess of \$1 billion: Jeff Bezos is estimated to have invested more than \$2.3 billion in Blue Origin since 2000 (with some sources placing this total much higher); Google, Fidelity, and other investors have invested over \$2.4 billion in SpaceX since 2006; and SoftBank and other investors have invested \$1.7 billion in OneWeb since 2015.<sup>1</sup> SpaceX and OneWeb closed billion dollar deals in 2015 and 2016, respectively.
- Venture capital in start-up space companies since 2000 totals \$8.4 billion, with roughly 85% invested in the last four years.
- Nearly 40% of the value from acquisitions in space start-ups since 2000 has come from transactions in the last three years. Seven acquisitions in 2018 totaled an estimated \$100 million (this is an approximation; no transaction values were announced), down this year following Planet Labs' estimated \$300+ million acquisition of Terra Bella in 2017, and SES's acquisition of O3b for \$730 million in 2016. Based on estimates, the largest acquisition in 2018 appears to be Boeing's procurement of Millennium Space Systems.

**Record Total Investment in 2018.** Investors provided a record \$3.2 billion to start-up space companies in 2018, about \$680 million more than in 2017 and \$200 million more than the previous record year, 2016. This is primarily driven by three large late-stage investments in SpaceX (at over \$200 million each) and one large investment in Blue Origin from Jeff Bezos (estimated at \$750 million). The number of start-up space companies reporting investment in 2018 was 82, similar to 2017 levels. The number of investors increased by 7% in 2018 while the number of deals grew 8%.

Investment Type	2016 (millions)	Change	2017 (millions)	Change	2018 (millions)
Seed/Prize/Grant	\$447.7	22%	\$548.3	44%	\$791.7
Venture Capital	\$1,617.8	2%	\$1,642.8	22%	\$2,002.4
Private Equity	\$0.0	0%	\$0.0		\$85.0
Acquisition	\$962.5	-63%	\$360.0	-72%	\$100.0
Public Offering	\$0.0	0%	\$0.0	0%	\$0.0
<b>Total Investment</b>	<b>\$3,028.0</b>	<b>-16%</b>	<b>\$2,551.0</b>	<b>17%</b>	<b>\$2,979.1</b>
Debt Financing	\$1.9	159%	\$5.0	5010%	\$254.0
<b>Total with Debt</b>	<b>\$3,030.0</b>	<b>-16%</b>	<b>\$2,556.0</b>	<b>26%</b>	<b>\$3,233.1</b>

**Table E-2. Total 2018 start-up space investment was higher than any previous year, beating the previous high in 2016.**

<sup>1</sup> In Q1 2019, OneWeb announced that it had raised a total of \$3.4 billion since its founding, including a \$1.25 billion round in 2019. This implies additional, undisclosed funding beyond the \$2.95 billion in disclosed transactions (roughly \$1.7 billion through 2018 and the \$1.25 billion transaction in 2019). Given the uncertainty around the timing and structure of this previously undisclosed funding, Bryce will treat it as a 2019 investment, consistent with the date OneWeb included the amount in its public statements.

# Executive Summary

**Venture capital investment crossed \$2B for the first time, increasing nearly \$360M over 2017.**

- Investment in start-up space is seeing sustained growth. In 2018, 187 investors (up from 177 in 2017) invested into 82 start-up space companies across 90 deals (up from 83 in 2017).
- Total venture investment crossed \$2 billion for the first time, reflecting an increase of nearly \$360 million from 2017.
- The year 2018 did not see any billion-dollar deals, although eight deals exceeded \$100 million. The largest was Blue Origin's estimated \$750 million angel investment from Jeff Bezos, followed by three raises for SpaceX totaling \$737 million from Series I, Series J, and a debt financing round, facilitated by Bank of America. Together these transactions made up 46% of all investment raised in 2018.
- Notable entities like Boeing, Goldman Sachs, Morgan Stanley, Raytheon, and Rolls Royce invested in or acquired start-up space companies in 2018.
- Companies in the US continue to receive the majority of start-up space investment, about 80%. Companies in China and the UK received 60% of the non-US total. The number of non-US investors increased from 84 to 94.

## **Record Venture Capital Investment in 2018 and Increase in Early Stage Deals.**

Total venture investment crossed \$2 billion for the first time, reflecting an increase of more than \$360 million from 2017. The number of early stage venture deals rose from 39 in 2017 to 51 in 2018. Venture deals overall increased by more than 20% to 59. Of the 113 venture capital firms (+20% versus 2017) that invested in start-up space companies in 2018, 42 had previously reported investment in start-up space companies; 71 had not, and appear to be new additions to the start-up space ecosystem.

- Total venture capital (VC) investment rose 22% from 2017 to 2018, to roughly \$2 billion.
- Excluding transactions over \$100 million, the average space venture deal in 2018 was about \$20 million, from \$18.8 million in 2017.
- The number of venture capital firms investing in start-up space increased in 2018, from 95 to 113 firms. (The reported number of venture capital firms investing in 2017 has increased since our previous report, as more companies have announced transactions and as new data sets have become available.)
- More than 330 VC firms have invested in space start-ups. Twenty-six VCs have repeatedly invested in common with others, with each of the following space start-ups reporting investment from at least two of these investors (see Figure E-1): Accion Systems, Akash Systems, Bagaveev Corporation, Cape Analytics, Enviview, Gilmour Space Technologies, HuaXun Microelectronics, Kepler Communications, LeoLabs, Mapbox, Orbital Insight, Planet, Relativity Space, Rocket Lab, Sairdrone, SkyWatch (SkyWatch Space Applications), SpaceX, Spire, Swift Navigation, Terra Bella, The Climate Corporation, Ursa Space Systems, and Vector. These are shown in Figure E-1. In addition, 29 VCs have invested in at least three different start-up space companies and 22 VCs have participated in at least five start-up space deals.

**Unicorns and a Few Exits.** Investors focus on valuations and exits. SpaceX is an undisputed space unicorn (a private company with a valuation of \$1 billion or more); after a \$273 million Series J, SpaceX’s valuation was reported at \$30.5 billion. Several other start-up space companies, including OneWeb, Planet, and Rocket Lab, have been reported by some sources to be unicorns, and two, Mapbox and Kymeta, are likely on the path. While unicorn valuations are increasing in number, some financial analysts caution that many unicorns (across sectors, not specifically in space) have exaggerated valuations.

- There were no large acquisitions in 2018. Seven acquisitions in 2018 totaled an estimated \$100 million (this is an approximation; no transaction values were announced). Based on estimates, the largest acquisition in 2018 appears to be Boeing’s purchase of Millennium Space Systems, a full service, end-to-end space mission solution provider.
- Planetary Resources, an asteroid mining venture, was acquired by blockchain software technology company ConsenSys, Inc. in October in an asset purchase transaction, following reported financial difficulties and problems raising additional funding. In 2016 Planetary Resources received funding from the government of Luxembourg, which has said it lost \$13.7 million on the deal. The company had previously reported about \$24 million of financing from other investors.

1	500
2	BESSEMER VENTURE PARTNERS
3	Data Collective
4	DFJ
5	First Round
6	FOUNDERS FUND
7	FRESCO CAPITAL
8	Horizons Ventures 唯港投资
9	IQT IN-TEL
10	khosla ventures
11	KPCB KLEINER PERKINS CALFIELD BYERS
12	LEMNOS Labs
13	LU+
14	main sequence ventures
15	NEA
16	NORWEST VENTURE PARTNERS
17	promusventures
18	RRE Ventures
19	SEQUOIA
20	SERAPHIM CAPITAL
21	SHASTA PARTNERS
22	SKVENTURES
23	SOCIALCAPITAL
24	ST
25	techstars
26	Y



Accion SYSTEMS	6	18	21				
AGORA SYSTEMS	3	10	23				
AGAVEBY	3	26					
CAPE ANALYTICS	3	10	13	17			
ENVIEW	12	17					
Gilmour Space Technologies	1	14					
HuaXun Microelectronics	4	11					
KEPLER	22	25					
LEO LABS	8	20	24				
mapbox	4	17					
Orbital Insight	9	13	19				
planet.	3	4	5	6	13		
Relativity	23	26					
ROCKET LAB	2	3	10	17			
SALDRONE	8	13	23				
SKYWATCH	22	24	25				
SPACE X	4	6					
spire	2	7	12	17	18	20	21
swift NAVIGATION	5	12	15				
Terra Bella	2	10	16				
THE CLIMATE CORPORATION	5	6	10	15			
Ursa	15	18					
VECTOR	19	21					

Figure E-1. Common investments among the most space-focused VCs.

# Executive Summary

**Non-U.S. Activity in a U.S. Dominated Sector.** While U.S. start-ups continue to dominate start-up space, with about 80% of all investment in 2018, close to half of investors and companies reporting investment in the last three years are based outside the U.S. For the first time, the number of non-U.S. investors investing in start-up space companies nearly matched the number of U.S. investors. Total investment in non-U.S. space start-ups rose in 2018, compared to 2017. The largest investments were in i-Space and Astroscale. Non-U.S. seed and venture investment, the number of non-U.S. firms reporting investment, and the number of non-U.S. investors are greater than in 2017. Note that this total considers investment in OneWeb to be investment in the U.S., given the location of the majority of OneWeb activities.

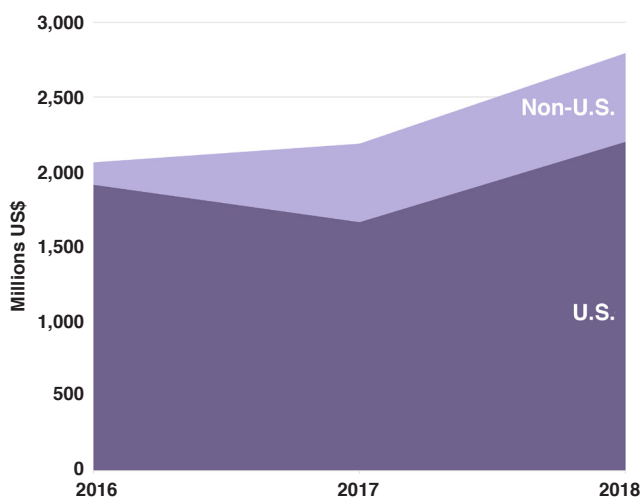


Figure E-2. Seed and venture capital investment in non-U.S. space start-ups increased from 2017 to 2018.

- Total investment in non-U.S. space start-ups in 2018 was about \$610 million, a 9% increase from last year.
- Seed and venture investment in non-U.S. space start-ups rose from \$527 million in 2017 to \$595 million in 2018. See Figure E-2.
- Ninety-four investors in 2018 were based outside the United States. From 2017 to 2018 the number of non-U.S. investors rose from 47% to 49% of all investors. Most non-U.S. investors in 2018 from China and the United Kingdom.
- Looking at all investors since 2000, investors in start-up space companies are primarily from the United States (382), representing about 54% of the total; California is home to nearly half of these investors. Non-U.S. investors are based in 37 countries.
- Thirty-five start-up space companies based outside the U.S. received funding in 2018. The largest investment in a non-U.S. space start-up was a \$90.6 million Series A in i-Space, a China-based launch start-up. Other notable 2018 investments in non-U.S. space start-ups included a \$50 million Series D round in Astroscale (Singapore), a 43.8 million Series B round in One Space (China), and a \$43 million Series B+ round in LandSpace (China).
- Overall, 21 space start-ups are headquartered in the United Kingdom., comprising roughly 23% of all non-U.S. space start-ups. Canada has the second most start-up space companies (11), followed by China (9), Japan, (5), Australia (5), Israel (4), and Spain (4).



**Tracking Future Performance.** As predicted, 2018 outpaced 2017 investment. Several pending megadeals, including recently announced investments in OneWeb, and Amazon interest in a large LEO constellation, suggest that growth will continue in 2019. Many services and products that attracted investment will be deployed in 2019, particularly those related to commercial human spaceflight (SpaceX, Virgin Galactic). The next few years have the potential to transform the start-up space ecosystem, and investors will be closely tracking the revenue dynamics and operational performance of maturing start-up space firms.

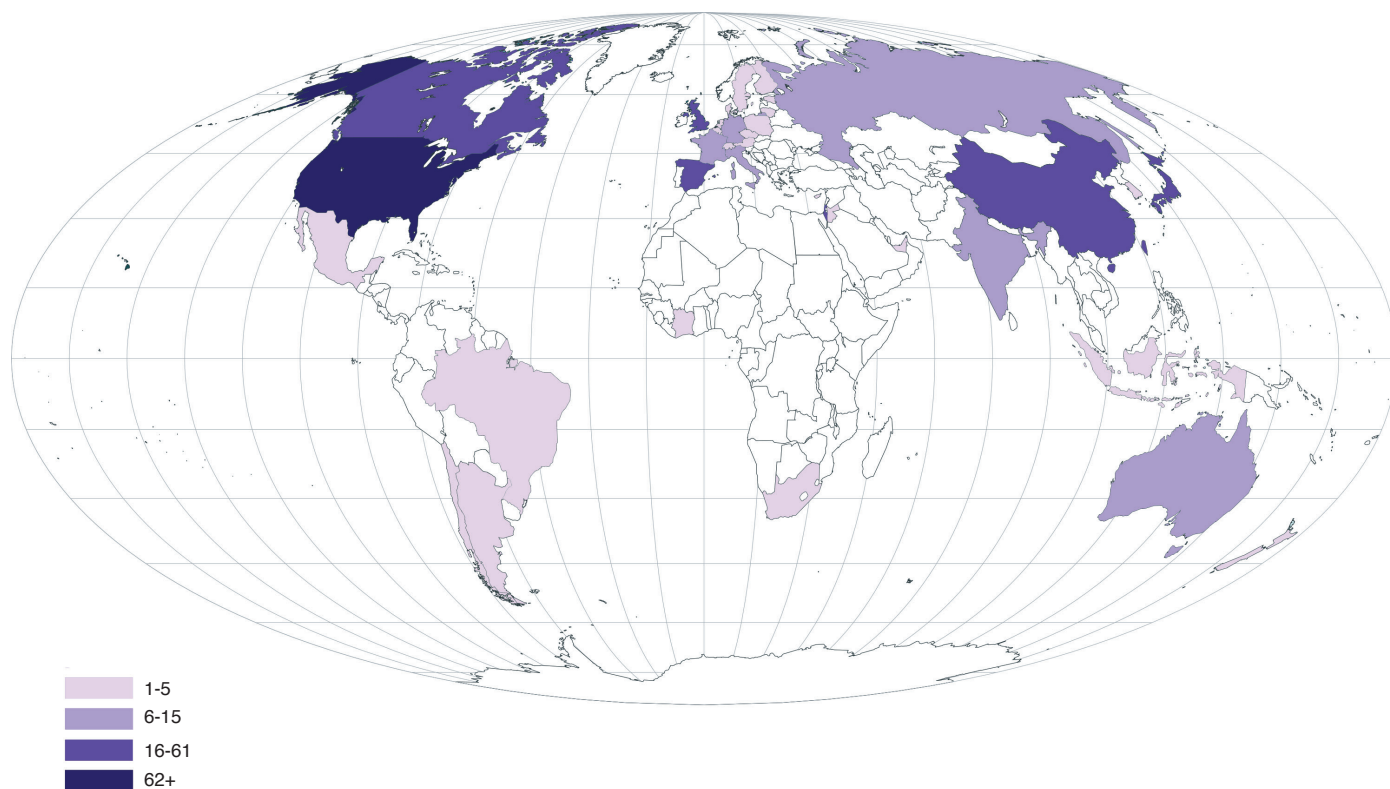


Figure E-3. Investors in start-up space ventures are headquartered in the U.S. and 37 other countries.

# Introduction

The *Start-Up Space* series examines space investment in the 21st century and analyzes investment trends, focusing on investors in new companies that have acquired private financing.

Start-up space ventures are defined here as space companies that began as angel- and venture capital-backed start-ups that have received investment in the 21<sup>st</sup> century. (This terminology and definition are intended to generally differentiate start-up space ventures from aerospace and defense government contractors and large, publicly traded space enterprises.) Start-Up Space seeks to provide insight into the dynamics of this growing space industry segment and the investment driving it.

Start-Up Space reports on investment in start-up space ventures, defined as space companies that began as angel- and venture capital-backed start-ups. The report tracks seed, venture, and private equity investment in start-up space ventures as they grow and mature, from 2000 through the end of 2018. The report includes debt financing for these companies where applicable to provide a complete picture of the capital available to them, and also highlights start-up space venture merger and acquisition (M&A) and initial public offering (IPO) activity.

## Purpose and Background

Bryce Space and Technology conducted the Start-Up Space study and produced this report, Start-Up Space 2019, the fourth report in this series. This project reflects Bryce's ongoing commitment to providing the space community with rigorous analyses of industry dynamics to aid good decision-making in industry, government, and academia.

Start-Up Space examines space investment in the 21st century and analyzes investment trends, focusing on new companies that have attracted private financing. Notably, capital that could be directed at any industry sector is flowing into space companies. This report seeks to inform investors, the aerospace industry, and the public about activity in this emerging space ecosystem.

## Methodology

Our dataset is sourced from a combination of: (a) publicly-reported investment transactions in start-up space ventures as they mature, with details on investment level and investors where reported; (b) additional companies for which little or no transaction data was reported, but which we have identified as start-up space ventures; (c) and qualitative data about investment trends and investor motivations. Bryce conducts ongoing interviews, surveys, and conversations throughout the global investment ecosystem, including at key nodes such as Silicon Valley/San Francisco, Southern California, Washington, D.C., Seattle, New York, Florida's Space Coast, Houston, Austin, Beijing, Brussels, Hong Kong, London, Luxembourg, Paris, Singapore, Sydney, and the United Arab Emirates.

## *Definition of Start-Up Space Venture*

What is a start-up space venture?

Our definition of a space company is a business entity that provides space products or services, specifically one that:

- Manufactures satellites, launch vehicles, or other space-based systems
- Manufactures satellite ground equipment
- Provides services that rely on these systems, such as satellite TV, radio, and broadband
- Provides analytic services based on data collected extensively from space-based systems, either alone or in combination with terrestrial systems

To define a start-up venture, we used a screening criterion that accepted those space firms that have received and reported seed funding or venture capital. We term these firms start-up space ventures throughout this report. There is no one standard, widely accepted definition for what constitutes a start-up. Typically, different stages within start-ups are described. For example, one typology is: seed stage is an idea that is not yet operational; early stage has begun operations but is not yet fully operational; growth stage has commercial revenues but needs outside capital to scale; and expansion stage is just prior to an initial public offering (IPO). Venture capital firms may choose to build a portfolio focusing on a particular stage, or diversify across companies at differing stages of maturity.

## *Data Set*

We include in our data set all firms that meet these criteria at any time during the period 2000–2018. Analysis of investment magnitude (i.e., value), investors, and transactions throughout this report is based on data available as of the first quarter of 2019, covering transactions through December 31, 2018.

Our data set includes six key types of investment (seed, venture, private equity, acquisition, debt financing, and initial public offering) in the firms that fall within the definition of a start-up space venture. A firm that receives venture funding and then receives a significant investment from a private equity group would be considered a start-up space venture by our definition, and the investments of both the venture firm and the private equity group would be included. On the other hand, a long-standing aerospace firm that recapitalizes and receives an investment from the same private equity group would not be considered a start-up, and the private equity investment would not be included in this analysis. The focus of this analysis is ‘new’ start-up space ventures and the capital they are attracting.

Note that the seed category includes funding from prizes (such as business plan competitions or XPRIZE), foundations, and crowdfunding campaigns, as well as seed funding from angels and “space billionaire” super-angels.

# Introduction

We include debt financing for start-up space ventures to provide a complete picture of the capital available to the management team at these companies.

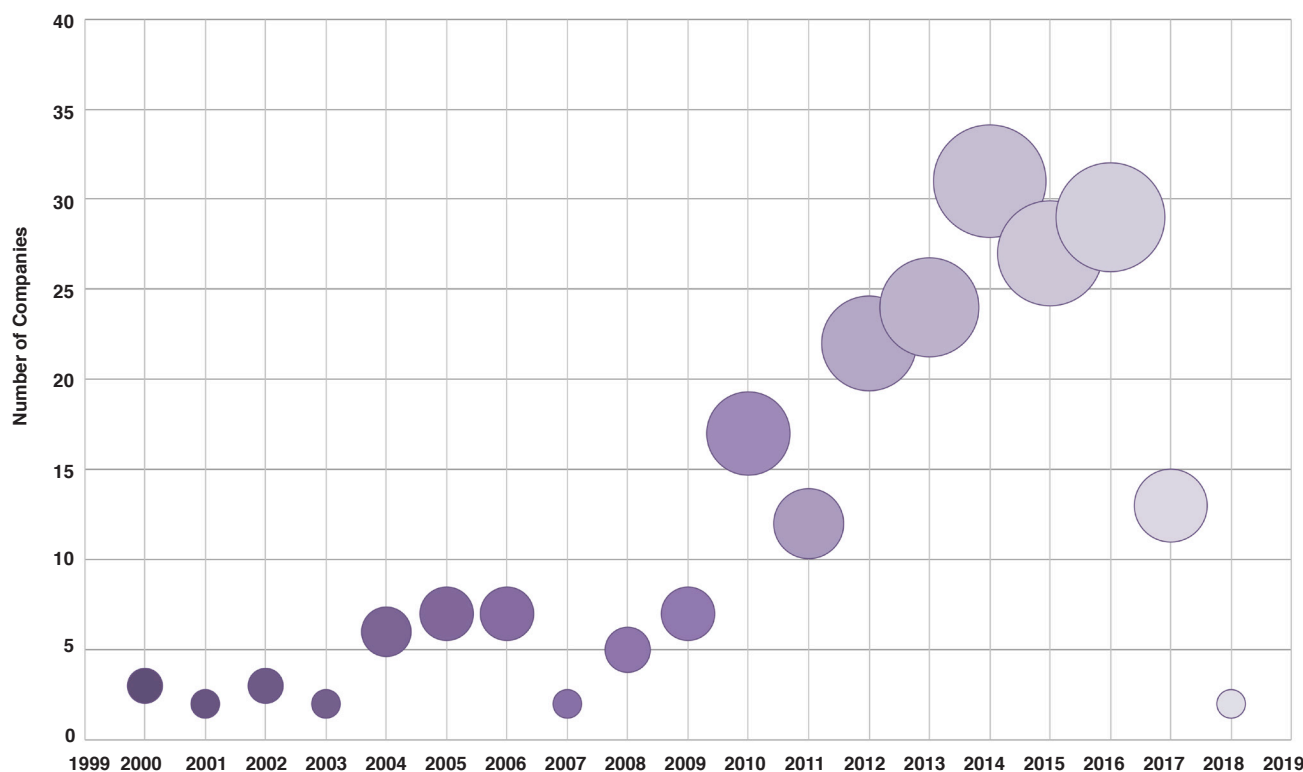
Sources of data on companies and investments include Bryce Space and Technology databases; company and investor press releases; annual reports, investor materials, and SEC filings; financial newsletters and databases, such as Crunchbase, PitchBook, NewSpace Hub, Owler, and CB Insights; news articles from major media outlets, such as Wired, Bloomberg, Fortune, Forbes; articles from investment publications, such as PE Hub, FinSMEs, VentureBeat, and TechCrunch; trade press, such as SpaceNews, Milbank's Space Business Review, Tech in Asia, and business journals; and on-going engagement with industry subject matter experts. Where possible, we confirmed the details of each investment using multiple sources. We further validated our data with venture capitalists, private equity investors, investment bankers, industry experts, management teams at space companies, and through targeted interviews.

The data set includes only publicly reported transactions; it does not include proprietary investment information. In some cases, transaction value, funding round, or investors are undisclosed. Depending on available information, these are either estimated or excluded.

The data set generally excludes government funding, except for certain grants, such as those provided by the Grand Duchy of Luxembourg. A few quasi-government corporations are included (e.g., Midland Development Corporation and The Valencian Institute of Finance), where they provide seed or venture investments with economic development objectives. Bryce also includes funding from publicly funded venture capital firms, such as the Central Intelligence Agency's In-Q-Tel.

# Overview of Start-Up Space Ventures

Over 220 new angel- and venture-backed space companies have been founded and funded in the period from 2000 to 2018. In the early 2000s, an average of four funded space companies were started per year; today the figure is five times higher. (In the last six years, the number of funded new companies has averaged 21 per year.) That average excludes new firms that have not yet secured investment. See Figure 1.



**Figure 1. Over 220 angel- and venture-backed space companies have been founded and funded since 2000.** Excludes companies that have not announced investment, including many founded in the last few years. In the 2018 Start-Up Space report, only five angel- or venture-backed start-up space companies were reported as having been founded in 2017. In the 2019 Start-Up Space report, the 2017 number increased to 13 companies. This suggests that the number of reported start-up space companies founded in 2018 (2) will likely increase in the future.

From 2009 to 2010, the number of new space start-ups more than doubled and venture capital investment increased 55%. Three of the newly founded companies were lunar exploration start-ups, which competed in the Google Lunar XPRIZE competition (Moon Express, ispace, and Team Indus). Other companies founded in 2010 attracted \$600+ million of venture capital in later years, including Planet, Satellogic, and Mapbox. The more than doubling of new start-up space companies from 2009 (7) to 2012 (22) coincides with a near quadrupling (to \$193 million) of venture capital invested in space start-ups during that span.

SpaceX conducted the first successful launch of its Falcon 1 launch vehicle in late 2008. In conversations with space investors, many interviewees pointed to SpaceX’s building a valuable company as a hallmark of industry activity. One investor noted, “SpaceX has really opened the doors. Space used to be the domain of NASA and large military contractors, and SpaceX showed that it is possible to build a purely

# Overview of Start-Up Space Ventures

## Examples of recently founded start-ups that have not announced investment

Capricorn Space	Origin Space
EarthAlytics	Orion Span
Golbriak Space	Space Horizon
Kiwi Orbitals	Space Origami
Leviathan Space Industries	Space Roasters
Mini-Cubes, LLC	

**Table 1. Examples of space start-ups that have not announced investment.** *Data reflects publicly reported investments through December 31, 2018.*

commercial enterprise doing launches. They have out-executed some of the more traditional folks. That gave permission to a whole bunch of other folks to think about the problem, which some investors have observed as a catalyst for investment.”

There is generally a multi-year lag from a company’s founding to when it receives external investment. Therefore, recently-founded companies have not had a chance to raise (and announce) external funding and are not included in Figure 1. Examples of recently founded start-up space ventures that have not yet secured or reported external investment are shown in Table 1. Potential reasons for not announcing funding include actively pursuing further funding rounds, or the protection of a competitive advantage while in “stealth” mode. The total number of reported start-up ventures has increased compared to Bryce’s Start-Up Space 2018 report, reflecting new announcements by existing companies, new companies, and enhanced data sets. Based on the recent trend, Bryce anticipates that the 2018 number will increase in the next 1 to 2 years.

# Overview of Space Investors

This analysis considers six categories of investor to aid in understanding trends in investment and investor motivation.

## Types of Investor

The investor typology used in this study consists of: angel investors, venture capital firms, private equity (PE) firms, banks (typically not strictly investors, but an important source of capital), corporations (as strategic partners and/or internal investors, or through corporate venture funds), and public markets. This typology conceptually groups some investor types that could be treated separately but share characteristics, such as sovereign wealth funds (included in venture capital category) and hedge funds (included in the venture capital firm category). While investor categories continue to shift and evolve, the typology here provides a useful (and generally accepted) broad brushstroke description of groups of investors and their typical investment behaviors.

We describe each type of investor and typical (1) role as a funding source, including the stage of involvement, (2) preferred funding instrument (e.g., debt, equity, or hybrid debt/equity instruments) and (3) general objectives in investing. For illustrative purposes, examples of select space deals are also provided.

## Angel Investors

Typically, angel investors are individuals or families (including family offices) that have accumulated a high level of wealth and seek potentially high returns by investing in ventures during their early stages. In recent years, angels have also participated in syndicates, pooling investments with other angels and venture capital firms to provide more funding to start-ups. This model enables an angel to invest in more companies and spread risk. For example, instead of investing \$100,000 in a start-up, four angels will invest \$25,000 each. If the start-up fails, the angels have minimized risk through smaller, more frequent investments. We include incubators and accelerators in this investor group because they provide equity as well as mentoring and networking at the pre-seed or seed stage of a start-up. Investment by angels into start-up space ventures is usually in the form of straight equity into the company. Investments often range from \$50,000 to more than \$1 million. There is a highly visible special category of angel investor in the space ecosystem, consisting of billionaires and other ultra-high net worth individuals who have personally staked investment in new space companies. The investment level by space billionaires far exceeds typical angel levels.

By getting in at the ground floor (i.e., when a company is just starting development of its product or service), an angel investor can realize an attractive potential return, as the early investment will secure a significant foothold in the company. Time horizons for angel investors are about 5 to 7 years, meaning they seek to realize their return (i.e., exit) about 5 to 7 years from the date of investment. Angels may expect an equity stake in the company as high as 30% to 40% in return for their investment; however, frequently, angel stakes are much lower, especially after subsequent, larger investors join the capital structure. Angel investors range from those who can comfortably make a \$50,000 investment to, as noted, particularly in commercial space ventures, 'super-angel' multi-billionaires who typically invest in space start-ups at the \$100+ million level. These

# Overview of Space Investors

investors have already made their mark in technology-driven enterprises, and include Jeff Bezos of Blue Origin (Amazon), Elon Musk of SpaceX (PayPal), and the late Paul Allen of Stratolaunch (Microsoft). Some super-angel investors have stated an interest in space investment for purposes other than or in addition to profit-seeking (e.g., exploration and the advancement of scientific knowledge), and some in the investment community have defined these investments as “self-finance.” Bryce defines these investors as super-angels, and caveats analyses of investment totals to highlight the impact of super-angel investment (\$100+ million deals) on the wider picture of investment activity.

## Venture Capital Firms

Venture capital (VC) firms are groups of investors that invest in start-up, early stage, and growth companies with high growth potential, and accept a significant degree of risk. The trade of risk for potential high returns results in a high failure rate. A 2012 research study by Shikhar Ghosh, senior lecturer at Harvard Business School, finds that, “About three-quarters of venture-backed firms in the U.S. don’t return investors’ capital.”<sup>2</sup>

VC funding has traditionally come in stages (or rounds), generally designated Series A, Series B, Series C, etc. The form of investment is equity; specifically, the instrument is usually preferred stock, which gives the VC firm an equity ownership stake in the company, but at a higher priority (or preference) than investors at common equity (e.g., founders, employees, and angels) and a lower priority than any holders of company debt. The preferred shares are usually convertible to common stock in the instance of a stock market launch or initial public offering (IPO; see “Public Markets”) or sale of the company, which are the typical instances of a VC’s exit. There is substantial variation in the size of rounds, but Series A investment rounds typically range from \$2 million to \$10 million; Series B, in the low tens of millions of dollars; and Series C, in the high tens of millions of dollars. Investment syndicates comprised of multiple VC firms may significantly increase these levels. Note that the distinct ‘series’ model for VC investments is evolving, with more continuous investment by an ongoing team of investors emerging as a trend. In addition, whereas historically each successive round would be labeled consecutively, by letter, a more recent model appends numbers to rounds. For example, if a start-up raises \$7 million in a Series A financing from a group of investors, and several months later raises an additional \$3 million from new investors, under the same terms as the Series A financing, then the new investment would be considered Series A-II.

Several space-oriented VC funds have emerged from this class of investors. Most recently, in February of 2019, Starburst Aerospace and Techstars announced plans to accept applications for a new space-focused accelerator based out of Los Angeles. The accelerator, reportedly backed by the U.S. Air Force, NASA’s Jet Propulsion Laboratory, Lockheed Martin, Maxar Technologies, SAIC, and Israel Aerospace Industries, plans to award each selected participant a \$120,000 seed investment, as well as executive mentorship. Starburst Ventures, a venture fund of Starburst Aerospace, had previously announced a \$200 million space-focused fund in 2016, but has so far reported only one investment, in 2017.

In 2017 the early stage-focused angel syndicate Space Angels announced a \$50 million inaugural fund, Space Capital, which has invested in 4 start-up space ventures as of the end of 2018.

<sup>2</sup> I Ghosh, Shikhar. “The Venture Capital Secret: 3 Out of 4 Start-Ups Fail.” Harvard Business School. President and Fellows of Harvard College, 19 Sept. 2012. Web. 1 Feb. 2015.



Seraphim Capital also launched a space technology fund in late 2016. Seraphim Space Fund is a \$95 million space-focused fund, whose investors include Surrey Satellite Technology, Airbus, SES, Telespazio, Teledyne, Rolta, First Derivatives, The British Business Bank, the European Space Agency, and the UK's Satellite Application Catapult. Based in London, the fund takes a broader interpretation in its definition of space technologies, extended to include those developed for use in space that may now be applied in other areas, such as unpiloted aerial vehicles. In early 2018, Seraphim launched the Space Camp accelerator, the UK's first accelerator programme dedicated to space start-ups, which has seen 16 companies participate. Seraphim has invested in start-up space companies, including LeoLabs, Spire, and Iceye, as well as drone-related aerospace companies.

In 2015, Bessemer Venture Partners announced the creation of its \$1.6 billion fund, BVP IX, to invest in innovative companies, including those the space sector. In addition to VC funds, governments and sovereign wealth funds have emerged as investors in start-up space companies. For example, in 2016, Luxembourg opened a \$227 million fund, SpaceResources.lu, to provide “early stage investments in innovative start-ups as well as in more mature companies, with a focus both on Luxembourg-based enterprises in the space resources industry, and companies developing substantial space resources related technologies in the Grand Duchy.”<sup>3</sup> Though Luxembourg realized capital loss of around US \$13.7 million, its fund dedicated to space resource utilization has remained active.<sup>4</sup> In November 2017, the Luxembourg Future Fund (LFF), set up by the European Investment Fund and the Société Nationale de Crédit et d'Investissement, also provided funding to a space start-up. LFF and RRE Ventures led a \$70 million Series C in Spire Global, a weather and asset tracking space start-up. Russia (Skolkovo) and China (Cyberagent) launched a \$200 million venture fund in 2015, with space technology as one focus area (reported by *Fortune*). In October 2015, a Russia-based satellite manufacturing start-up, Dauria Aerospace, secured a \$70 million project from Cybernaut (as reported by *Tech in Asia*).

## Private Equity Firms

Private equity firms manage funds of capital on behalf of limited partner investors, typically with a mandate to invest directly in companies. They traditionally invest in established companies (not start-ups) at large transaction sizes, often acquiring an entire company or a group of related companies that can merged. The funds managed by private equity firms primarily consist of capital commitments made by institutional investors, such as sovereign wealth funds, pension funds, and family offices. These investors may also invest in other types of funds, for example venture capital, as well as directly into private companies. Family office investors may be single or multi-family offices, where multi-family offices represent aggregated pools of capital from high net worth individuals.

Larger investment firms, which typically have multi-billion-dollar investment funds from which they draw funds, have shown some interest in space over the past 15 years. Historically, the appetite for such investment has been limited to investment in the telecommunications industry or government contracting, such as deals from Blackstone, Columbia Capital, Permira, Apax, and the Carlyle Group. Large private equity firms tend to invest magnitudes

<sup>3</sup> Bartunek, Robert-Jan. “Luxembourg Sets aside 200 Million Euros to Fund Space Mining Ventures.” *Reuters*, Reuters, 3 June 2016.

<sup>4</sup> Outside of investment activity, the government of Luxembourg signed four Memoranda of Understanding (MOUs) for cooperation in space resource utilization in 2018, with Poland, the United Arab Emirates, China, and the Czech Republic.

# Overview of Space Investors

over \$100 million, usually in firms that are ideal candidates for debt restructuring or leveraged buyouts. This has been the case for several large commercial satellite operators.

However, in recent years, the traditional characteristics distinguishing private equity from venture capital investments have somewhat broken down. In an environment where asset managers of both classes are awash with investor capital looking to be deployed, many private equity and venture capital managers have expanded their investment mandates to include debt and “hybrid” capital offerings. In high growth technology sectors such as space, often characterized by companies that are yet to demonstrate profitability, debt is typically offered secured against the revenue streams generated by customer contracts. Of late, many PE managers are making equity investments at earlier stages of companies’ maturity – on a minority basis, and with longer expected exit time-horizons. It should be noted, however, that these developments are not limited to the start-up space sector, and are at least in part a reflection of the widespread proliferation of new technologies and business models throughout the global economy.

Examples of private equity investment in space include Blackstone’s \$200 million investment in Sirius Satellite Radio and its nearly \$1 billion purchase of the commercial satellite capacity provider New Skies Satellite; Columbia Capital’s substantial investment in XM Satellite Radio and Ligado Networks (formerly LightSquared Company); and Apax, Permira, and Carlyle Group’s multi-hundred million dollar investments in the acquisitions of large satellite services companies, such as Intelsat, Inmarsat, and PanAmSat from 2003 to 2004. Permira bought Asia Broadcast Satellite for \$200 million in September 2010; however, there have been few space-related private equity deals since the financial downturn in 2007/2008.

## Corporations

Corporations have often provided the funding necessary to bring space-based programs to initial operating capability, as well as to sustain ongoing programs. Corporations invest internally, in R&D, in manufacturing, in operations and processes, and in many other areas to enhance capabilities to create or strengthen an existing expertise or advantage.<sup>5</sup>

A corporation may also provide funding for a venture, usually in the form of straight equity or sometimes in the form of debt, often with the option to convert the instrument into equity of the investee company. Some large companies may also invest through a corporate venture fund (examples include Boeing HorizonX and Lockheed Martin Ventures), which acts as a company-owned VC equivalent.

Examples of a corporation serving as a strategic partner include: Liberty Global, a longtime cable operator, participating in private equity and venture capital deals from 2008 to 2013 in O3b, a satellite-based internet delivery constellation; and Kymeta, an omnidirectional satellite antenna developer. In 2009, SES, a commercial geosynchronous orbit (GEO) satellite fleet operator, invested \$75 million (a 30% stake, early in the investment cycle) in O3b.

More recently, the industry has seen a variety of investors in space, with Japanese-based Mitsui & Co., Ltd., among existing investors investing \$150 million of Series C funding in Spaceflight Industries, China-based HCH Group investing \$100 million in a Series B

<sup>5</sup> A special category of internal investment typical of space firms for whom the U.S. government is a major customer is “independent research and development (IR&D),” which is a type of government-sanctioned R&D expenditure that affects how the government pays a contractor firm for the work that it does.

equity transaction for Cloud Constellation Corporation (formerly known as SpaceBelt), and Goldwind of China joining one other corporation, an angel investor, and three venture capital firms to invest \$43 million of Series B+ funding in LandSpace. SoftBank, Virgin, Coca-Cola, Intelsat, Airbus, Qualcomm, and Hughes Network Systems, Totalplay, and Bharti Enterprises invested a total of \$1.7 billion in OneWeb from 2015 to 2016.<sup>6</sup> Softbank, a Japanese corporation, has made additional billion dollar investments in OneWeb. In February 2015, Google invested \$900 million in SpaceX, “to support continued innovation in areas of space transport, reusability and satellite manufacturing.”

Corporations may also acquire firms. A record-setting example is the AT&T purchase of DirecTV in 2015 for \$48.5 billion, which set a new bar for acquisition of a space company. More recently, Northrop Grumman acquired Orbital ATK for \$7.8 billion in mid-2018. Note that DirecTV and Orbital ATK are not start-up space ventures under our definition. These transactions are more typical of the merger and acquisition activity for established companies. With that said, corporations have recently also acquired firms that fit the model of start-up space ventures. In 2018, corporations acquired seven space start-ups for an estimated total of \$100 million. (See Table 5 later in this report.)

## Banks

Banks have been heavily involved in providing and facilitating funding for space-based programs of large, established firms, such as GEO satellite operators, during the past 19 years. The basic model is that equity investors provide a substantial “cushion” (e.g., 30% of the total capital expense or CapEx required for a certain program, such as deployment of a satellite or satellites). The remainder of CapEx (or other types of programmatic expenditure) is financed by debt, sometimes in the form of “convertible debt,” meaning that the initial instrument is in the form of debt. At certain trigger points, the debt can be converted, in whole or in part, into an equity stake in the financed company.

Commercial banks based in the U.S., such as Wachovia, Wells Fargo, and Citibank, and non-U.S.-based banks, such as Deutsche Bank, BNP Paribas, and ABN AMRO, in Europe, have provided debt financing at a magnitude of \$100 million to \$1 billion (sometimes exceeding \$1 billion) per funding event. Most of the companies financed are companies with large satellite CapEx requirements, such as Intelsat, SES, and Inmarsat, for which multiple GEO satellites are required at a cost of \$250 million to \$300 million each to build, launch, and insure. Other companies financed (e.g., Iridium and GlobalStar) have \$2 billion to \$3 billion CapEx requirements for low Earth orbit (LEO) satellite constellations.

In addition, government-backed banks (i.e., export credit agencies), such as U.S. Export-Import (Ex-Im) Bank and COFACE of France have provided debt funding (or guaranteed third-party debt funding) for several satellite systems. The purpose of these banks is to support deals that benefit domestic enterprises, for example, the Ex-Im bank may provide financing to benefit an export deal involving a U.S. satellite manufacturer. Ex-Im Bank has provided multi-hundred million-dollar debt financing at various points

<sup>6</sup> In Q1 2019, OneWeb announced that it had raised a total of \$3.4 billion since its founding, including a \$1.25 billion round in 2019. This implies additional, undisclosed funding beyond the \$2.95 billion in disclosed transactions (roughly \$1.7 billion through 2018 and the \$1.25 billion transaction in 2019). Given the uncertainty around the timing of this previously undisclosed funding, Bryce will treat it as a 2019 investment, consistent with the date OneWeb included the amount in its public statements.

# Overview of Space Investors

in the past to satellite operators, including ViaSat of the U.S., AsiaSat and Asia Broadcast Satellite in Asia, and Spacecom in Israel. However, the Export-Import (Ex-Im) Bank lost its quorum in 2015, which meant that its board of directors did not have enough people to make any commitments over \$10 million. COFACE has backed the debt obligations of several satellite constellations, including O3b, GlobalStar, and Iridium. Both Ex-Im Bank and COFACE have provided loans and debt guarantees to an Australian company, NewSat, for \$400 million. Moreover, Ex-Im Bank provided \$525 million in debt financing for ViaSat in November 2014. Proceeds were earmarked for the build and launch of the company's two Ka-Band (broadband) satellites.

Banks are less likely to have a major role in providing financing for start-up ventures.

Note that investment banks and investment bankers—often-visible actors in complex investment transactions typically involving private equity, corporations, and/or public markets—often act as brokers arranging and facilitating these transactions, rather than as the principal lenders or investors. Whilst significant non-strategic equity investment has become extremely difficult for banks since the introduction of regulatory changes in the wake of the global financial crisis, banks can still lend (debt finance) in material size on their own balance sheet. Investment banks play a variety of roles, including advising on capital raising approaches and more strategic transactions such as mergers and acquisitions (M&A), as well as underwriting a capital raising event (e.g., an IPO). Investment banks often focus on large transactions (typically in the multi-hundred million-dollar to over \$1 billion range) and large space/satellite communications companies work with investment banks as financial advisors. These institutions will usually take the role of “lead managers” of a financing transaction, often with several fulfilling that position. For example, in November of 2018, Bank of America facilitated a \$250 million high-yield loan sale for SpaceX. Likewise, J.P. Morgan, Lehman Brothers, and UBS acted as joint lead managers for a \$500 million capital raise in 2007 for fledgling mobile satellite services operator TerreStar (now owned by DISH Network).

## Public Markets

Toward the later stages of a space-based company's funding trajectory, there can be a public sale of the company's equity (common stock), or initial public offering (IPO). The IPO enables additional capital to be raised to supplement prior funding rounds and provide previous investors an exit mechanism for their investments (i.e., sell their equity shares in the public market place). Many established space companies and government contractors have long since had their IPOs and continue to trade publicly. Examples include Boeing, Lockheed Martin, Northrop Grumman Corporation, and Harris Corporation.

IPOs in the space industry, while somewhat rare, have ranged from around \$100 million (e.g., GlobalStar and Orbcomm) to about \$800 million (e.g., Intelsat). Secondary offerings (post-IPO) also serve to provide funds for capital expenditures and other corporate purposes (e.g., operations, working capital, and retirement of debt). DigitalGlobe raised \$279 million in 2009, and in 2014, Iridium raised \$170 million through public sales of \$50 million in common stock and \$120 million in convertible preferred stock. (Iridium is not a start-up space company, by our definition.) IPOs of space start-ups have been very limited, with the only notable examples being UrtheCast, which went public on the Toronto Stock Exchange through a reverse IPO in 2013, and exactEarth, a geospatial analytics and maritime AIS data services company, which went public in 2016 for an undisclosed amount. See Table 2.

Type of Investor	Characterization of Investor	Typical Space Investment	Investment Type	Examples of Transactions	Expected Returns/Exit Horizon
<b>Angel Investors</b>	High net worth individuals, families, or groups of angels	\$50K – \$1M	Equity	York Space Systems with \$250K of angel investment from Dylan Taylor in 2015	5-10X investment/5-7 years
<b>Venture Capital Firms</b>	Groups of investors focusing on early stage, high growth ventures and accepting a significant degree of risk	\$2M – \$75M	Equity preferred stock in several tranches (e.g., Series A, B, C)	Kymeta with \$144M of venture capital from multiple (2012–present)	5X investment/5 years
<b>Private Equity Firms</b>	Large investment houses that have multi-billion dollar investment funds— focus on established companies	\$100M – \$1B	Equity	Virgin Galactic with \$490M of investment from Aabar Investments (2009 and 2011)	3-5X investment/3-5 years
<b>Corporations</b>	<p>Large companies providing strategic investments to support large CapEx space projects</p> <p>Internal R&amp;D for special projects</p> <p>Independent R&amp;D as government contractor</p> <p>Merger and acquisition</p> <p>Venture investing</p>	\$100M – \$1B	Equity and sometimes debt	OneWeb with \$1.7B of investment from SoftBank, Intelsat, and other corporations in 2015 and 2016	Significantly less returns than for PE firms/horizon is over a long term
<b>Banks</b>	Private and government-backed banks providing substantial debt financing layered over equity	\$100M – \$1B	Debt, sometimes convertible into equity	O3b with \$184M of debt financing from COFACE in 2015	Straightline interest rates (e.g., 5–10%)
<b>Public Markets</b>	Independent R&D as government contractor	\$100M – \$1B	Equity	Iridium raising \$170M in an IPO	Serves as a vehicle to allow the earlier investors to exit

Table 2. Different types of investors pursue different types of investment objectives.

# Space Investment by the Numbers

Cumulative investment (including debt financing) in start-up space ventures since 2000 totals \$21.8 billion, including \$8.4 billion in early and late stage venture capital, \$3.1 billion in seed financing, \$1.8 billion in private equity, and \$4.7 billion in debt financing. This also includes \$3.7 billion in merger, acquisition, and public offering events. More than 75% of investment in start-up space ventures since 2000 has occurred in the last six years. Including debt financing, investors have provided \$2 to \$3 billion to space start-ups in each of the last four years: \$2.8 billion in 2015, \$3 billion in 2016, \$2.6 billion in 2017, and \$3.2 billion in 2018. More than \$9 billion (almost 80%) of investment since 2015 has been seed and venture capital. Looking at investment only (excluding debt financing), more than two thirds of investment in start-up space ventures since 2000 has been in the last four years.

The year 2018 did not see any billion-dollar deals, although eight deals exceeded \$100 million. The largest was Blue Origin's estimated \$750 million angel investment from Jeff Bezos, followed by three raises for SpaceX totaling \$737 million from Series I, Series J, and a debt financing round, facilitated by Bank of America. Together these transactions made up 46% of all investment raised in 2018.

The mix of investment types (including debt financing) has evolved over the last 19 years. Seed funding is evident in most years; however, seed funding has typically been at a lower magnitude as compared to other investment types, with the notable exception of Jeff Bezos's super angel investment in Blue Origin. Debt financing is prominent in the middle years of this timeframe, whereas venture capital has significantly increased in more recent years. Private equity is also most evident in the middle period, when debt financing peaked. See Figure 2 for annual investments by type. Figure 3 shows annual investment of private equity, venture capital, and seed/prize/grant investment. In addition, Table 3 shows investment by type and percent change between the past three years.

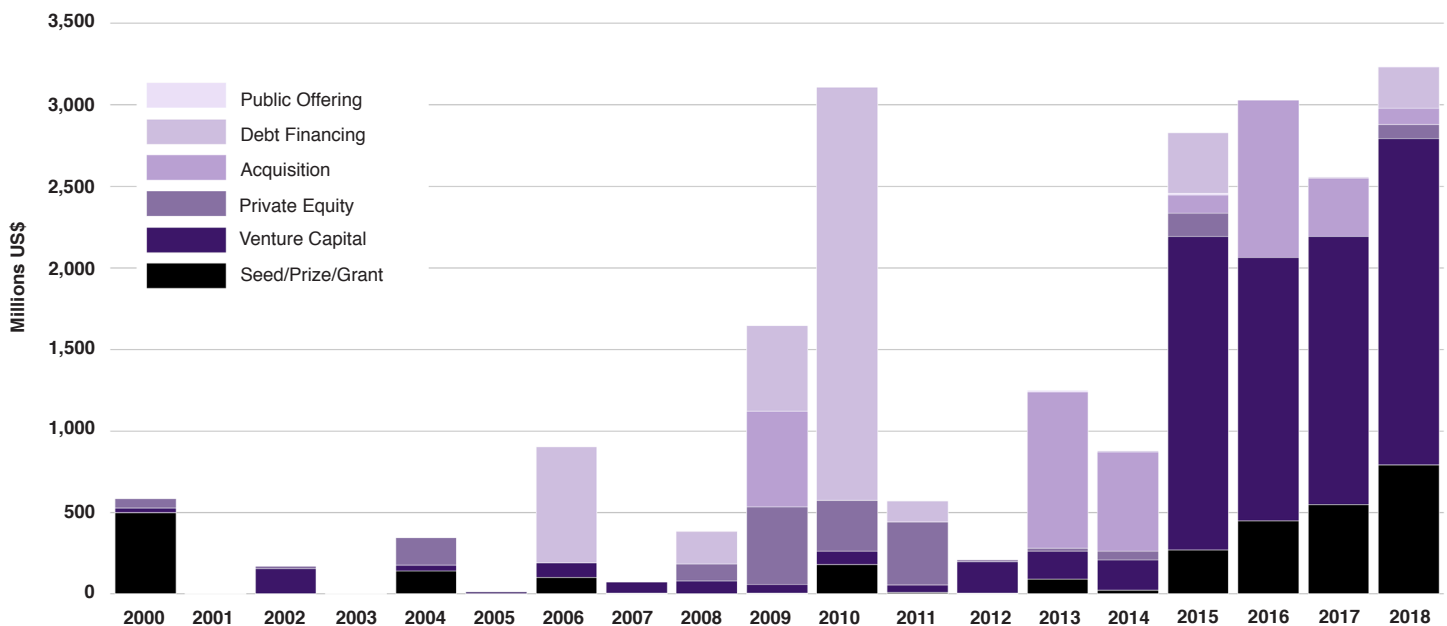
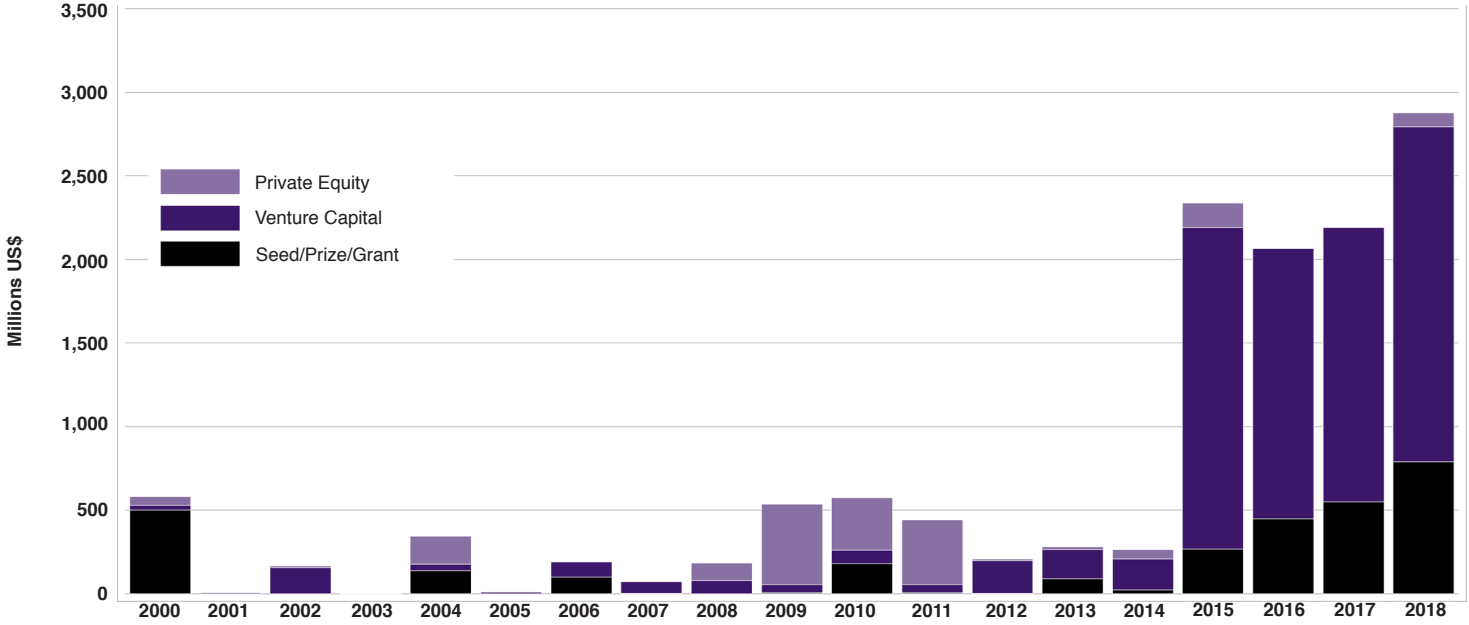


Figure 2. The mix of types of investment in space companies varies from 2000 to 2018.



**Figure 3. The mix of public offering, private equity, venture capital, and seed/prize/grant investment in space companies varies from 2000 to 2018.**

Investors provided a record \$3.2 billion to start-up space companies in 2018, about \$680 million more than in 2017 and \$200 million more than the previous record year, 2016. This difference is primarily driven by three large late-stage investments in SpaceX (at over \$200 million each) and one large investment in Blue Origin from Jeff Bezos (estimated at \$750 million). The number of start-up space companies reporting investment in 2018 was 82, similar to 2017 levels. The number of investors increased by 7% in 2018 while the number of deals grew 8%.

Investment in 2018 stemmed from 187 investors in 82 companies, across 90 deals.

The number of investors increased in 2018 (187) compared to 2017 (177). But the total number of start-up space companies reporting new funding in 2018 (82) increased only marginally over the 2017 total (79). Deal count increased steadily in 2018 (90) compared to 2017 (83).

Investment Type	2016 (millions)	Change	2017 (millions)	Change	2018 (millions)
Seed/Prize/Grant	\$447.7	22%	\$548.3	44%	\$791.7
Venture Capital	\$1,617.8	2%	\$1,642.8	22%	\$2,002.4
Private Equity	\$0	0%	\$0.0		\$85.0
Acquisition	\$962.5	-63%	\$360.0	-72%	\$100.0
Public Offering	\$0	0%	\$0.0	0%	\$0.0
<b>Total Investment</b>	<b>\$3,028.0</b>	<b>-16%</b>	<b>\$2,551.0</b>	<b>17%</b>	<b>\$2,979.1</b>
Debt Financing	\$1.9	159%	\$5.0	5010%	\$254.0
<b>Total with Debt</b>	<b>\$3,030.0</b>	<b>-16%</b>	<b>\$2,556.0</b>	<b>26%</b>	<b>\$3,233.1</b>

**Table 3. Total 2018 start-up space investment increased about 26 percent.**

# Space Investment by the Numbers

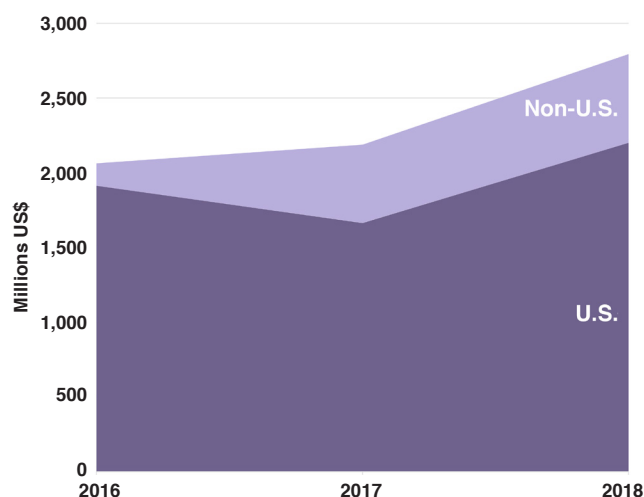


Figure 4. Seed and venture capital investment in space start-ups increased from 2017 to 2018.

U.S. start-ups continue to dominate start-up space, with about 80% of all investment in 2018, close to half of investors and companies reporting investment in the last three years are based outside the U.S. For the first time, the number of non-U.S. investors investing in start-up space companies nearly matched the number of U.S. investors. Total investment in non-U.S. space start-ups rose in 2018 compared to 2017. The largest investments were in i-Space and Astroscale. Non-U.S. seed and venture investment, the number of non-U.S. firms reporting investment, and the number of non-U.S. investors are greater than in 2017. Note that this total considers investment in OneWeb to be investment in the U.S, given the location of the majority of OneWeb activities. The number of non-US investors increased from 84 to 92 (94 including two government organizations). From 2017 to 2018 the number of non-U.S. investors rose from 47% to 49% of all investors. Most non-U.S. investors in 2018 from China and the United Kingdom. See Table 4.

Total investment in non-U.S. space start-ups in 2018 was \$610 million, a 9% increase from last year (\$562 million). Companies in China and the UK received 60% of the non-US total. Seed and venture investment in non-U.S. space start-ups rose from \$527 million in 2017 to \$595 million in 2018. The 2018 non-U.S. total was up 13% from the previous year.

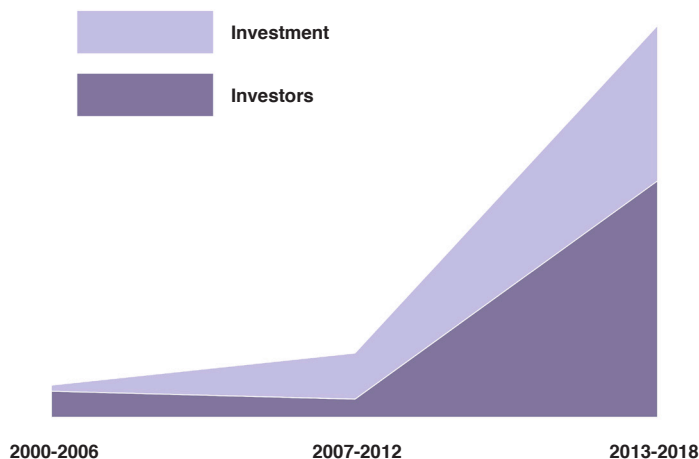
Category	Location	2016	Change	2017	Change	2018
		(millions)		(millions)		(millions)
Total Investment	U.S.	\$2,146.0M	-7%	\$1,994.0M	32%	\$2,622.8M
	Non-U.S.	\$884.4M	-36%	\$562.1M	9%	\$610.3M
Seed and Venture Investment	U.S.	\$1,912.6M	-13%	\$1,664.5M	32%	\$2,198.8M
	Non-U.S.	\$153.4M	243%	\$526.6M	13%	\$595.3M
		Number		Number		Number
Number of Investors	U.S.	90	3%	93	3%	95
	Non-U.S.	51	62%	84	12%	92
Number of Recipients	U.S.	37	22%	45	4%	47
	Non-U.S.	22	55%	34	3%	35

Table 4. Investment magnitude in U.S. and non-U.S. space start-ups, number of investors, and number of recipients from 2016 to 2018.



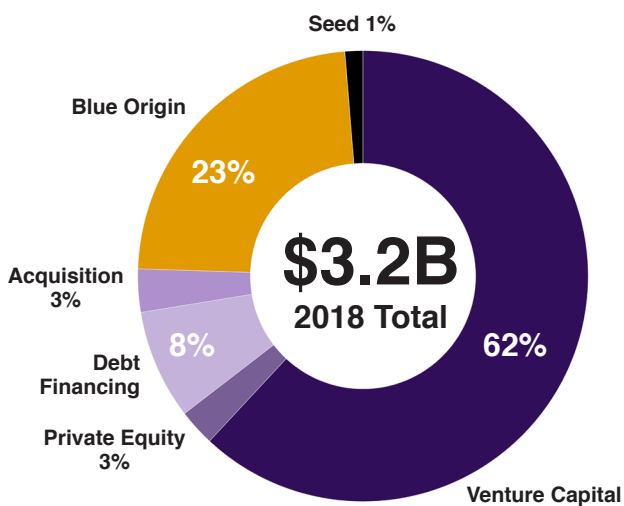
## Seed Funding

For the total period covered in this report, seed funding is \$3.1 billion. Note that the large seed funding amounts in 2000 and from 2015 to 2018 primarily represent an estimated \$2.3+ billion commitment by Jeff Bezos to Blue Origin; \$500 million of this estimated funding is counted here in the year of the company’s founding. However, the timing of the commitment is not public. It may be spread more evenly over the study period, and (based on company activity and employment) appears to have been spent at a higher rate in recent years. In early 2017, Blue Origin publicly commented on the New Glenn launch vehicle. In these public comments, Jeff Bezos said he would sell about \$1 billion per year of Amazon stock to finance development of the new launch vehicle, which Blue forecasts will have a development cost of \$2.5 billion. We have assumed that investment in Blue in 2018 was \$750 million, marking a steady increase from 2017, when we estimated investment in the range of \$500 million. This increase reflects development and operations costs associated with the New Glenn and New Shepard launch vehicles and other activities.



**Figure 5. The yearly average magnitude of seed investment and average number of seed investors are trending up.** Note that this figure excludes super-angel investments.

Overall, seed investment rose by 44% in 2018, from \$548 million to \$792 million. Seed funding totals are dominated by a few super-angel seed investments, including investment by Jeff Bezos in Blue Origin, Elon Musk’s early investment in SpaceX (\$100 million in 2006), Richard Branson’s investment in Virgin Galactic (\$100 million since 2004), and Robert Bigelow’s investment in Bigelow Aerospace (\$250 million largely invested around the period 2010 to 2013). Figure 6 separates estimated super-angel investment in Blue Origin from other seed investments in 2018.



**Figure 6. Blue Origin comprised over 20 percent of all investment in start-up space companies in 2018.** Note that the 2018 investment magnitude for Blue Origin is an estimated figure.

Excluding super-angel investments, average seed funding dropped by a fifth from the 2000-2006 (\$6.0 million) to 2007-2012 (\$3.6 million) periods, and then increased thirteen-fold from the 2007-2012 to 2013-2018 (\$49 million) periods. Despite the drop in magnitude between the

# Space Investment by the Numbers

2000-2006 and 2007-2012 periods, the average number of angels more than tripled at the same time. This upward trend continued from the 2007-2012 to 2013-2018 intervals, with the number more than tripling again. See Figure 5 on Page 16.

Excluding investment from super-angels, total seed investment in 2018 was \$41.7 million, a decrease from 2017 (\$48.3 million); seed investment has increased 125% since 2015 (\$18.5 million). In addition, average investment per seed deal increased modestly from \$1.7 million in 2017 to \$2.2 million in 2018. Average investment per seed deal has risen by nearly 270% since 2015 (\$0.6 million).

Including investment from super angels, seed investments in start-up space ventures increased 42% from 2017 (\$548 million) to 2018 (\$792 million). Average deal size more than doubled, surging from \$18.9 million to \$37.7 million. The number of seed deals declined from 2017 (29) to 2018 (21).

## Venture Capital

Venture capital investment in start-up space ventures since 2000 totals \$8.4 billion, with roughly 85% invested in the last four years.

Total venture capital (VC) investment rose 22% from 2017 to 2018, to roughly \$2 billion, reflecting an increase of nearly \$360 million from 2017. Venture deals continued to increase in frequency, with 58 deals in 2018, including 50 early-stage venture deals (the most of any year). Of the 113 venture capital firms (+20% versus 2017) that invested in start-up space companies in 2018, 42 had previously reported investment in start-up space companies; 71 had not, and appear to be new additions to the start-up space ecosystem.

Six 2018 venture deals exceeded \$100 million, as compared to three 2017 deals exceeding \$100 million. The top two largest venture capital deals belonged to SpaceX, with a \$273 million Series J round at the very end of the year and a \$214 million Series I round closing in April. The third largest deal was Planet Labs' \$168 million Series D. In past years, the largest venture deals have been those in SpaceX and OneWeb. Figure 7 shows the impact of venture investments in SpaceX and OneWeb on total annual venture investment. The category "Other" represents the total sum of all venture deals each year, excluding the SpaceX

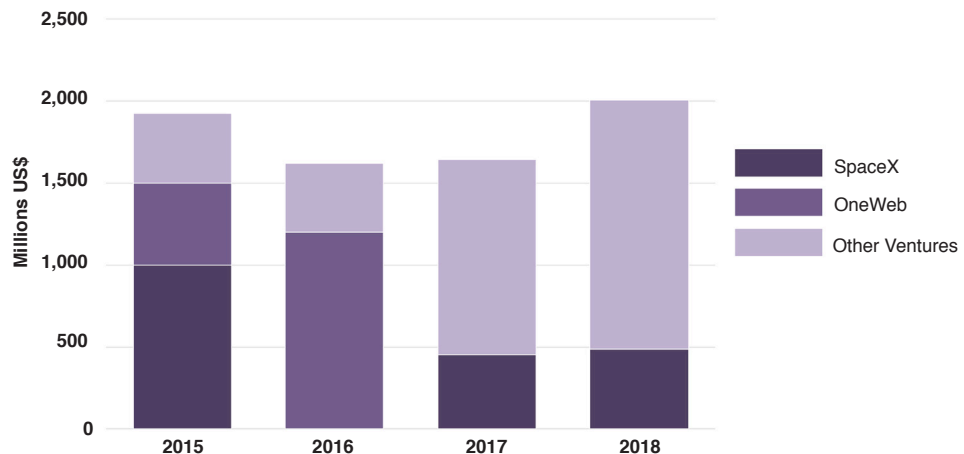


Figure 7. About 60 percent of all venture investment in the last four years has gone to SpaceX and OneWeb.

and OneWeb deals. About 51% of all venture investment in the last four years has gone to SpaceX and OneWeb.

Excluding \$100+ million deals, venture investment increased from 2017 (\$847 million) to 2018 (\$957 million).

Across all segments (not only space), 2018 saw an historic number of venture capital deals valued at \$100+ million (184), surpassing a record-breaking 2017 (109).<sup>7</sup> Six venture mega-deals were in start-up space companies, and the overall number of venture deals in space start-ups increased by 23% from 2017 to 2018. Global funding across all venture capital investments (not specifically space) increased from 2017 by 26% to \$207 billion in 2018. By contrast, venture capital investment in start-up space companies grew by about \$400 million from 2017 to 2018.

In 2018, 52 space start-ups reported venture investment, surpassing the prior record set in 2017 (48). During the 19-year period of this study, venture investment totaled nearly \$8.4 billion in 122 firms. The largest venture investments in that period were in SpaceX's \$900 million Series E in 2015, OneWeb's \$500 million Series A and \$1.2 billion unattributed round in 2016.

Venture deals overall increased by more than 20% to 59, a more modest increase than the 78% increase the previous year. The number of early stage venture deals rose from 39 in 2017 to 51 in 2018. 2018 saw 8 late stage venture deals, a slight decrease from the 9 in 2017, which itself was a quintupling from the previous year (2). Venture deal size remained about the same. Including "mega-deals" over \$100 million, the average venture deal in 2018 was \$33.9 million, compared to \$34.2 million in 2017. Excluding transactions over \$100 million, the average space venture deal in 2018 was about \$20 million, up from about \$19 million in 2017.

The number of venture capital firms investing in start-up space increased by 19% in 2018, from 95 to 113 firms.<sup>8</sup>

Since 2000, three start-up space companies have attracted investment in excess of \$1 billion: Jeff Bezos is estimated to have invested more than \$2.3 billion in Blue Origin since 2000 (with some sources placing this total much higher); Google, Fidelity, and other investors have invested over \$2.4 billion in SpaceX since 2006; and SoftBank and other investors have invested \$1.7 billion in OneWeb since 2015.<sup>9,10</sup> SpaceX and OneWeb closed billion dollar deals in 2015 and 2016, respectively.<sup>11</sup>

<sup>7</sup> PwC | CB Insights MoneyTree™ Report Q4 2018. PwC, 9 Jan. 2018. Web. 22 Feb. 2018.

<sup>8</sup> The reported number of venture capital firms investing in 2017 has increased since our previous report, as more companies have announced transactions and as new data sets have become available.

<sup>9</sup> A few sources have labeled the Softbank investment as private equity. Based on the nature and purpose of the investment, we have designated it as venture.

<sup>10</sup> In Q1 2019, OneWeb announced that it had raised a total of \$3.4 billion since its founding, including a \$1.25 billion round in 2019. This implies additional, undisclosed funding beyond the \$2.95 billion in disclosed transactions (roughly \$1.7 billion through 2018 and the \$1.25 billion transaction in 2019). Given the uncertainty around the timing and structure of this previously undisclosed funding, Bryce will treat it as a 2019 investment, consistent with the date OneWeb included the amount in its public statements.

<sup>11</sup> In October 2016, SoftBank announced the SoftBank Vision Fund, and in May 2017, funding closed at \$93 billion. Some reports suggest the investment in OneWeb will be offered to the Vision Fund.

# Space Investment by the Numbers

## Private Equity

Private equity investment in space start-ups has totaled \$1.84 billion since 2000. The year 2018 marked the first time since 2015 that publicly disclosed private equity funding was invested in a start-up space venture; there were no publicly reported private equity investments in start-up space in 2016 or 2017. HyperSat received \$85 million from Incentrum Group in September. Previous notable private equity transactions since 2000 include Aabar Investments' \$380 million to Virgin Galactic in 2009 and another \$110 million in 2011. Additionally, O3b received investment of \$230 million in 2010 from a group of investors including Google, North Bridge Venture Partners, Allen & Company, SES, Liberty Global, HSBC Holdings, Development Bank of Southern Africa, Sofina, and Satya Capital. In 2011, Ligado Networks raised \$265 million from Harbinger Capital Partners, Spectrum Equity Management, and other undisclosed investors.

## Acquisition

Acquisitions of start-up space ventures total \$3.7 billion from 2000 to 2018. Nearly 40% of the value from acquisitions in space start-ups since 2000 has come from transactions in the last three years. Over 220 angel- and venture-backed space companies have received investment since 2000; 24 of these companies have been acquired. The substantial values for acquisitions in 2013, 2014, and 2016 largely represent Monsanto's acquisition of the Climate Corporation, Google's acquisition of Terra Bella, and SES's acquisition of O3b, respectively.

There were no large acquisitions in 2018. Seven acquisitions in 2018 totaled an estimated \$100 million (this is an approximation; no transaction values were announced), down this year following Planet Labs' estimated \$300+ million acquisition of Terra Bella in 2017, and SES's acquisition of O3b for \$730 million in 2016.<sup>12</sup> Based on estimates, the largest acquisition in 2018 appears to be Boeing's procurement of Millennium Space Systems, a full service, end-to-end space mission solution provider. Other acquisitions in 2018 include: Taranis's acquisition of Mavrx, a California-based geospatial analytics start-up founded in 2012; and Viasat's acquisition of Horsebridge Defence and Security, a UK-based defense communications service provider. The year 2018 also saw the acquisition of several smaller start-up space companies, including Poncho, FeatureX, and TellusLabs.

Planetary Resources, an asteroid mining venture, was acquired by blockchain software technology company ConsenSys, Inc. in October in an asset purchase transaction following reported financial difficulties and problems raising additional funding. In 2016 Planetary Resources funding from the government of Luxembourg, which has said it lost \$13.7 million on the deal. The company had previously reported about \$24 million of financing from investors.

Other acquisitions in recent years include SES's acquisition of O3b for \$730 million (2016), and Apple's acquisition of Mapsense for \$25 million (2015). In addition, Uber acquired deCarta in 2015 and Spaceflight Industries acquired OpenWhere in 2016, both for undisclosed amounts.

<sup>12</sup> *Estimated values of acquisitions were typically based on a 3x revenue multiple of acquired entities. Revenues were derived from company research on Owler and Crunchbase. In some cases, a 3x multiple of the investment raised was used, particularly for software and analytic companies that were founded more recently, in order to account for the low revenue levels and higher future earnings potential of such companies.*

Company	Acquirer	Acquisition Year	Acquisition Value (millions)	Pre-Acquisition Total Investment (millions)
WildBlue	ViaSat Inc.	2009	\$568.0	\$756.0
The Climate Corporation	Monsanto	2013	\$930.0	\$108.9
deCarta	Uber	2015	\$0.0	\$56.2
Terra Bella	Planet	2017	\$325.0	\$91.0

**Table 5. Examples of start-up space ventures acquired for substantial values.**  
*Note that the acquisition value for Terra Bella in 2017 is an estimate.*

Table 5 shows nine companies that started and exited during the study period. Note that in the 2014 Terra Bella transaction, the acquisition value was approximately 5.3 times the reported previous investment. In the Climate Corporation example, it was 8.5 times. Other acquisitions during the study period include BlackBridge by Planet (undisclosed), Deimos by UrtheCast (\$84.2 million), SkyWave by ORBCOMM (\$130 million), Horsebridge Defence and Security by Viasat (undisclosed), and Millenium Space Systems by Boeing (undisclosed).

## Public Offering

UrtheCast and exactEarth are the only start-up space companies to raise funding through a public offering since 2000. The last major public offering for a space company was in 2013 when Intelsat raised \$349 million through an IPO. (Intelsat does not meet our criteria for a start-up company.)

## Debt Financing

Debt financing for start-up space ventures totals \$4.7 billion since 2000. A majority of debt financing transactions were concentrated in or near the 2007-2012 period for Protostar (2006, 2008), WildBlue (2006), O3b (2009, 2010), and Ligado Networks (2010). In 2015, O3b, Planet, and UrtheCast obtained significant debt financing. In 2016, Ecometrica, Kepler Communications, Space Tango, and Ursa Space Systems also reported debt financing, and in 2017, Ecometrica and Vector reported debt financing. 2018 saw debt financing transactions reported by SpaceX and Audacy.

Excluding the atypically large \$250 million debt financing transaction by SpaceX in 2018 facilitated by Bank of America, total debt financing in 2018 remained steady at \$4 million, on par with \$5 million in 2017.

## Investment Across All Types

Since 2000, start-up space ventures have attracted around \$21.8 billion of investment, including \$8.4 billion in early and late stage venture capital, \$3.1 billion in seed financing, and \$4.7 billion in debt financing. More than 220 angel- and venture-backed space

# Space Investment by the Numbers

companies have been founded and funded since 2000. Twenty-four of these companies have been acquired, at a total value of about \$3.7 billion. Most investment activity has occurred recently, and since 2015, annual investment has consistently reached at least \$2 billion. In 2018, investment reached \$3.2 billion, a record amount.

Over 60% of all investment since 2000 occurred in the period 2013-2018. Ninety percent of venture capital investment occurred in the period 2013-2018, and contributed over half of all investment in that period. All investment types have grown noticeably with the exception of private equity and debt financing.

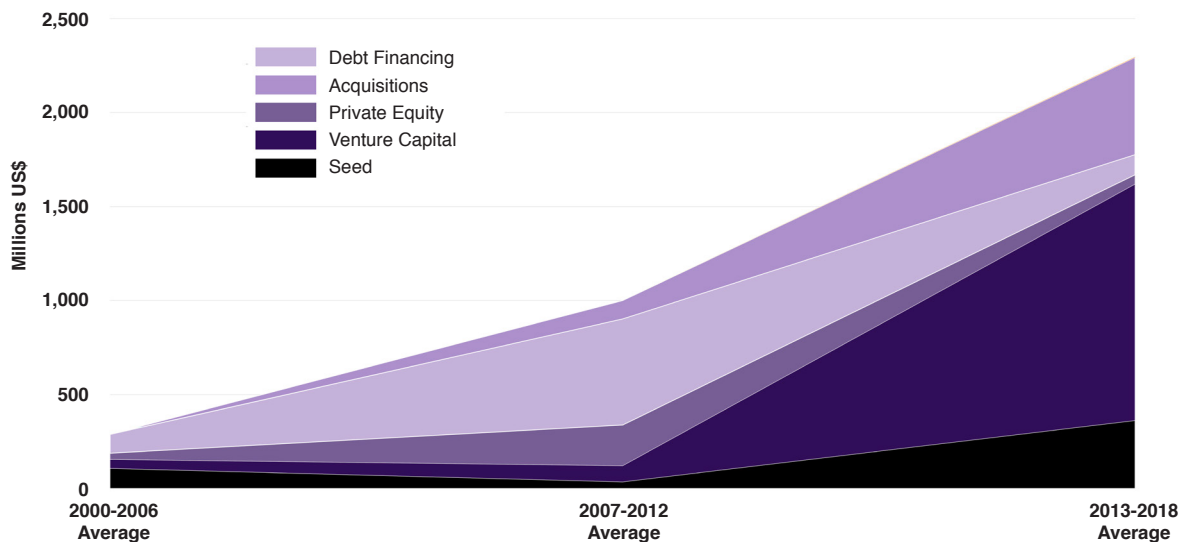
The average start-up space investment per year over the period since 2000 is over \$1 billion, which is affected by a surge in debt financing in 2010. Excluding debt financing, average annual investment totals about \$879 million. Looking at the other investment types, average annual venture capital activity totals \$441 million per year since 2000, with

Investment Type	2000-2006 (millions)	2006-2012 (millions)	2012-2018 (millions)	Total 2000-2018 (millions)
Seed/Prize/Grant	\$742.0	\$201.9	\$2,170.3	\$3,114.2
Venture Capital	\$327.9	\$519.6	\$7,543.5	\$8,390.9
Private Equity	\$234.2	\$1,300.8	\$301.0	\$1,835.9
Acquisition	\$0.0	\$584.0	\$3,098.3	\$3,682.3
Public Offering	\$0.0	\$0.0	\$23.4	\$23.4
<b>Total Investment</b>	<b>\$1,304.1</b>	<b>\$2,606.3</b>	<b>\$13,136.4</b>	<b>\$17,046.8</b>
Debt Financing	\$710.0	\$3,388.4	\$637.8	\$4,736.2
<b>Total with Debt</b>	<b>\$2,014.1</b>	<b>\$5,994.6</b>	<b>\$13,774.2</b>	<b>\$21,782.9</b>

Table 6. The magnitude of investments varies based on investment type and time period.

Investment Type	Average 2000-2006 (millions)	Average 2006-2012 (millions)	Average 2012-2018 (millions)	Average 2000-2018 (millions)
Seed/Prize/Grant	\$106.0	\$33.6	\$361.7	\$163.9
Venture Capital	\$46.8	\$86.6	\$1,257.2	\$441.6
Private Equity	\$33.5	\$216.8	\$50.2	\$96.6
Acquisition	\$0.0	\$97.3	\$516.4	\$193.8
Public Offering	\$0.0	\$0.0	\$2.3	\$1.2
<b>Average Investment</b>	<b>\$186.3</b>	<b>\$434.4</b>	<b>\$2,187.8</b>	<b>\$897.2</b>
Debt Financing	\$101.4	\$564.7	\$106.3	\$249.3
<b>Average with Debt</b>	<b>\$287.7</b>	<b>\$999.1</b>	<b>\$2,294.1</b>	<b>\$1,146.5</b>

Table 7. The annual average of space investments varies based on investment type and time period.



**Figure 8. Considering multi-year periods, average annual start-up space seed funding, venture capital, and acquisitions have increased**

an average of \$1.26 billion in the most recent six-year period. The average acquisition activity equals about \$193 million per year, and is \$516 million per year in the most recent six-year period. The average seed funding level is about \$362 million per year in the last six years, up 10x from a \$34 million average per year in the prior six-year period. In addition, the average private equity funding level is \$50 million in the last six years, a decrease from the \$217 million per year in the 2007-2012 period. Looking at the data in these multi-year groupings, average annual values for seed, venture, acquisition, and public offerings have increased, while those of private equity have decreased, and debt financing has decreased and risen again somewhat in recent years. See Table 7.

## Valuation

Investors focus on valuations and exits. SpaceX is an undisputed space unicorn (a private company with a valuation of \$1 billion or more); after a \$273 million Series J in 2018, SpaceX's valuation was reported at more than \$30.5 billion.

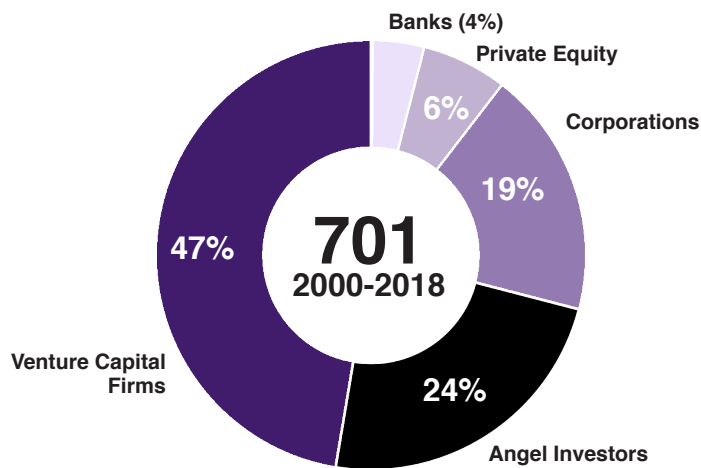
Several other start-up space companies, including OneWeb, Planet, and Rocket Lab, have been reported by some sources to be unicorns. Investment publications and analytics firms have published valuations for each of the companies that exceed \$1 billion. After Planet closed a Series C round of venture capital, PitchBook valued the company at \$1.13 billion. Forbes published a valuation in excess of \$1 billion for Rocket Lab after the space start-up closed a Series D round of venture capital in March 2017, and PitchBook highlighted the company in its Unicorn List of 2018, publishing a \$1.1 billion valuation as of March 2017. OneWeb has reported over \$1.7 billion of investment since 2015; however, no valuation has been reported. Mapbox and Kymeta, are likely on the unicorn path; both companies have raised nearly \$225 million in venture capital and seed investment.

While unicorn valuations are increasing in number, some financial analysts caution that many unicorns (across sectors, not specifically in space) have exaggerated valuations.

# Space Investors by the Numbers

## Overall

This research has identified 701 investors in start-up space companies, a 26% increase from last year's report (555). Since all investors are not always disclosed, the total number of investors is higher.



**Figure 9. By number of investors, VCs are the largest investor group for space start-ups.** *Note that angel investors and altruists are combined into the angel investors category in this chart.*

Over the 19-year period, we looked at the distribution of investors across five categories. Venture capital firms represent the largest number of investors in start-up space companies, followed by angel investors. Together, these two investor groups comprise about 70% of the investors in start-up space ventures. Corporations, private equity firms, and banks make up the remaining 30%. There is small participation by a few altruists, who have provided grants or prizes, such as Thiel Foundation, Knight Foundation, XPRIZE Foundation, and Space Frontier Foundation, primarily through business plan pitch contests or other competitions. These altruists are included in our numbers for Angel Investors. See Figure 9.

Investment in start-up space is seeing sustained growth. In 2018, 187 investors (up from 177 in 2017) invested into 82 start-up space companies across 90 deals (up from 83 deals in 2017). New investors continue to enter the ecosystem; 71 venture capital firms and 27 corporations invested in start-up space ventures for the first time in 2018. Notable entities like Boeing, Goldman Sachs, Morgan Stanley, Raytheon, and Rolls Royce invested in or acquired start-up space companies in 2018.

The profile of investment in start-up space companies has diversified substantially over the last 19 years. From 2000 to 2006, the number of investors per year averaged only 9, but by the end of 2012, the average number had increased to 29. Since 2013, this figure has more than quadrupled, reaching an average of 137 investors. This represents a more than fifteen-fold increase from the first period to the third. Figure 10 shows the number of investors and investment magnitude (excluding debt financing) since 2000.

The mix of investors changes from year to year, as shown in Figure 11. The trend for each investor group is discussed in the sections below. From 2000 to 2006, an average of four venture capital firms, two corporations, one angel investor, and two private equity firms invested in start-up space companies each year. During the middle years of the study period (2007-2012), the average number of venture capital firms investing nearly tripled (from 4 to 11). The average annual number of angels investing grew from one to eight during this period. Banks also entered into play during this period, at an average of 4 participating in investment activity in some form annually, while the number of private equity firms and the number of corporations increased slightly.

From 2013 to 2018, the average number of venture capital firms, angel investors, and corporations all significantly increased. On average, 75 venture capital firms, 27 angel investors, and 27 corporations have invested per year since 2013. Private equity firms have played a comparatively smaller role in start-up space investment in recent years.



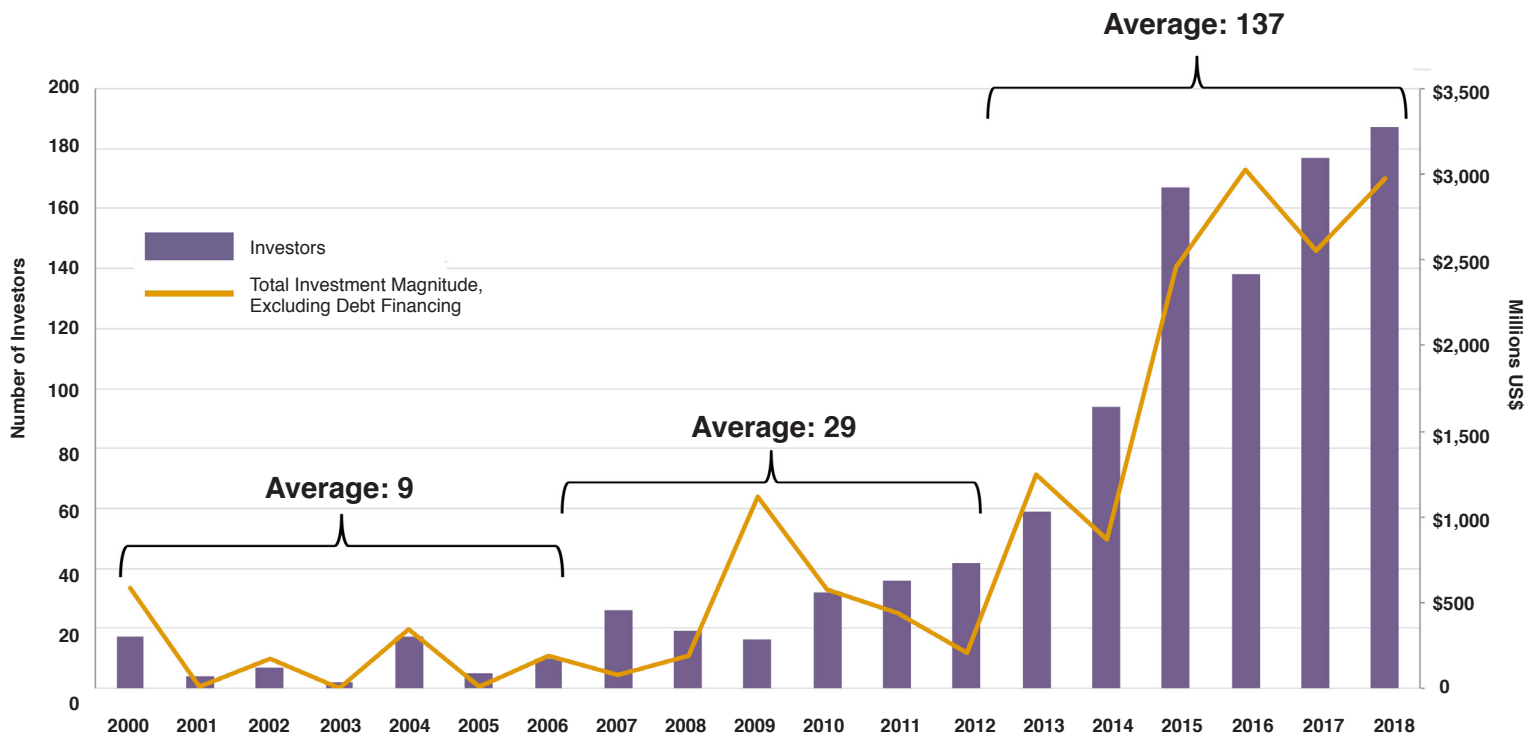


Figure 10. The average number of space investors per year has grown from 9 to 137, looking at six-year periods.

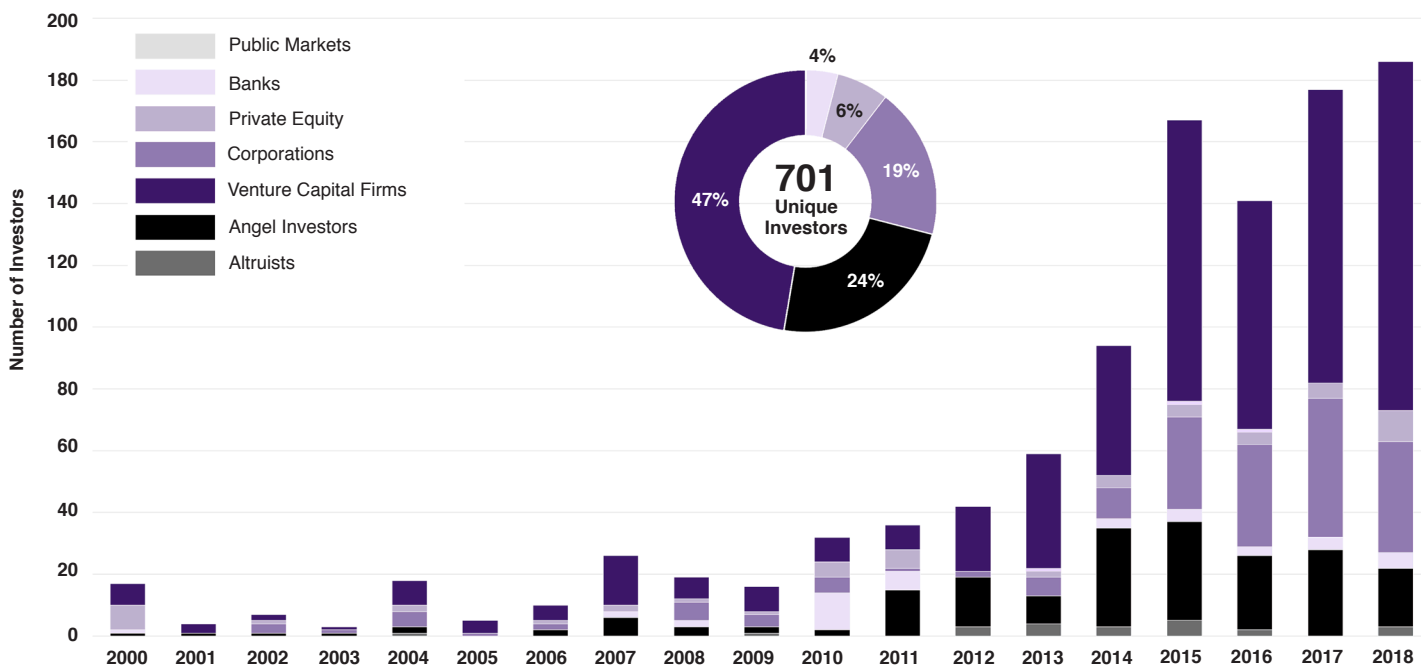


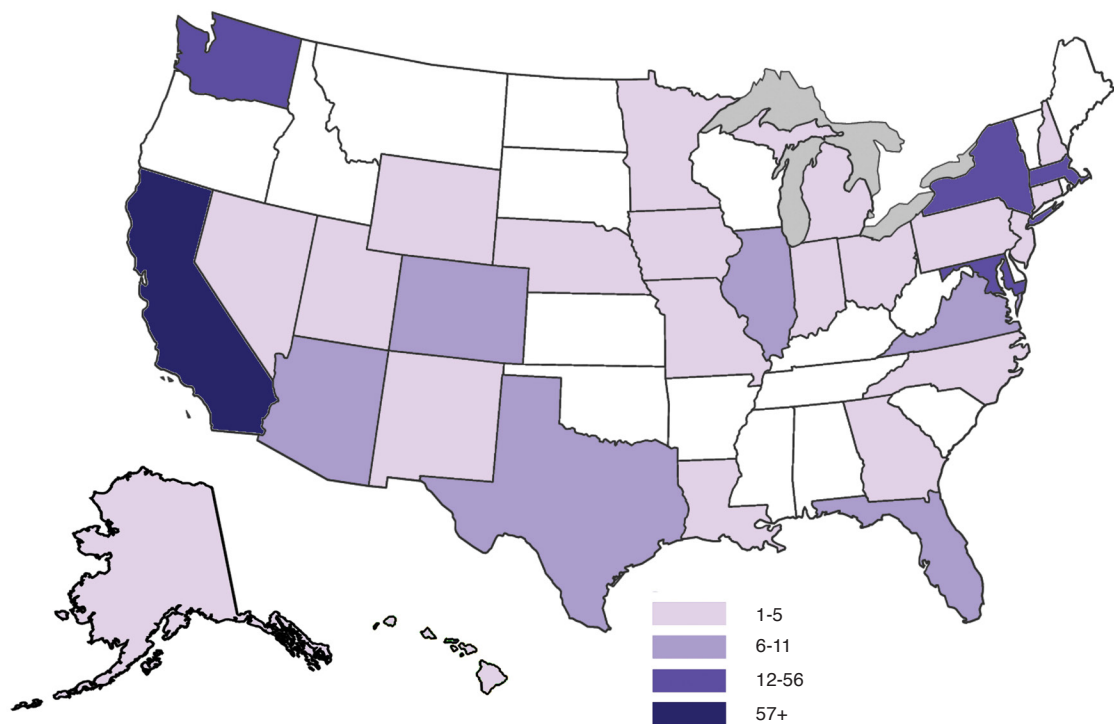
Figure 11. The mix of investors in space companies varies year to year, with more venture capital firms in recent years.

# Space Investors by the Numbers

In the most recent six-year period, there has been a sharp increase in the number of corporations investing in start-up space ventures, driven largely by a seven-fold increase in the number of non-U.S.-based corporate investors from 2014 (4) to 2018 (23). However, from 2017 to 2018, the number of corporations investing decreased from 45 to 37, and the number of international corporations investing also decreased, from 31 in 2017 to 23 in 2018.

Banks (typically acting as the initial provider of debt financing) appear prominently in 2010 and 2011. Deals for O3b and Ligado Networks brought many banks to the table in 2010 and 2011. There has been comparatively little activity in public markets from 2000 to 2018, as UrtheCast and exactEarth remain the only start-up venture companies to have gone public, in 2013 and 2016 respectively.

Looking at all investors since 2000, investors in start-up space companies are primarily from the United States (382), representing about 54% of the total; California is home to nearly half of these investors, representing 26% of the global total. Of the other 197 investors in the U.S., New York hosts the remaining majority (57). See Figure 12.

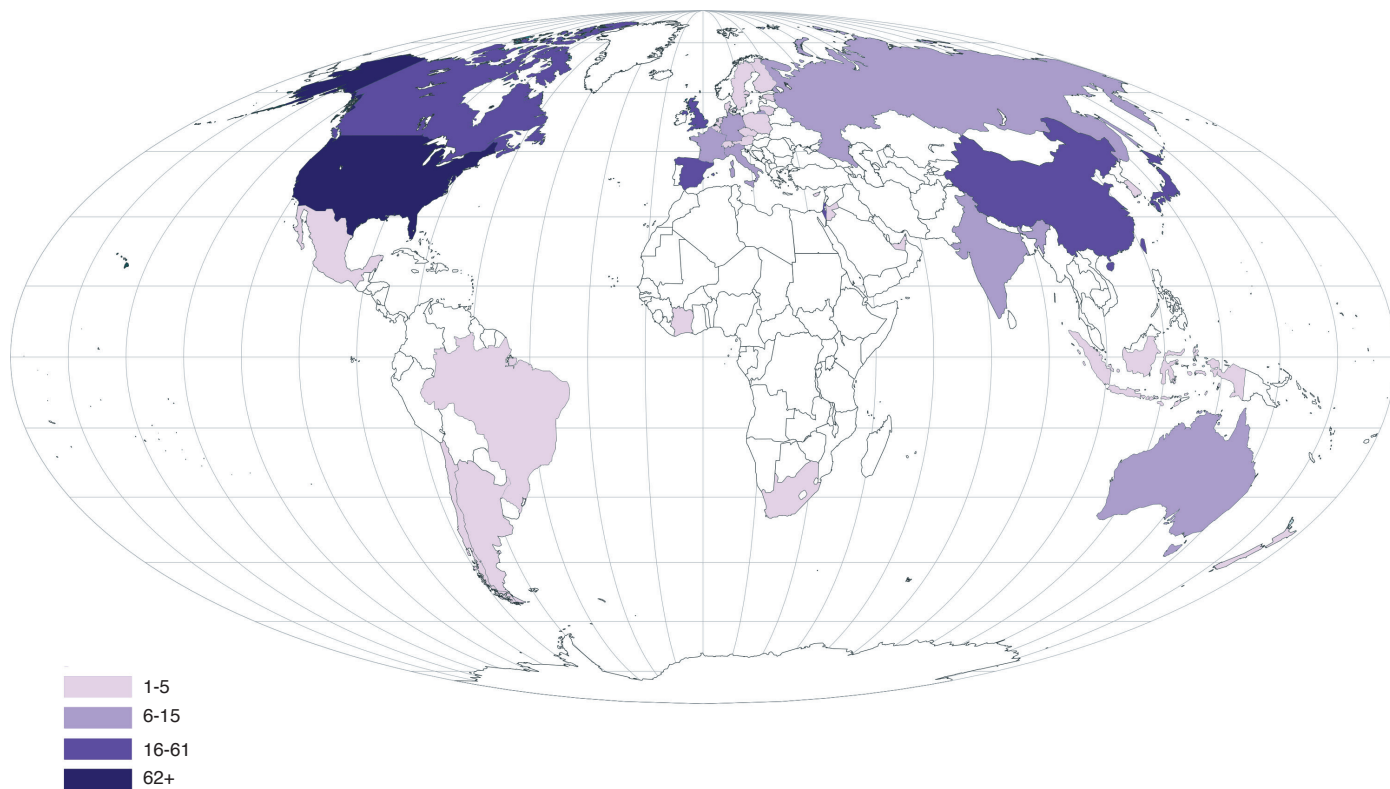


**Figure 12. Investors in start-up space ventures headquartered in the U.S.**

A total of 315 non-U.S. investors are based in 37 countries. The United Kingdom is home to 19% of these investors (60), followed by Japan (50), China (39), Canada (22), Israel (19), Spain (17), Australia (12) and India (10). See Figure 13.

Ninety-two commercial investors in 2018 were based outside the United States, compared to 95 in the U.S. Most new non-U.S. investors were venture capital firms. Fifty-one non-U.S. venture capital firms provided funding to space start-ups in 2018. Eighteen of these venture capital firms are headquartered in China, with 12 based in the UK.

Start-up space companies themselves are also primarily based in the United States.



**Figure 13. Investors in start-up space ventures headquartered outside the U.S.**

These 155 companies make up 63% of the global total (246). California is home to 63 of these companies, which represents 41% of the U.S. total and 26% of the overall global total. Start-up space companies headquartered outside of the United States (89) make up 37% of the global total. Overall, 21 space start-ups are headquartered in the United Kingdom., comprising roughly 23% of all non-U.S. space start-ups. Canada has the second most start-up space companies (11), followed by China (9), Japan, (5), Australia (5), Israel (4), and Spain (4). Thirty-five start-up space companies based outside the U.S. received funding in 2018.

The largest investment in a non-U.S. space start-up was a \$90.6 million Series A in i-Space, a China-based launch start-up. Other notable 2018 investments in non-U.S. space start-ups included a \$50 million Series D round in Astroscale (Singapore), a 43.8 million Series B round in One Space (China), and a \$43 million Series B+ round in LandSpace (China).

## Angels

Since 2000, 196 angel investors have invested in start-up space companies. Angel investors include individual angels and groups of angels. In the United States, angels must be accredited investors, as defined by the Securities and Exchange Commission (SEC), with either earned income that exceeds \$200,000 (or \$300,000 if married) per year or net worth over \$1 million, either alone or together with a spouse (excluding the value of the person’s primary residence). This is not the case for direct investments in other prominent start-up-space-investing countries. (As noted in the U.S. Jobs Act of

# Space Investors by the Numbers

2012, crowdfunding platforms are also exempt from these requirements.) For example, Space Angels, a global syndicate of 250 accredited angel investors, provides funding to primary early and seed-stage space start-ups. For an angel syndicate to be included in our data set, at least one angel has to have announced an investment as a part of the syndicate. Most angel investments are not made public, so the actual number of angel investors is higher.

The most prominent angel investors are “space billionaires.” These billionaires have accrued their wealth through other successful businesses or investments and have either founded a space company or invested their own money in a space company. Several high-profile billionaires such as Jeff Bezos, Richard Branson, and Elon Musk, are space investors. Other well-known billionaires, such as Bill Gates, Mark Zuckerberg, and the late Paul Allen, have been affiliated with space ventures.

Other notable individual angel investors are Dylan Taylor and Esther Dyson. Taylor has invested in 10 different space start-ups, and Dyson has invested in NanoRacks, Space Adventures, and XCOR. Other start-ups receiving standout support from individual angel investors are Moon Express (14 angels), Team Indus (10), Planetary Resources (9), Astroscale (8), Sen (8), Vector (7), Dauria Aerospace (6), XCOR (5), and York Space Systems (5).

Individual angel investors often pool their resources. These angel investment groups (sometimes called syndicates) include Desert Angels, which invested in Vector in 2017, Green Angel Syndicate, which invested in Global Surface Intelligence in 2014, and Boston Harbor Angels, which invested in XCOR Aerospace in 2007. Of angel groups, Space Angels based in New York City has been the most active, establishing an online investment platform for angels to provide largely early stage capital to well over two dozen different start-up space companies. Notable investments by Space Angels in 2018 include GHGSat, HawkEye 360, LeoLabs, Made in Space, and SkyWatch.

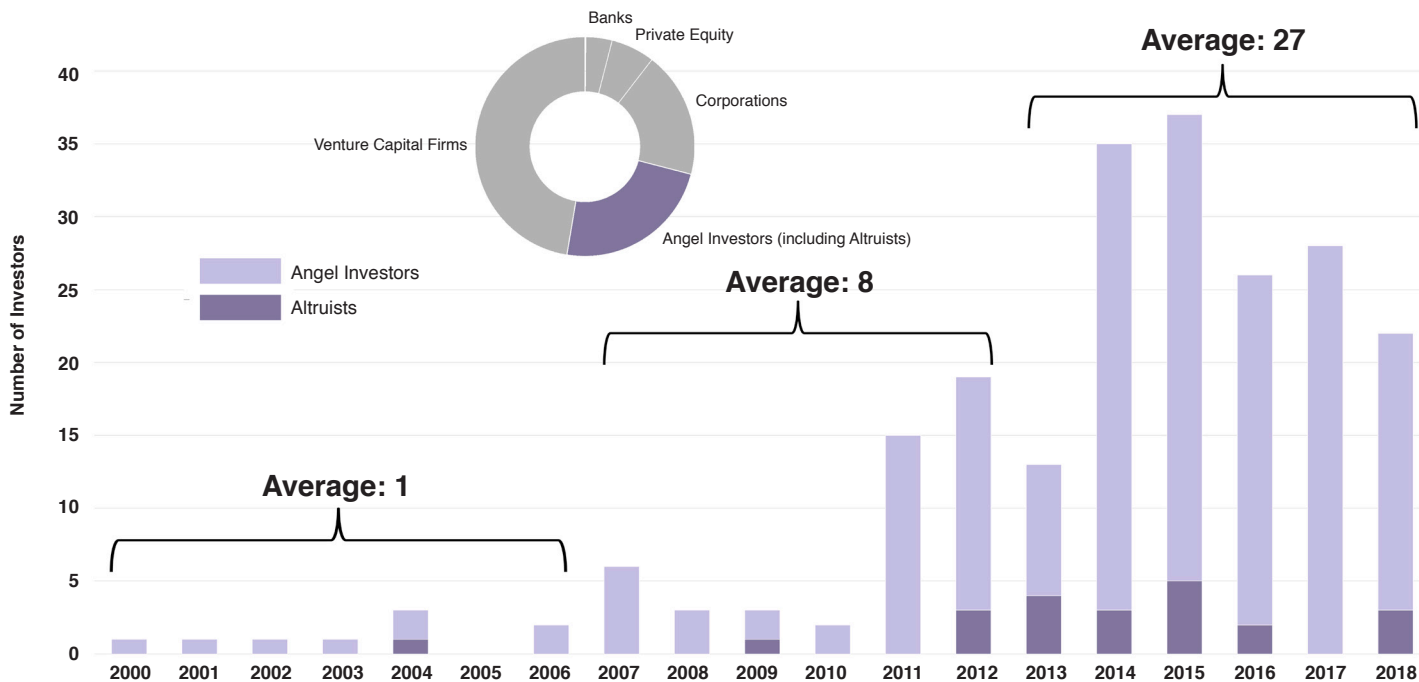
Angels are still predominately based in the United States (109), comprising two-thirds of the global total (165). Of U.S.-based angels, nearly half are based in California, marking 32% of the overall global total. The other 52% of U.S.-based angels investing in start-up space companies in the U.S. are spread across New York, Washington, Arizona, Florida, Massachusetts, and several other states.

Australia, India, Israel, Japan, Russia and the United Kingdom are host to four or more angels investing in space companies. Nearly one-third of non-U.S. angels are based in the U.K., with Japan and India following, with 14% of non-U.S. angels each.

Angel activity has continued to increase in recent years. From 2000 to 2006, the average number of angel investors per year was one, with no angel activity publicly reported in 2005. From 2007 to 2012, the average was eight. Starting in 2013, the average number of angel investors per year jumped to 27—more than a three-fold increase over the 2007-2012 period. Twenty angel investors reported investing in start-up space ventures in 2018. See Figure 14.

## Venture Capital Firms

Since 2000, more than 330 VC firms have invested in start-ups. VCs generally invest in start-ups and early stage companies with high growth potential, and accept a significant degree of risk. These investors frequently invest in syndicates, pooling investment with other VCs, but they can



**Figure 14. Considering multi-year periods, angel investor activity has increased.**

also include angel investors, corporations, private equity firms, and banks in their transactions. The number of venture capital firms investing in start-up space increased in 2018, from 95 to 113 firms. (This reported number of venture capital firms investing in 2017 has increased since our previous report, as more companies have publicly announced transactions and as new data sets have become available.) Of the 113 VCs that invested in start-up space companies in 2018, 42 had previously reported investment in start-up space companies, while 71 appear to be new additions to the start-up space ecosystem. See Figure 15.

As shown above, the average number of VC firms investing in space companies has taken a sharp upturn in the most recent six-year period of our study. From 2000 to 2006, the average number of VCs per year is four. Over the next six years, the average is eleven. From 2013 to 2018, the average is 27, a nearly seven-fold increase from the 2007-2012 period. See Figure 15.

VCs investing in space companies are primarily based in the United States (198), nearly two thirds of the global total. Over half of U.S. VCs (57%) are based in California, representing 34% of the global total. New York, Massachusetts, Maryland, Illinois, and Virginia lead the remaining states hosting U.S. VCs investing in space.

Non-U.S. VCs investing in start-up space ventures have headquarters in 29 countries. Australia, Canada, China, Germany, Israel, Japan, Spain and the United Kingdom are all home to five or more VCs investing in space companies, with China and the U.K. hosting 28 firms, Japan hosting 10, and Israel hosting 9.

### Most Active Space VCs

Twenty-nine venture capital firms have invested in three or more start-up space companies. Data Collective has invested in seven; Khosla Ventures, Promus Ventures, and Seraphim Capital have invested in six; Draper Fisher Jurvetson, Founders Fund,

# Space Investors by the Numbers

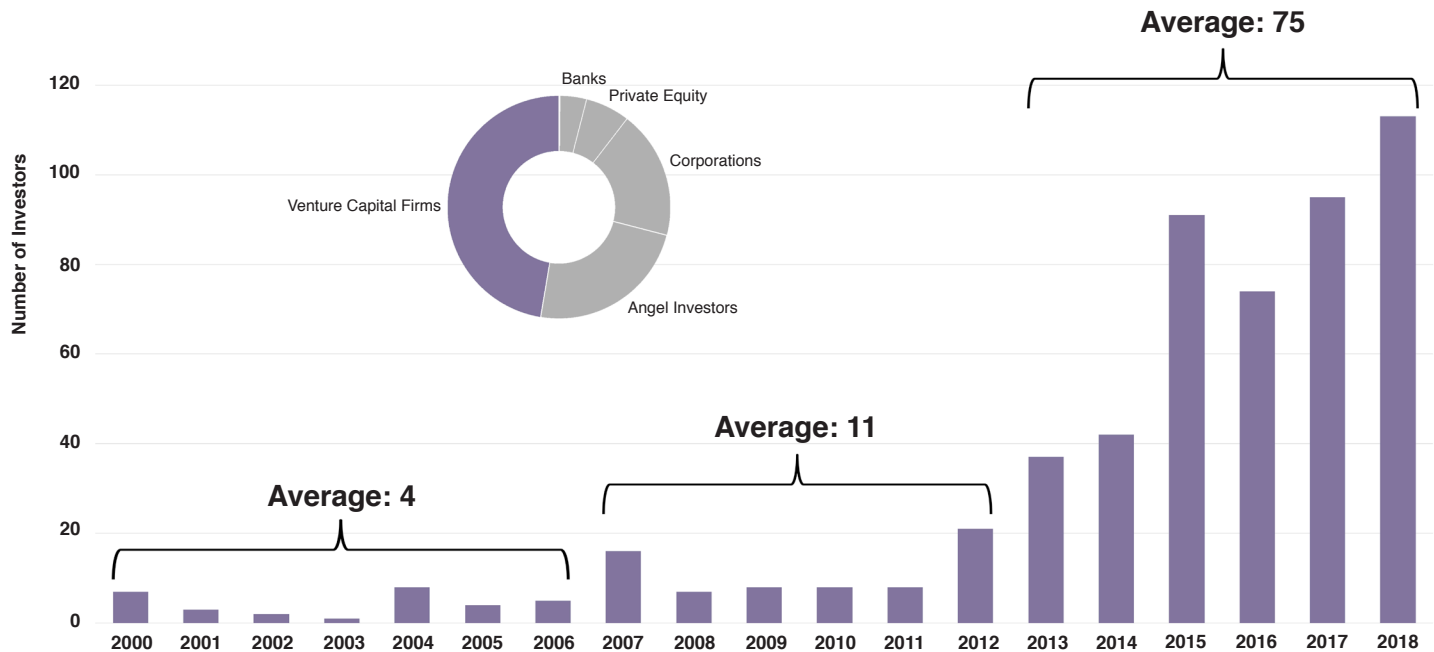


Figure 15. More VCs have invested in start-up space in recent years.

In-Q-Tel, Lux Capital, RRE Ventures, and Y Combinator have invested in five; Kleiner Perkins Caufield & Byers, New Enterprise Associates, Shasta Ventures, and Space Capital have invested in four; and 15 other companies have invested in three start-up space companies. In addition, 39 venture capital firms have invested in two start-up space companies and 266 VCs have invested in one company. See Figure 16.

Twenty-three start-up space companies have attracted investment from two or more of the most space-focused VCs (that is, of the 29 VCs shown in Figure 16 that have invested



Figure 16. VCs investing in three or more space companies.

in three or more start-up space companies, 26 VCs have repeatedly invested in common with others). The 23 companies reporting investment from at least two of these investors are: Accion Systems, Akash Systems, Bagaveev Corporation, Cape Analytics, Enview, Gilmour Space Technologies, HuaXun Microelectronics, Kepler Communications, LeoLabs, Mapbox, Orbital Insight, Planet, Relativity Space, Rocket Lab, Sairdron, SkyWatch, SpaceX, Spire, Swift Navigation, Terra Bella, The Climate Corporation, Ursa Space Systems, and Vector. The relationships are diagrammed in Figure 17.

Twenty-two VCs have participated in at least five start-up space deals since 2000. (That is, these VCs have participated in multiple rounds or other specific transactions, which may include more than one investment in a single company.) Draper Fisher Jurvetson, Khosla Ventures, and Lux Capital lead this group, each having participated in 13 start-up space deals during the study period. They are followed by Founders Fund (11); Data Collective (10) and RRE Ventures (10); Promus Ventures (9); Bessemer Venture Partners (8), New Enterprise Associates (8), and Sequoia Capital (8); First Round Capital (7), In-QTel (7), and Kleiner Perkins Caufield & Byers (7); Lemnos Labs (6), Norwest Venture Partners (6), and Seraphim Capital (6); 500 Startups (5), Allied Minds (5), Capricorn Investment Group (5), Midven (5), Shasta Ventures (5), and Y Combinator (5). See Figure 18.

### Private Equity Groups

Since 2000, 45 private equity (PE) firms have invested in start-up space companies. The number of PE firms investing in space start-ups has varied over the study period, averaging three to four per year. In recent years, several PE firms have been observed participating in atypical private equity investments such as early- and mid-stage venture capital rounds, as

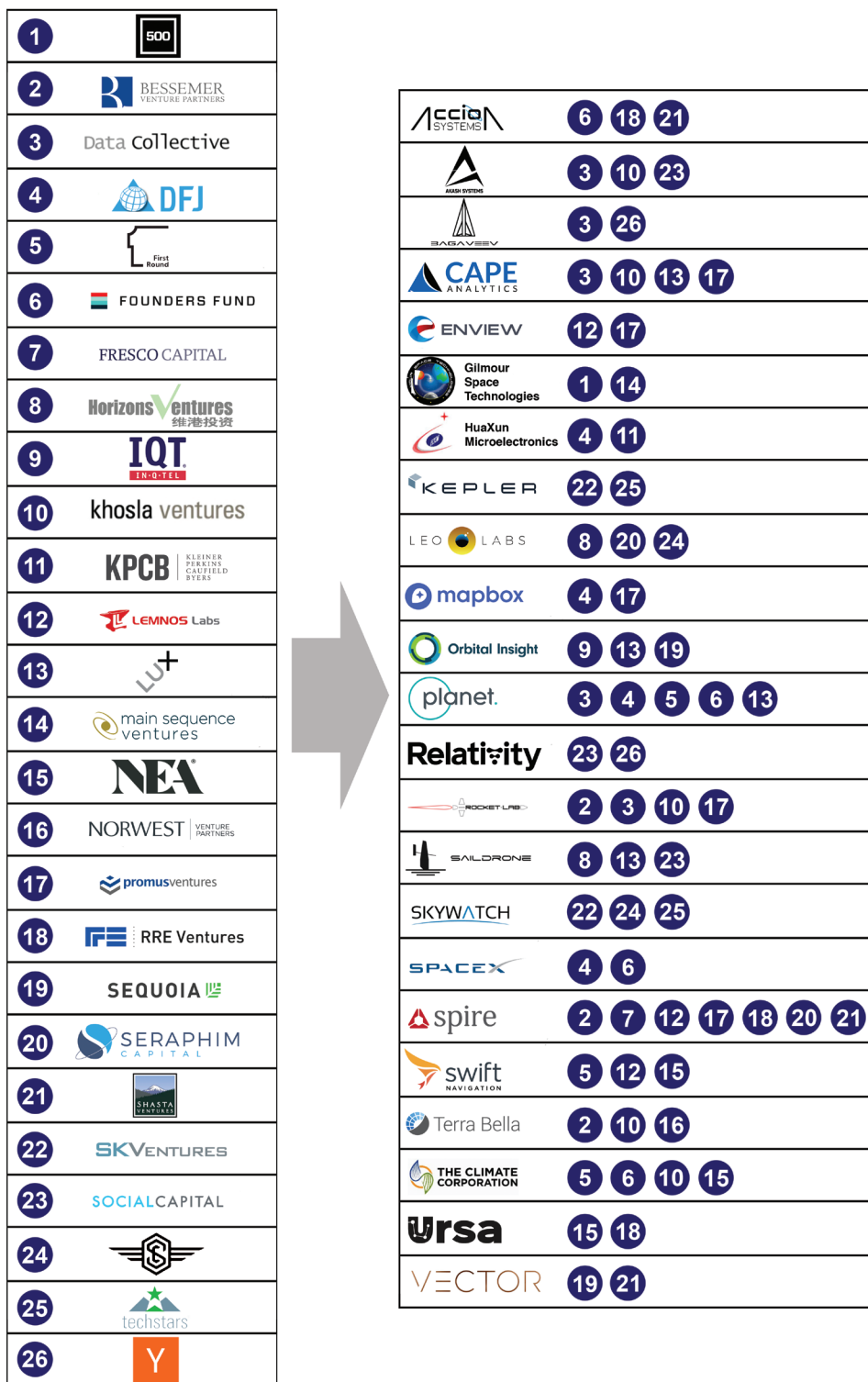


Figure 17. Common investments among highly space-focused VCs.

# Space Investors by the Numbers

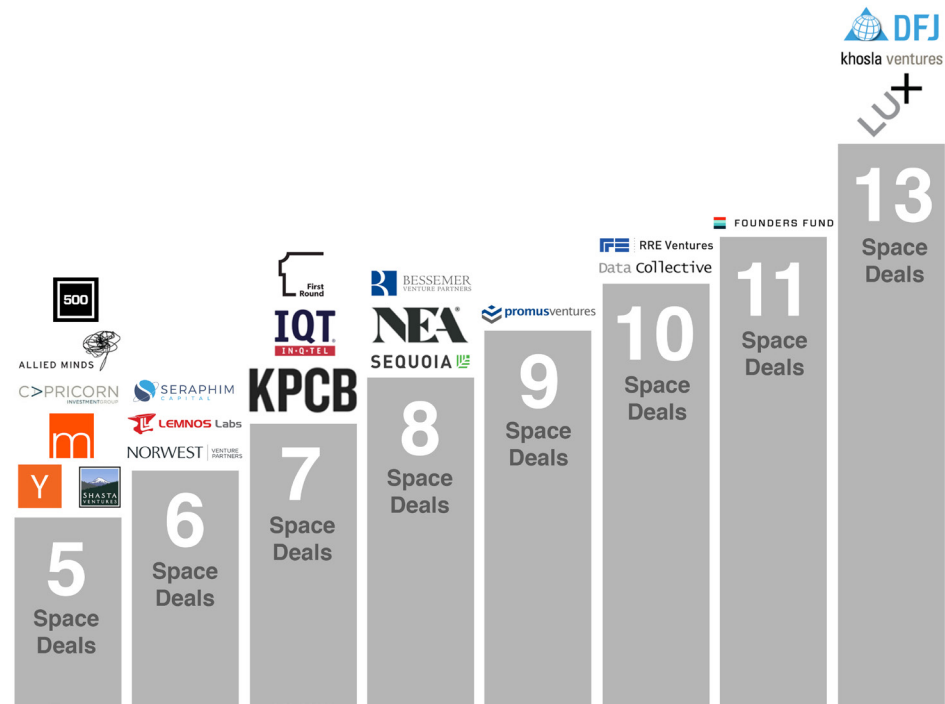


Figure 18. VCs that have participated in multiple start-up space deals since 2000.

noted on page 14. (For the purposes of our dataset, those transactions have been categorized as venture capital activity.) 2018 saw only one private equity transaction, the \$85 million investment in Earth Observation satellite operator HyperSat from Incentrum Group. The year 2018 also saw an increase in the number of private equity firms participating in non-PE-led financing activity, nearly doubling to 9 from the previous year (5). Private equity transactions over \$100 million, involving Ligado Networks, O3b, and Virgin Galactic, took place in 2004, 2009, 2010, 2011, and 2015. See Figure 19.

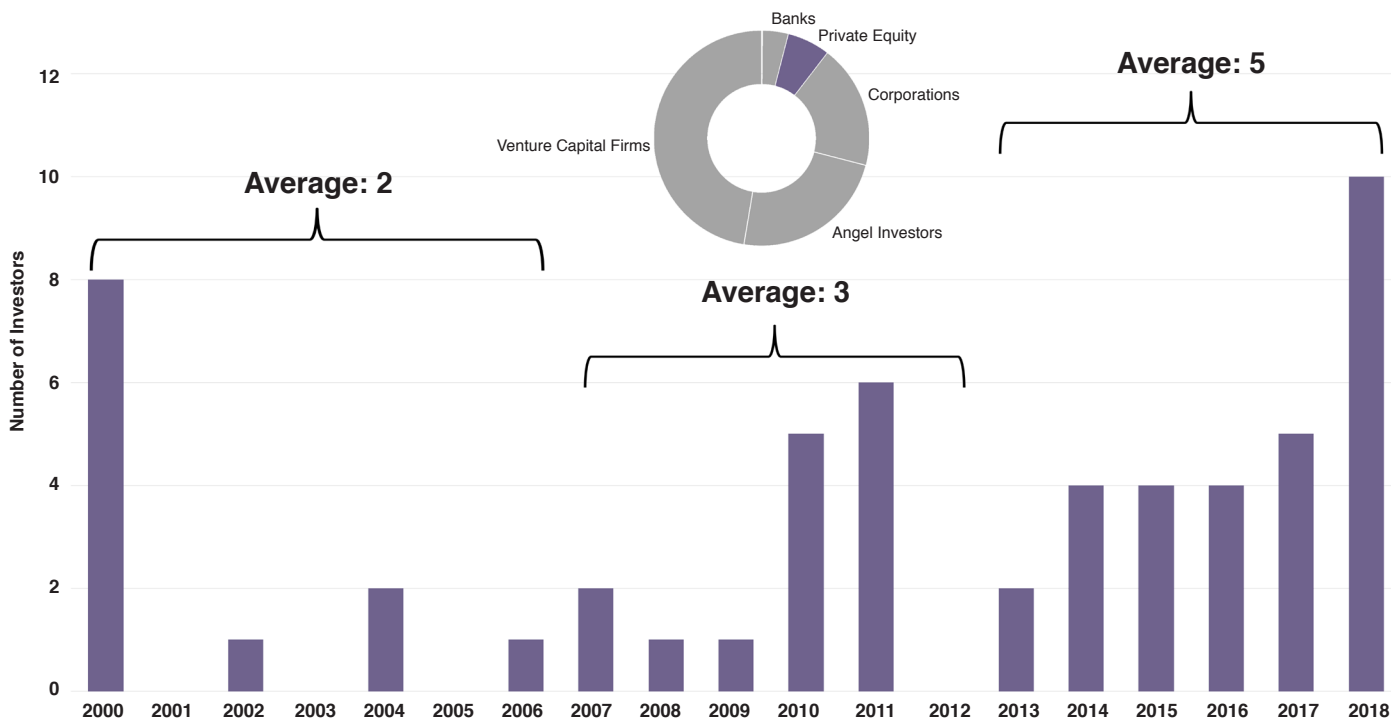
Less than half of PE firms investing in space companies (40%) are headquartered within the United States. About a third of these U.S.-based private equity firms are based in California, with remainder largely split between Massachusetts, Maryland, Texas, and New York.

Non-U.S. PE firms have headquarters in 13 countries. Canada, Israel, and the United Kingdom are home to more than three such firms, with the U.K. squarely in the lead, hosting 8 (equivalent to about 30% of the international total).

## Corporations

Since 2000, 130 corporations have invested in start-up space companies. The number of corporations investing in start-up space ventures decreased by 18% from 2017 (45) to 2018 (37). From 2000 to 2006, the average number of investors per year was two, and from 2007 to 2012, the average was three. From 2013 to 2018, the average is 27. This represents a nearly nine-fold increase in the average number of corporations investing in start-up space ventures since the 2007 to 2012 period. See Figure 20.





**Figure 19. Private equity investment activity is variable over the study period, looking at multi-year periods.**

Of the corporations investing in start-up space ventures, 38% are headquartered in the United States, about a third of which are based in California (12% of the global total). The remaining U.S. portion of the global total is distributed across the United States, with Maryland, New York, and Virginia leading. Non-U.S. corporate investors comprise 62% of the global total, nearly half of which are headquartered in Asia.

Both space companies and non-space companies are investing in start-up space ventures. Space companies represent 36% of this investor group at 47 companies, while non-space corporations represent a 64% majority (83 companies). Of space companies investing in space-start-ups, 36% (17) are U.S.-based. Of the non-space corporations, 37% (32) are headquartered in the U.S. See Figure 21.

Corporations outside the U.S. investing in start-up space companies stem from 21 countries. Japan is home to 35% of these companies (28), followed by Spain (9), Canada (8), China (8), and the United Kingdom (6). Others include Australia, Luxembourg, and the Netherlands, each of which is home to two corporations investing in start-up space companies.

Corporations have invested in 89 start-up space companies and participated in 135 deals since 2000; about 19% of deals in which corporations have invested have been acquisitions. 2018 acquisitions include FeatureX by Orbital Insight, Horsebridge Defence and Security by ViaSat, Mavrx by Taranis, Millennium Space Systems by Boeing, Planetary Resources by Consensusys, Poncho by Dirty Lemon, and TellusLabs by Indigo Ag. Previous acquisitions include Clyde Space by AAC Microtec, OmniEarth by EagleView Technologies, Terra Bella by Planet, BlackBridge by Planet, deCarta by Uber, Deimos by UrtheCast, Terra Bella by Google, SkyWave by Orbcomm, The Climate Corporation by Monsanto, WildBlue by ViaSat, O3b by SES, GATR Technologies by Cubic Corporation, and Mapsense by Apple.

# Space Investors by the Numbers

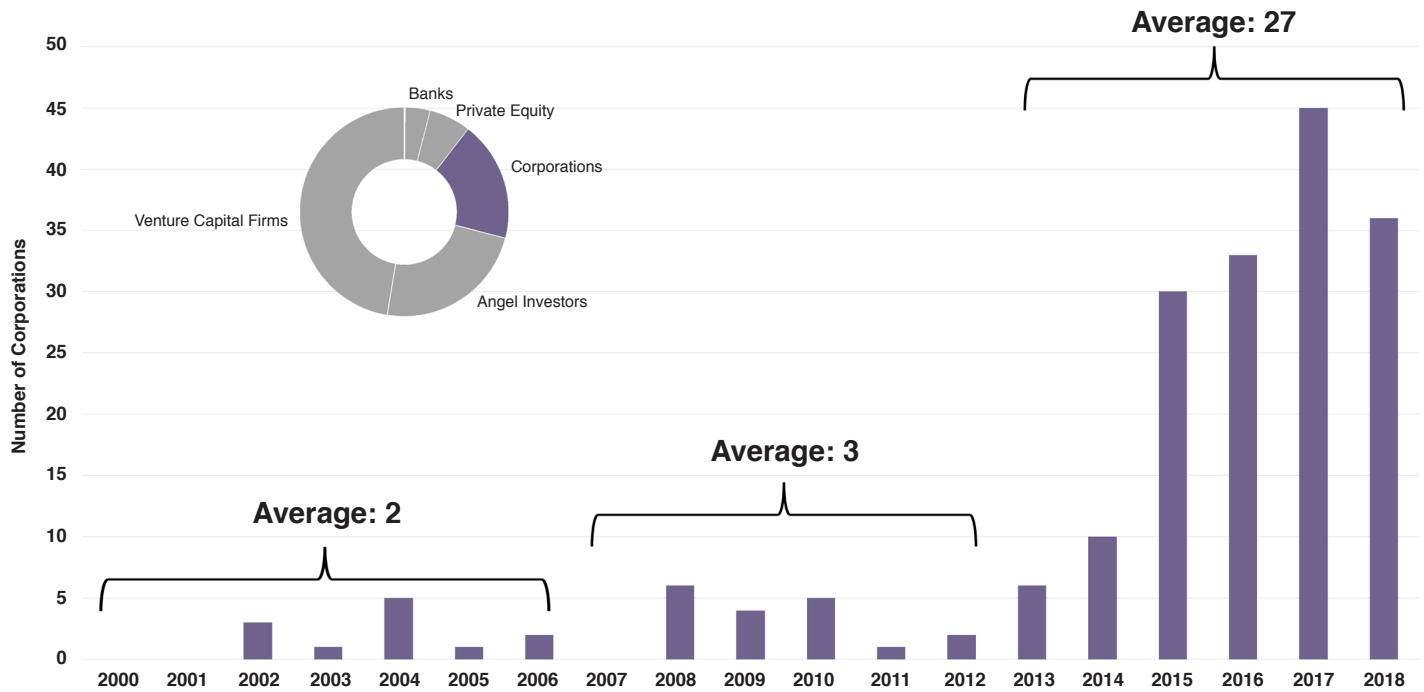


Figure 20. The number of corporations investing in start-up space ventures decreased 22 percent from 2017 (45) to 2018 (37).

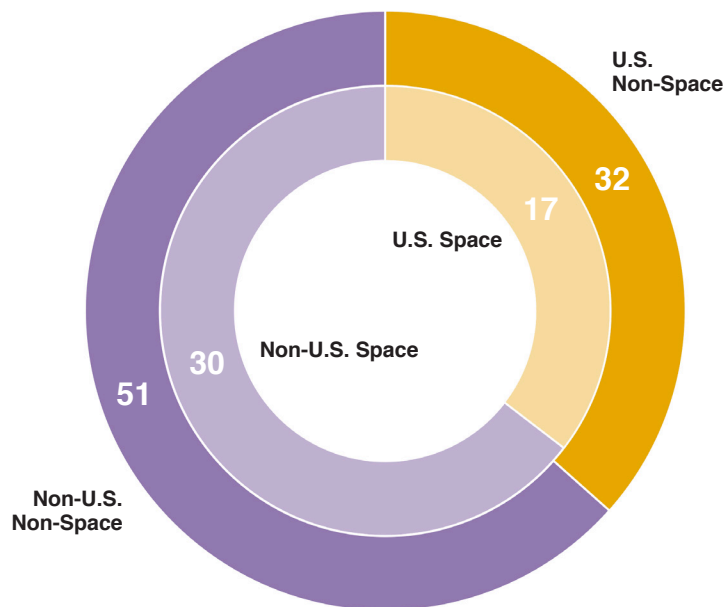


Figure 21. Space and non-space corporations investing in start-up space ventures have traditionally been more likely to be headquartered outside of the United States, though this gap is closing.

## Banks and Other Financial Institutions

Relatively few—only about 1 in 20—of the transactions covered in this analysis have reported debt financing as a significant component. The number of banks (typically acting as the initial provider of debt financing) investing in start-up space ventures peaked in 2010 and 2011. See Figure 22.

Notable examples of start-up space ventures receiving debt financing include:

- SpaceX received a \$250 million debt financing round facilitated by Bank of America in 2018.
- Vector received a \$4.5 million round of debt financing from Desert Angels, Arizona Technology Investors, Kurrent Investment, Space Angels, Kanematsu Corporation, Sequoia Capital, and Shaun Coleman in 2017.
- Ecometrica received about \$900,000 of debt financing from Clydesdale Bank in 2016.
- O3b received \$525 million in debt financing from COFACE, France’s export credit agency, and others in 2009.
- Planet received a debt facility of \$25 million from Western Technology Investment in 2015.
- Kepler Communications received a \$100,000 convertible note from Right Side Capital Management in 2016.

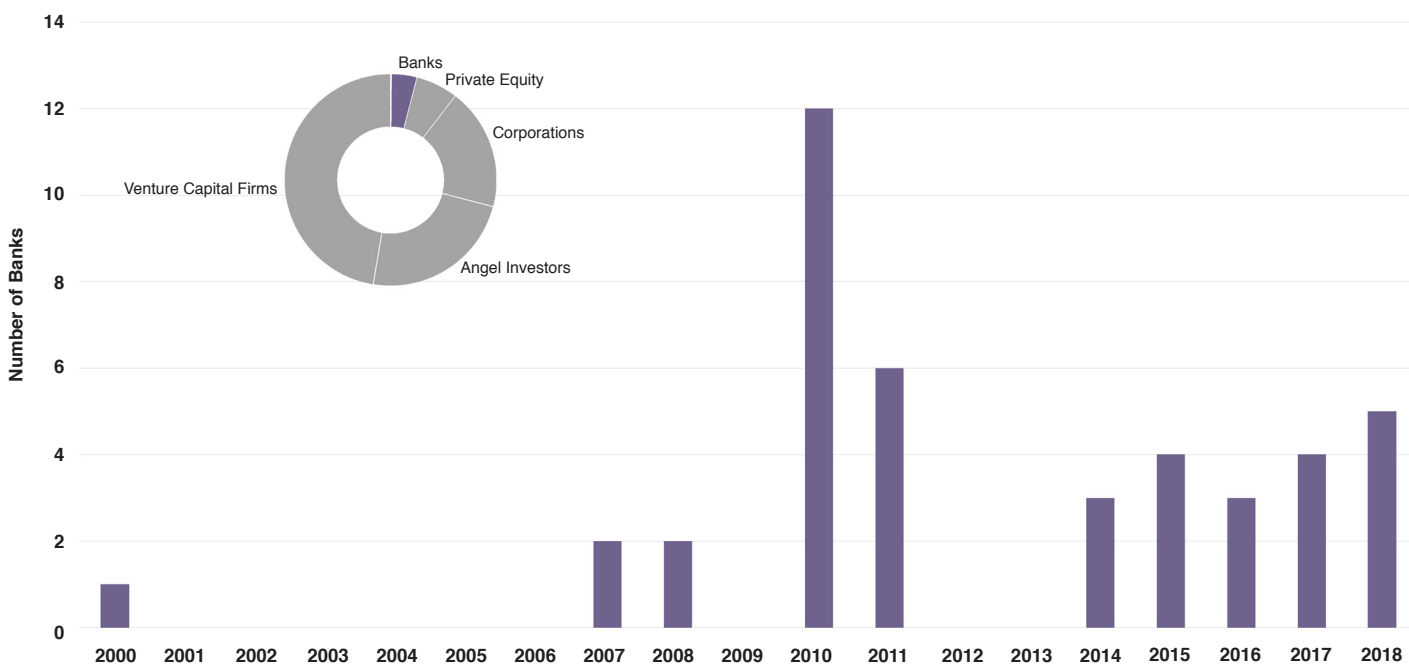


Figure 22. Banks financing start-up space ventures peaked in 2010 and 2011, coinciding with the peak in debt financing during the study period.

# Start-Up Space: What's Next?

This year was a record-setting year for start-up space. During 2018, the start-up space industry saw over \$3.2 billion in investment, marking the largest year ever in terms of total investment magnitude. Several companies are planning important technical demonstrations for 2019, and others are promising an expansion of capabilities. Many services and products that attracted investment will be deployed in 2019, particularly those related to commercial human spaceflight (SpaceX, Virgin Galactic). The next few years have the potential to transform the start-up space ecosystem, and investors will be closely tracking the revenue dynamics and operational performance of maturing start-up space firms. At time of writing, here are important planned next steps for start-up space firms.

**Large LEO Constellations:** Several pending megadeals, including recently announced investments in OneWeb and Amazon interest in a large LEO constellation, suggest that growth will continue in 2019. OneWeb started 2019 with a major, \$1+ billion funding infusion from SoftBank, bringing total investment to \$2.95 billion, soon followed by the launch of its first six satellites. SpaceX saw significant rounds in 2018, and its constellation was licensed in 2018 for constructing, deploying, and operating 12,425 non-geostationary orbit satellites. Planet just completed the deployment of 20 next-generation Dove satellites—Flock 4a—to sun synchronous orbit in April 2019. Additionally, Planet has signed a contract with Italian launch provider D-Orbit for the deployment of six Dove-series satellites in August 2019. Spire Global launched its 100<sup>th</sup> satellite in April 2019. It also plans to host the payloads of third party KeyW this year as part of its “Space-as-a-Service” product. The potential of large LEO telecom and remote sensing constellations drives interest in smallsat launch ventures and attracts the attention of the non-space business and financial community. This potential is coupled with on-going business model uncertainty.

**Smallsat Launch Ventures:** The year 2019 will be an active one for smallsat launch ventures. Several companies, including Rocket Lab, Virgin Orbit, and Firefly Aerospace, will be entering various phases of advanced development and commercial operation.

**Space Tourism:** Commercial suborbital human spaceflights are expected to begin in 2019. Virgin Galactic achieved historic milestones in recent months, surpassing 50 miles in altitude on two separate flight tests—one in late 2018 and one in early 2019. Blue Origin tested its crew capsule escape system in mid-2018 and completed a test flight in January of 2019. The company is planning to launch a crewed mission onboard the New Shepard launch vehicle by the end of 2019.

**Commercial Crew:** In March 2019, SpaceX successfully launched the Demo-1 mission of an autonomous, uncrewed flight of the Crew Dragon spacecraft to the International Space Station (ISS), where the vehicle docked and later splashed down to Earth. This test paved the way for the planned launch of the first crewed flight to ISS later this year. This would mark the return of U.S. astronaut transportation to the ISS from the U.S. and will be a significant start-up space milestone. Though not a start-up, Boeing is another contractor for commercial crew program, and plans to conduct an uncrewed test flight of its CST-100 Starliner vehicle by the end of this year.

**Exploration:** The Google Lunar XPRIZE (GLXP) Grand Prize went unclaimed as the competition officially ended in 2018. However, several teams continued to progress and the XPRIZE Foundation has announced some additional prize money.

In late 2018, NASA announced the Commercial Lunar Payload Services (CLPS) program. Nine companies were selected to compete for task orders to fly specific NASA payloads to the Moon, with up to \$2.6 billion in potential funding over the next ten years.

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## PHOTO CREDITS

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Points of Contact:

**Carissa Christensen, CEO**

Carissa.Christensen@brycetechnology.com

**Mike French, Senior Vice President, Commercial Space**

Mike.French@brycetechnology.com

**Manny Shar, Start-Up Space Project Lead**

Manny.Shar@brycetechnology.com

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