

# How the Space Economy Is Achieving Liftoff

Disruptive Forces in Investing

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**Anu Rajakumar:** Since the launch of the Sputnik satellite in 1957, the birth of the space age came into our existence here on Earth, and since that time, mankind has continued to develop technologies to discover more about our solar system. Satellite communications have become ingrained into the fabric of society to better understand the world and the universe around us, and the sector only continues to grow, launching us into what we call the space economy. Almost 10,000 objects have found their way to and into outer space since Sputnik with about 30% of these objects being launched in the last decade alone. So what else do we know about the investment opportunities in space and what else could we expect as we make our way further into the space age?

My name is Anu Rajakumar and I'm delighted to bring back a seasoned veteran to the show, Michael Barr, Senior Portfolio Manager and research analyst covering aerospace here at Neuberger Berman, to shed light on a fascinating area of the investment universe. Michael, always a pleasure having you on the show.

**Michael Barr:** Thanks, Anu. It's always great to be back.

**Anu Rajakumar:** So as we take off here, pun very much intended, I think some people might just associate the space economy with the work that companies like SpaceX are doing, but, of course, it's actually much broader than that. So, Michael, let's start off with hearing a little bit more about what the space economy entails, as well as what the greater opportunity set looks like.

**Michael Barr:** You know, you're right. It is definitely more than SpaceX when we think about the space economy, but I think the company does deserve a lot of credit to getting the industry where it is today. They really were some of the leaders in changing the industry from one that was basically dominated from government to one that is now being led by commercial enterprises. And I'm pretty much sure we all understand the differences that happens when you go from bureaucracy as being replaced by fast-paced innovation.

So it's really no wonder that according to the UN, the space economy has grown a faster pace compared to global GDP over the past 10 years, which coincides roughly to the launch of SpaceX Falcon rockets in their effort at reusability. So, that history lesson, taken into account, what has this really brought us?

So it's allowed us to lower launch costs by almost tenfold. This is not only lowering the cost and access to space, but it is opening up to many companies and entrepreneurs. And this in turn generates meaningful improvement in satellite technology with many industries right now already leveraging capabilities, such as global positioning, imagery, and monitoring, or even communications.

Now we know that companies like Blue Origin and Virgin Galactic are getting a lot of the headlines with space tourism, but we really think the real opportunities are what satellites can do for us here on earth, and the infrastructure needed to service a fleet that is expected to grow over 20% a year over the next decade.

**Anu Rajakumar:** All right. Perfect. Thank you very much for the helpful color. Would love to understand a little bit more about the sectors that are getting impacted because as we've said, and you've touched upon space tourism, but that's not just what we're talking about here, so what are some of the key areas of the space economy that folks maybe may not be aware of?

**Michael Barr:** Right. And you highlighted tourism, and, obviously, everyone knows about broadcast TV or satellite radio, but satellites are always already doing so much more in our industry and our economies right now. So let's take a couple of examples, right, that people might not think of.

Let's start with the advent of ridesharing. Now, we have created billion-dollar enterprises off of these ridesharing applications, but you remove global positioning from that and we're basically calling those things taxis next, right? Another thing that people don't really think about is ATM and banking infrastructure use GPS timestamps as a critical part of their infrastructure to track and trace all transactions, another one that we use is, supply chain logistics, tracking and tracing not only products but goods.

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Last time I was on the show, we talked about the problem from COVID, so satellites can also be a way out of the supply chain issues that COVID has caused. Another one is the build-out of LEO-based satellite constellations which we are excited about because they have the opportunity to truly address the digital divide, as well as provide supplemental backhaul services for terrestrial networks.

**Anu Rajakumar:** Can I ask a quick question?

**Michael Barr:** Yes.

**Anu Rajakumar:** When you said LEO-based satellite, what is LEO?

**Michael Barr:** Yes, that's fair. So historically speaking, there is a strong utilization of geosynchronous orbit satellites. Those are the large monolithic satellites roughly 35,000 miles away from the earth. And think of companies that utilize that as direct TV broadcasting television into our homes.

We've seen the proliferation of low earth orbit satellites or LEO satellites over the past couple of years, and those are satellites that are basically 500 to 1,500 miles away from the earth. They operate within a constellation, so you need multiple ones as they go across as face of the earth. But the benefit of these satellites are, they're cheaper, have higher bandwidth, lower latency, improved resolutions. And these are the ones that are really creating this whole opportunity that we're talking about right now.

So other opportunities to think about is the data that's coming from these satellites, right? So if we're talking about 20% annual growth in satellites in the coming decades, what about all the data that is created from these satellites? So we're left asking the questions about how are we going to manage and protect all this data? How should we think about the capabilities on the ground stations or cloud infrastructure to help harness all this data?

So we see huge opportunity in data management and data security that's really not part of the space ecosystem right now. Another one to think about is the space station. So not only talking about satellites but all the research that is done on the International Space Station. This has already brought us improvement in water and air filtration systems but recently, as in last year, uh, Procter & Gamble sent a test of Tide to go to the space station to actually find ways to wash the astronauts' clothes.

So, typically speaking, the astronauts wear these clothes for a couple of days and throw 'em away. Tide is going up there to find ways to wash these clothes with minimal use of water because you're already resource-constrained. Now that sounds trivial a little bit to us down here, washing clothes at the space station, but if you're able to leverage that technology and bring it back to earth, and let's just say, you're able to reduce the amount of water that you use to wash your clothes by a gallon multiplied by the number of gallons that are used in the number of washes across the world, you can see the payoff of that capability that's being brought down to earth.

And finally, I would talk about climate change, right? Satellites are actually—not many people know this—but satellites are actually the only true way to accurately measure many of the gases that lead to climate change, which is hugely important considering where we are right now. And as the old saying goes, if you can't measure it, you can't manage it.

**Anu Rajakumar:** That's a good one. I like that one. I was just thinking about whether they use Febreze or something in space at the moment. I was like that probably doesn't work either. You know, Michael, you mentioned, a little bit about climate change tracking at the end there. Could you talk a little bit more about that and other ESG factors that the space economy is helping to support?

**Michael Barr:** Right. I think that's a great question. And now, historically, I know that people think of rockets and satellites which are not very viewed as ESG friendly, but we actually view the space economy as the building blocks of ways to combat and address climate change. And I talked about that because they're the only ways to accurately measure many of these greenhouse gases that are responsible for it.

So what we think this can do as we put these satellites into space, it'll take away from estimating what your carbon footprint is, to actually knowing what your carbon footprint is. And it'll be a way to measure it scientifically and allow both governments and corporations to be utilizing the same number. Now, there's been studies that show, you know, how important this is, because self-reporting is estimated to underestimate the amount of greenhouse gas emissions by over 5.5 billion tons. So you can see the magnitude here.

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Other things that we think are hugely important is water treatment. We used to have satellites that were tasked with trying to find water on the surfaces of Jupiter and Saturn and places like that. Companies have now decided to turn that back on earth, find water leaks on earth, and with roughly \$17 billion of potable water that is lost every year to leakage, finding these leaks early and efficiently is going to be a huge advantage for our society.

And the last one I think is really important for ESG is precision agriculture. The amount of waste that happens on farms every year is exceptionally high—it's not on purpose, it's just the byproduct of the beast, but using precision agriculture and using satellite data, there have been studies that show if 90% of farmers adopt precision agriculture, we will see a 6% increase in crop production, a 14% decrease in fertilizer use, 15% reduction in herbicides, 16% reduction in fossil fuels, and a 21% reduction in water.

These are massive numbers, and this is why we think— “yes, the headlines show rockets going up in space,”— but the capabilities of these satellites are really what is going to drive real change and opportunities with addressing climate issues.

**Anu Rajakumar:** Wow. Okay. So lots of opportunities for more efficiency and for reducing the global footprint here. Just out of curiosity, now how-how are these companies-- when you speak to the companies, how are they actually thinking about space sustainability, and what are companies doing to address major issues like debris management in space?

**Michael Barr:** Right. So sustainability can mean a bunch of different things to a bunch of industries. So we talked about ESG sustainability, space sustainability as the same principle, but to your point, there are tens of thousands of pieces of debris floating around space right now. We have seen, in the past few years, a couple of countries conduct anti-satellite testing, which is basically firing a rocket and shooting down a satellite. That explosion can create additional tens of thousands of pieces of debris floating on space and make it very dangerous for the existing satellites up in orbit. So what's happening is the U.S. and many of our allies are trying to form a coalition to restrict anti-satellite testing and find ways to improve the sustainability in space.

Now why we think this is super important is that we've talked about opportunities in existing businesses. The space economy continues to expand and one of the way, just expanding is we're creating businesses that are now addressing the sustainability. Be it tracking all those pieces of debris and knowing where they are finding ways to get into space and decommission satellites already in space that are going to stay there for a while. Some companies are even going to try to find ways that you will put artificial drag on satellites at their end of life to deorbit them faster. So you're creating all of these new business models to address that problem, but more importantly, you are creating business models within the space economy that don't exist today.

**Anu Rajakumar:** Absolutely. No, that's fascinating. So, let's just transition a little bit and talk about the market environment that we're in right now. What do you see are some of the key risks that you've been seeing in the space economy, you know, again, near term, as well as just longer term as well?

**Michael Barr:** Right. So there's no question we're in a tough, volatile market and there's always risk when investing. And specifically when you talk about some of the pure play[s] that have more growth in the out years, be it 2025, 2026, those, some of those companies are coming more under pressure from a stock perspective, not really a not operational perspective, but the stocks are coming under pressure right now because of the market dynamics, but we're also seeing other companies that aren't pure plays that have space in businesses within their greater enterprise, they're actually investing heavily in building out their space capability.

So it's still a growing business and I think you put it on at the very beginning, this is an industry that's been in place since about 1950. So it's not really a new business, it's fairly mature and there are estimates that it's, uh, \$400 billion business. So when we look at the growth outlook, we actually, despite current marketing conditions, we aren't all that concerned about the growth because we think the analogy here is, the cell service transitioning to smartphones. So back in the day, the cell service, that was a pretty big industry in and of itself. The introduction of the smartphone, the build out of the app store, and all the applications took a fairly large and mature industry and showed exceptional growth out of that.

We're at the same part of the space economy in our opinion. So you're in the process of building out the infrastructures, getting lower costs, launch lower-capable satellites. So you're in the infrastructure build-out, right? We are now going to be adding capabilities and at the end of it, like the smartphone, you're going to be adding all these new applications that these satellites can unlock. So despite being a mature industry and the concerns of the market of near-term growth, the long-term opportunity we think is still meaningful despite the size and maturity of this industry.

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- Anu Rajakumar:** Perfect. Well then, with that in mind, because you sort of dangled it in front of us, if you had a crystal ball, Michael, and you could look into the future to 2050, what is the future for space economy? What do you think will happen by, let's say 2050 or 2100, whatever you think the right long-term view is, but give us some of your thoughts or your key takeaways for the future here?
- Michael Barr:** Right. So that's pretty exciting. So it's August right now. So at the end of this month, hopefully, we are going to launch our first return mission to the Moon. I think that'll be a huge opportunity for not only the U.S., but the globe. We hopefully will put our first female and first person of color on the Moon. I think that's going to be exceptionally exciting.
- We all know Elon Musk's opportunity and wish to go to Mars. If we're making our way to the Moon, Mars is not that much farther away. So I think there's a huge opportunity in the 2050 plus timeframe. The other thing to think about is the International Space Station's being decommissioned in the next decade. And we already see proposals out by multiple private companies to build the next space station.
- So we could have private space stations floating around outer space in LEO orbit, that are doing research, but maybe even tourism. So adding space stations, plus the Moon, plus Mars in any sort of opportunity, I think that the opportunity set ahead of us in 2050, 2075 is huge. And I don't know if you've seen one of the pictures from the James Webb telescope yet, but our ability to look further than we've ever looked before into outer space and actually see planets in distant solar systems. Uh, you know, I'm not one smart enough to understand what that can really mean, but it definitely is exciting.
- Anu Rajakumar:** Absolutely. I think that's a good place to wrap up, but Michael, before I let you go, I'm going to ask you a bonus question. Let's just say you are given the opportunity of a lifetime to go into space, but you get to choose where exactly you go, where would you like to go in space?
- Michael Barr:** Where I would go, wow. So, I would probably be very apart from the trip, which would be very long. Um, I would probably want to go to Mars. I would love to-- no, I'd probably want to go further out than that, but we're going to pretty uninhabitable planets after that. So my guess my route would be Mars, um, Moon is second. Um, but that's-that's a good question. So, you know, outside the solar system would be awesome, but I don't think that's in my time lifetime.
- Anu Rajakumar:** Fair enough. Thank you very much. Um, always appreciate you coming back, and sharing your insights on the show, Michael, particularly on this topic, which is very fascinating, and the investment opportunities are a lot wider than a lot of folks may believe. So looking forward to seeing what's in the next phase of the space age, Michael, thanks for joining me today.
- Michael Barr:** Wonderful. Thanks for having me again.
- Anu Rajakumar:** And to our listeners, if you've enjoyed today's episode of *Disruptive Forces*, I encourage you to subscribe to the show via Apple podcast, Google podcast, or Spotify, or you can visit our website [www.nb.com/disruptiveforces](http://www.nb.com/disruptiveforces) for previous episodes, as well as more information about our firm and offerings.

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