THE COMMERCIAL SPACE LANDSCAPE: INNOVATION, MARKET, AND POLICY

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Madam Chair, Ranking Member Babin, and Distinguished Members. Thank you for the opportunity to testify today. In my remarks today, I would like to address three questions: First, what is commercial space? Second, what benefits does it bring? And third, how can the government best leverage commercial space?

First, what is commercial space? The term is used loosely and generally refers to two distinct concepts. Sometimes it is used to describe commercial *companies*, that are often but not always, startups. These companies put angel or venture funding or their own resources at risk to build space systems. And at other times, it refers to commercial *approaches*, which are often fixed-price, milestone-based contracts typically used in our market-based economy, but less often by space agencies. Thus, in using the term commercial space, most people are alluding either to innovative start-ups or to non-traditional contracting mechanisms.

The second question is what benefits does commercial space bring? Commercial-style contracts such as the one mentioned above, as well as private investors with "skin in the game," incentivize two kinds of behaviors: rapid development and a focus on cost reduction. As a result, the most important benefit commercial space brings to the space sector is low-cost, although at times, this is at the expense of performance and reliability. Commercially built rockets offer an illustration of this tradeoff. The Falcon Heavy may have less thrust at liftoff than, say the Space Shuttle, but it is also less than one tenth as expensive per kilogram of payload launched to low Earth orbit (SpaceX and NASA websites). Given the potential for cost-savings, commercial approaches are not just being considered in the launch sector, but also in other sectors such as space situational awareness or SSA; space nuclear power; on-orbit servicing assembly and manufacturing; and even deep space exploration.

Commercial space has brought more than cost reductions into the space sector. Commercial companies have leveraged innovations such as miniaturization, satellite mass-production, and use of commercial off-the shelf components, to produce capable lightweight satellites. These satellites can be simultaneously deployed, meaning that many hundreds can be launched and operated, and provide round the clock simultaneous multi-point imagery of any place on Earth or in space for scientific, national security, and commercial purposes. This coverage is impractical with traditional satellites.

In some cases, commercial capabilities have surpassed government ones. For example, data collected by commercial sensors enables a catalogue of objects in the geosynchronous orbit that includes objects that may be unknown to the government. Additionally, commercial networks have enough capacity to provide persistent tracking coverage of all objects in GEO for the majority of the day at a rate of multiple observations per minute. Government systems may be able to match either the breadth or speed of this coverage, but not both.

My last point on this topic is that despite the high levels of innovation and cost-effectiveness, if you draw the system boundaries around space-based activities, the principal customers of commercial space today and in the near term are governments not private. Lack of demand in the private sector constrains robust development and growth in the commercial space sector.

The final question is how can the government best leverage commercial space? Our research has shown that government purchases of products and services from commercial companies using commercial approaches has the twin benefit of (1) reducing costs and accelerating the development of many government space systems, as well as (2) fostering the growth of the space sector and promoting the industrialization of space.

In light of potential government benefits and commercial needs, we have two recommendations. At a conceptual level, space agencies should design mission plans and architectures that are sufficiently flexible such that when commercial capabilities reach adequate readiness levels, they can be incorporated in these missions and architectures. For example, there are several companies exploring water extraction systems on the Moon, as well as companies investing in technologies and systems related to space-based propellant depots and tugs. NASA or DOD should have architectures is place so when these capabilities are commercially available, the government can quickly transition their operations to exploit them.

Second, and more concretely, space agencies should consider *as a norm rather than an exception,* fixed-price, milestone-based contracts when purchasing space goods and services. In some cases, a cost-plus contract is necessary. But more often than not, fixed-price contracts suffice, and allow companies to propose their own innovative solutions. The question is would space agencies consider accepting, in cases where it makes sense (I do want to reinforce this), an 80 percent solution at half the cost and double the speed?

I'd be happy to expand on any of my points above. Thank you for your time.

References

1. B. Lal, R. Wei. 2019. *What is Commercial Space, and Why Does it Matter?* Accepted paper. 70th International Astronautical Congress. Available on Request.
2. K. Crane, E. Linck, B. Lal. 2019. *Estimating the Size of the Space Economy*. IDA Report. Available on Request.
3. H. Jones. 2018. *The Recent Large Reduction in Space Launch Cost,* 48th International Conference on Environmental Systems 8-12 July 2018, Albuquerque, NM
4. K. Crane, E. Linck, S. Carioscia, B. Lal. 2019. *Assessment of the Utility of a Government Strategic Investment Fund for Space*. IDA Report D-10616. https://www.ida.org/-/media/feature/publications/a/as/assessment-of-the-utility-of-a-government-strategic-investment-fund-for-space/d-10616.ashx?la=en&hash=A0E0F5DA11D73198284879A1600DCADC

5. B. Lal, B. Corbin, R. Meyers, T. Colvin, K. Crane, C. Cavanaugh. 2018. *An Assessment of the Ability of the United States and Other Countries to Extract and Utilize Asteroid-based Natural Resources*, IDA Paper P-10372.
6. I. Boyd, R. Buenconsejo, D. Piskorz, B. Lal, K. Crane, E. Blanco. 2017. *On-Orbit Manufacturing and Assembly of Spacecraft*. IDA Report P-8335. https://www.ida.org/-/media/feature/publications/o/on/on-orbit-manufacturing-and-assembly-of-spacecraft/on-orbit-manufacturing-and-assembly-of-spacecraft.ashx
7. B. Lal, E. Blanco, J. Behrens, B Corbin, E. Green, A. Picard, A. Balakrishnan. 2018. *Global Trends in Small Satellite*s. IDA Report P-8638. https://www.ida.org/research-and-publications/publications/all/g/gl/global-trends-in-small-satellites
8. B. Lal. 2016. “Reshaping Space Policies to Meet Global Trends.” *Issues in Science and Technology*, VOL. XXXII, NO. 4, Summer 2016. https://issues.org/reshaping-space-policies-to-meet-global-trends/

Ratio Calculation

	Cost	Payload to LEO (kg)	Cost/kg	Ratio Cost/kg	Source
Space Shuttle	$450M	27500	16,364		https://www.nasa.gov/centers/kennedy/about/information/shuttle_faq.html#10
FH	$90M	63800	1,411	11.6	https://www.spacex.com/about/capabilities

Alternative Data (not used)

Table A2. Launch cost to LEO for Saturn V, space shuttle, Falcon 9, and Falcon Heavy.

System	Saturn V	Shuttle	Falcon 9	Falcon Heavy
kg to LEO	140,000	27,500	22,800	63,800
Cost per launch, 2018 $M	728	1,697	62	90
2018 $k/kg	5.20	61.72	2.72	1.41
Reference	Williams, 2016	Pielke and Byerly, 2011	SpaceX.com, 2018	SpaceX.com, 2018

Source: Jones 2018