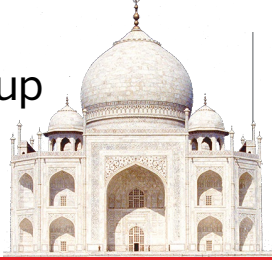


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## Reach for the stars

Invest in the space economy

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# Reach for the stars: the space economy is here

The notion of a commercial space industry has long been a pipe dream. But it is now becoming a reality, transforming several industries and producing new ones. Matthew Partridge investigates

The space industry has until recently been seen as the domain of government space agencies and “the odd eccentric billionaire who had got the yacht and wanted something a bit different”, says Ben Baseley-Walker of space consultancy Andart Global, one of the leading industry experts.

However, rapid technological change has fundamentally altered the picture. The sector can now generate enough revenue to capture the attention (and wallets) of even “boring bankers”. With applications ranging from communication to space exploration and mining, the future of space technology, or “spacetechnology”, is assured. The industry is already worth around \$371bn.

## Elon Musk has changed the game

The catalyst behind the rapid boom in spacetechnology over the past fifteen years has been Elon Musk and his firm SpaceX, says Baseley-Walker. Traditionally, rocketry was “dominated by the big national programmes”. But the US government decided it “would be best to have a range of potential suppliers”, and therefore decided to subsidise Musk’s early forays into space exploration. The success of his early launches “encouraged other private companies” to enter the sector.

The increased involvement of the private sector has in turn led to several changes, says Baseley-Walker. One is an overall shift in attitude. Unlike government agencies, “which tend to test things a billion times before the final launch”, private companies are far more willing to “just fire something into space and see if it works”. Other key novelties include the use of reusable rockets and 3D-printed components, which have been “gamechangers” in helping bring down costs.

The impact on launch costs has been dramatic, says Mark Boggett, CEO and co-founder of Seraphim Capital. Before Musk, companies could expect to pay around \$86,000 per kilogram (kg) to launch their satellites into space. However, this has now reduced to barely more than \$1,000/kg.

What’s more, strong competition between providers means that prices are continuing to fall. With the first fully reusable rocket, Musk’s SpaceX Starship, set to have its first test flight by the end of this year, and the industry benefiting from economies of scale as demand soars, Boggett is confident that costs “are likely to halve again in the next few years”.

## A truly global internet

The cost of satellites is also falling fast, says Boggett. While they “used to be the size of a bus”, private companies can now build “smaller, lighter and cheaper” ones that still have all the functionality of their larger counterparts. As a result, we are now in an era “where it is possible to put up thousands, and soon tens of thousands of satellites”. This will have major implications for the communications industry.

At present “only half of the world can connect to the internet”, with many people in emerging economies still left out or subject to very slow speeds, notes Boggett. However, if this can be rectified, with

populations in the developing world given the sort of service taken for granted in industrialised countries, then this will “drive improvements in health, education and boost entrepreneurship”. Rather than relying on traditional land-based systems using broadband, several companies, including SpaceX, OneWeb and Amazon, are developing internet systems that can be delivered via satellites; mobile and broadband internet can be replicated in this way.

The boom in the number of satellites should also change other aspects of communications. While car companies are pouring billions into self-driving cars, one of the big problems is that they rely on the Global Positioning System (GPS), which is “only accurate to around ten metres”, says Boggett.

While that may be good enough to enable a human driver to navigate, in the hands of a machine it could be the difference between completing your journey and ending up on the side of the road, “or even driving in the wrong direction”. GPS is also not particularly secure “as it is currently very easy to send out false signals [a practice] known as ‘spoofing’”. So, any companies that can improve both the accuracy and security of GPS should do well.

## Keeping an eye on Earth

Satellites are also starting to give us a better picture of what is going on back down on Earth, says David Du Toit of Dragonfly Aerospace. One of the key industries starting to benefit is agriculture. Instead of farmers having to monitor their crops, a satellite can do it for them, saving time. Most importantly, remote monitoring can provide an indication of the health and growth of specific areas, enabling farmers to target their resources more efficiently, thereby cutting down on the amount of water and fertiliser that they have to use and reducing soil erosion and run-off.

Dragonfly’s satellites can currently provide high-resolution photographs “good enough to give an idea of the condition of a set of crops”, says Du Toit. What’s more, while the technology isn’t quite good enough yet to monitor individual plants, it is advancing so quickly that this milestone may not be far away. Du Toit notes that Dragonfly has a camera coming online “that can increase the resolution down to 0.5 metres”. He also predicts that over the next few years the level of detail should increase further, to just 20 centimetres.

Other industries could be transformed by cheap and effective Earth-monitoring. The global drive to improve sustainability will be enhanced by the ability to use the data generated by satellites to fine-tune areas such as water management, urban planning and disaster management, as well as to improve the efficiency of mining, so that its carbon footprint and general environmental impact is reduced.

The use of satellite imagery in helping Ukraine’s forces resist Russia’s invasion has also boosted awareness, particularly in the West, of how information from satellites can be used to provide battlefield intelligence. Du Toit has “never seen so much interest from generals as I have over this past year”.

*“Several companies are developing internet systems that can be delivered via satellites”*



SpaceX has transformed the industry, but remains dependent on Nasa

### Exploring space

Even though Musk and SpaceX have transformed the industry, those involved in spacetech “should never forget the legacy of Nasa”, says Du Toit. Without it the space industry wouldn’t exist. Despite the commercial uses of satellites, Nasa and the other big government space agencies involved in the race to explore space are “still a major driver for the industry”.

Alan Thompson, head of government affairs at spacetech company Skyrora, which aims to launch the first rocket from Britain, notes that even SpaceX remains dependent on Nasa: it was facing severe financial problems until Nasa controversially awarded it a contract worth \$300m last year. Thompson also notes that the budget of the European Space Agency, of which the UK remains a member, recently received a substantial funding increase of 17%.

Michael Barr, co-portfolio manager of the Neuberger Berman Next Generation Space Economy Fund, predicts that last month’s launch of the Artemis 1 mission to explore the moon will be the catalyst that “reignites interest in traditional space projects”, including trips to Mars.

Barr notes that “there is still a big effort to understand what is going on outside planet Earth”, and the impetus no longer stems just from the US or the EU; “multiple countries and multiple companies” are putting large amounts of money into their own space programmes.

Still, while the overall goal of reaching for the stars might be similar, the way in which modern space-exploration programmes are delivered has changed.

Traditionally, Nasa and even the European space industry grew rather like “an English stately home”, says Andart’s Baseley-Walker. Just as stately homes “involved their owners building extensions and modifications to a basic plan that might be centuries old”, Nasa focused on building out from its legacy system. By contrast, newer players “find it more efficient to design their programmes from scratch, mainly by buying the latest technology from the private sector”.

The Saudi government’s large space programme, for instance, “is going to work by injecting capital into various private companies, or even buying them outright”. There are also large sums available from the public investment and sovereign wealth funds of various other countries, which creates an additional opportunity “for companies to be bought out at a large premium”.

### Space agriculture and mining

The continued growth in global space programmes also provides opportunities for mining in space. Despite the drop in the price of satellite launches, “it still costs around \$50,000 to deliver one kilo of water to the International Space Station”, says Baseley-Walker. So “if you can mine water from an asteroid for less than that you should be able to make a nice profit”. In the longer run, increasing demand for the rare-earth minerals used in smartphones and other high-end electronics, which many believe to be available in large

*“It still costs \$50,000 to deliver a kilogram of water to the International Space Station”*

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quantities on the moon, will “create momentum behind space mining”, says Michael Barr of Neuberger.

Meanwhile, says Seraphim’s Boggett, recent studies “have shown that you can grow crops in moon soil and in conditions of zero gravity”. So space agriculture could cut the cost of space colonies by removing the need to ship food supplies into space. It could also benefit those who stay behind by developing “hardier breeds of crops that could be grown more efficiently back on Earth”. Pharmaceutical companies are also becoming interested “in the effects that zero gravity has on drug manufacturing and development”. Microgravity (near-zero gravity) causes “molecules and proteins to behave and bind together in different and unexpected ways”.

Gilead Sciences, a biotechnology group, has been so intrigued by the potential for making “gamechanging discoveries” in space that it flew researchers to the International Space Station to conduct experiments on its Covid-19 drug Remdesivir. Early results suggested that drugs produced in space were of better quality with fewer defects. In the very long run, even manufacturing could follow suit, with concern about climate change prompting a relocation of our most polluting industries to other planets.

### The regulatory framework

The number of satellites in operation has soared from 958 in 2010 to 3,371 in 2020, according to a report by the Satellite Industry Association. Between 30,000 and 100,000 will be in orbit by the end of the decade, says Barr. So a global regulatory framework is required. Since “countries have been able to sit down together and [agree] on how to allocate radio spectrum... producing a framework that provides clear rules for space should be possible”.

While most industries usually see the prospect of more regulation as a problem to be overcome, Barr thinks that spacetechnology may prove an exception, with more regulation likely to provide a “net positive” to the private sector – not just because of the certainty provided, but also because rules governing sustainability could create new opportunities. For



It is possible to grow crops in moon soil and in zero-gravity

instance, the current boom in the provision of satellites risks leading to many disused satellites floating around in space. As a result, various regulatory bodies are trying to cut the 25-year period before the operators are required to de-orbit disused satellites (usually by altering their trajectory so they are burned up in the Earth’s atmosphere) to just five years.

Such regulations are particularly likely to help companies offering “a service-based model approach where launch, deployment, manoeuvring in orbit and recovery could be included to push a one-stop-shop service”, says Skyrora’s Alan Thompson. Adopting such a “value-based” model could also prevent operators “from being dragged into a head-to-head fight with those companies that have deep pockets”.

He notes that providers such as SpaceX keep costs down by providing a “bus” service, which involves payloads being dropped off at a fixed point, with the customer responsible for any additional travel. But some “might prefer to pay a higher price for a taxi-like service that takes them to a specific location”.

Spacetechnology, in short, is at an “inflection point”, says Barr, with “a long period of growth ahead of it that touches upon multiple industries”. I look at some stocks and funds likely to benefit in the box below.

*“Space agriculture could cut the cost of founding space colonies by eliminating the need to send food into orbit”*

## What to buy now

One problem with investing in spacetechnology is that many of the companies are unlisted. One way to gain access to them is through the **Seraphim Space Investment Trust (LSE: SSIT)**, the first listed fund that focuses exclusively on spacetechnology. It’s run by experienced venture capitalist Mark Boggett and has a range of holdings in more than one hundred companies, which are mostly in the early to mid-stages of raising money. These cover all parts of the spacetechnology industry, from communications to data, but also areas such as agriculture in space. Owing to the bear market in tech stocks, Seraphim trades at an almost 50% discount to the value of its net assets, although it will be some time before this value is realised.

One of Seraphim’s holdings that has been able to reach the stockmarket is **Arqit Quantum (Nasdaq: ARQQ)**. The growing amount of data produced by satellites increases the need for reliable encryption. Arqit’s system can mass-produce encryption systems able to withstand the advances in computing

power that threaten to break even the most complex codes, even from possible attacks by a quantum computer. Arqit’s revenue is already growing exponentially, more than tripling between 2022 and 2023. Viewed in this light the stock’s valuation of 27 times 2023 earnings looks reasonable.

An alternative to Seraphim that focuses on listed rather than private companies is the **Neuberger Berman Next Generation Space Economy** fund. It was launched by Michael Barr and Hari Ramanan earlier this year and focuses on firms that will benefit from the growth of the space economy, especially those involved in creating space infrastructure. Its holdings range from large aerospace and telecommunications companies such as Teledyne Technologies, Motorola Solutions and Airbus to smaller, dedicated firms. Despite its specialised nature, it has a relatively moderate ongoing charge of 1.05%.

One of Neuberger’s major holdings is **Rocket Lab USA (Nasdaq: RKLB)**. Rocket Lab is already known as one of the leading providers of low-cost satellite launches.

However, in an attempt to boost revenue further and diversify its business into higher-margin areas, it is now starting to help companies design, repair and replace their satellites, as well as work on building its own constellations of satellites. While the company isn’t yet profitable, it has plenty of cash. Strong ongoing relationships with the US government add a degree of security.

**Maxar Technologies (NYSE: MAXR)** focuses on using satellites to provide Earth-monitoring services to a variety of governmental, non-governmental and commercial organisations. These include the US military and intelligence services, but also humanitarian and disaster-response agencies, the shipping and mining industries, and conservationists. It is working on developing cutting-edge mapping tools, which will use the data its satellites produce to create detailed 3D-maps. Unlike many spacetechnology companies, it is already profitable and trades at only 15.5 times 2023 earnings. It even pays a small dividend.