

Measuring the Value of the U.S. Space Economy

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The Space Economy Satellite Account (SESA) is a new, collaborative effort to measure the relative importance of the space sector on the U.S. economy, with a special emphasis on the growing commercial space segment. Using input from industry experts and multiple government agencies, chiefly the U.S. Department of Commerce (DOC) Office of Space Commerce, the forthcoming SESA statistics will show the impact of the U.S. space economy on the overall U.S. economy. Specifically, the SESA statistics will provide an estimate of the space economy's contribution to current-dollar gross domestic product (GDP) and will illustrate the contributions of individual industries to the U.S. space economy. In addition to GDP, the SESA will include gross output, compensation, and employment by industry statistics for the space economy. This article begins with a brief description of economic satellite accounts produced by the Bureau of Economic Analysis (BEA). Then, we describe the first stage of developing the framework for the new SESA statistics, most notably determining definitions for "space economy" and "commercial space." We also summarize existing definitions and estimates of the U.S. and global space economy from various private and government organizations. Based on this past research, we present a preliminary list of industries to initiate the framework of the SESA statistics. The article concludes with an overview of next steps for the project.

Economic Satellite Accounts

A satellite account refers to statistics that complement BEA's official U.S. economic statistics, such as GDP and personal income. These satellite accounts provide additional detail and allow for a more in-depth analysis of key sectors of the U.S. economy, such as health care, travel and tourism, and outdoor recreation. The international System of National Accounts explains that satellite accounts "allow experimentation with new concepts and methodologies, with a much wider degree of freedom than is possible within the central system" (European Commission and others 2009, 523). As with other BEA satellite accounts, the SESA will be built using BEA comprehensive supply-use tables (SUTs), which provide insight into the internal workings of the U.S. economy. The SUTs detail the contribution of specific commodities and industries to GDP using the North American Industry Classification System (NAICS). The SUTs detail the flows of goods and services purchased by each industry, the incomes earned from production in each industry, and the

distribution of sales for each commodity. The goal of the SESA is to highlight space-related production and spending that is already present in the SUTs. In practice, the SESA will reflect a rearrangement of existing BEA data to isolate spending and production related to the space economy. Therefore, while BEA national SUTs show the value of all research and development (R&D) in the U.S. economy, the SESA will show the value of R&D specific to the U.S. space economy. Additionally, BEA will endeavor to publish statistics for space-related activities that are relevant to data users, such as navigation and earth observation.

Measuring the Space Economy and Commercial Space Activities

Defining the “space economy” and “commercial space” is the first step in developing the SESA statistics. Determining definitions is often the most important aspect of developing a satellite account because it provides the overall framework and influences the data and methods BEA uses to develop the new statistics. Many definitions related to the space economy and commercial space activities already exist from various private and government organizations (table 1). As shown in table 1, these definitions describe a wide range of concepts and industries. The definition from the Organisation for Economic Co-operation and Development (OECD 2012, 20) broadly characterizes the “space economy” as “the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space.” A Congressional Research Service report (2012, 1) was more specific, describing the “space industry” as “economic activities related to the manufacture and delivery of components that go into Earth's orbit or beyond.” Many concepts reference both the commercial and government aspects of the space economy (Federal Aviation Administration 2018; OECD 2012; DOC 2001). The definitions related to commercial space activities are often centered on the concept of competitive markets and competitive bidding processes (Federal Aviation Administration 2010; George 2019; White House 2010).

Table 1. Sample of Existing Definitions and Concepts Related to the Space Economy and Commercial Space Activities

Report or Organization	Space Economy Definitions and Concepts
Bureau of Industry and Security (2013, 5)	“ Space-related [goods and services]: Any product, service, or object that is a) used in or launched into space; b) used to directly or indirectly support space applications from Earth; and/or c) used to manufacture any product that is used in space or directly supports space applications”
Congressional Research Service (2012, 1)	“The space industry refers to economic activities related to the manufacture and delivery of components that go into Earth’s orbit or beyond”
Economics and Statistics Administration (1993, 11)	“ US Commercial Space sector revenues [come] from space-related goods and services to US private industries, export markets, and government procurement of commercial launch services and remote sensing data”
Federal Aviation Administration (2010, 4)	“ Commercial space transportation is carried out using orbital and suborbital vehicles owned and operated by private companies or organizations for profit, procured through a competitive bidding process”
Federal Aviation Administration (2018, 93)	<p>“A commercial suborbital or orbital launch has one or more of these characteristics:</p> <ul style="list-style-type: none"> ● The launch is licensed by FAA AST [Office of Commercial Space Transportation] ● The primary payload’s launch contract was internationally competed (see definition of internationally competed below). A primary payload is generally defined as the payload with the greatest mass on a launch vehicle for a given launch ● The launch is privately financed without government support <p>Commercial payload has one or both of these characteristics:</p> <ul style="list-style-type: none"> ● The payload is operated by a private company ● The payload is funded by the government, but provides satellite service partially or totally through a private or semi-private company”
George (2019, 182), “The Economic Impacts of the Commercial Space Industry” <i>Space Policy</i>	“ Commercial space transportation is the orbital and suborbital activities performed by profit-pursuing companies in a competitive marketplace”
OECD (2012, 20)	“The Space Economy is the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space. Hence, it includes all public and private actors involved in developing, providing and using space-related products and services, ranging from research and development, the manufacture and use of space infrastructure (ground stations, launch vehicles and satellites) to space-enabled applications (navigation equipment, satellite phones, meteorological services, etc.) and the scientific knowledge generated by such activities”
Space Foundation (2019, B)	“ Commercial [mission]: Products and/or services sold to the public, using little or no public investment for running the business and mission”
U.S. Department of Commerce (2001, 2-2)	“A “ commercial launch ” may carry a commercial, civil, or military payload, but is commercial if the payload owner commercially procured the launch service”
White House (2010, 10)	The term “ commercial [space], ” for the purposes of this policy, refers to space goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the activity, operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment, and have the legal capacity to offer these goods or services to existing or potential nongovernmental customers”

Commercial and governmental space activities have been intertwined since the formation of the National Aeronautics and Space Administration (NASA) in 1958, which has always relied on private industry contractors to produce most of its space launch equipment (Hertzfeld 2002). In the 1960s, the commercial space sector expanded when privately sponsored communications satellites were first launched into space (NASA 2012). Two decades later, the Commercial Space Launch Act of 1984 was passed by Congress, establishing guidelines for federal licensing of commercial space launches (Commercial Space Launch Act 1984). In the 1990s, the Federal Aviation Administration (FAA) provided licenses to four private companies to construct commercial spaceports (DOC 2001). By 2012, a commercial spacecraft (SpaceX Dragon)

delivered cargo to the International Space Station for the first time, a trend that continues today (NASA 2014). When considering how to measure commercial space activities within the SESA, BEA must take into account the considerable overlap between government and commercial space activities. The challenge of measuring commercial space activities was highlighted in a report prepared for the DOC by the George Washington University Space Policy Institute (Hertzfeld 2002), which stated it is often impossible to separate civilian space activity from military space programs. Similarly, the Congressional Research Service (2012, 1) reported,

“The commercial space sector overlaps the government (civil and military) space sector in a number of different ways. Many manufacturers sell to both commercial and government customers, making use of common systems (for instance, satellites use standard buses), common launch vehicles, and interdependent supply chains. Many of the largest commercial aerospace companies play a major role in the space industry, and some are almost entirely dependent on government space programs for their space-related work.”

Existing estimates of the U.S. and global space economy

Many estimates of the global and international space economy currently exist from various private and government organizations. The Space Foundation (2019), a nonprofit advocacy organization, reported global space activity to be \$414.8 billion in 2018, with commercial space revenues representing 79 percent of total space activity. The OECD (2014) found commercial revenue in the global space economy was dominated by consumer services (58 percent), followed by space manufacturing and launch services (33 percent), and satellite operator services (9 percent) in 2013. The Canada Space Agency (2018) reported Canada's space sector generated revenues of \$5.6 billion (CAD) in 2017, spearheaded by satellite communications. Likewise, the German space industry generated an estimated \$3.1 billion in sales in 2013, driven by satellite manufacturing (OECD 2014).

In the United States, the FAA (2018) estimated the U.S. space industry was valued at approximately \$158 billion in 2016. Similar to Canada, satellite communications reportedly lead the space sector in the United States, specifically, satellite services, manufacturing, ground equipment, and launch services (FAA 2018). The DOC Bureau of Industry and Security (2014, 3) estimated employment for the “U.S. space industrial base” was over 2.6 million workers in 2012. Additionally, a report by Aerospace Industries and Association (2019, 3) estimated that “space systems” within the aerospace and defense industries contributed \$39 billion to U.S. economic output in 2018. When developing the new SESA statistics, BEA will refer to the data and methodologies used in these and other reports for guidance.

Preliminary list of industries comprising the Space Economy Satellite Account

The OECD publishes a handbook for measuring the space economy (OECD 2012) and produces a substantial amount of research about the global space economy. A definition of the space economy is provided in their handbook (table 1), along with a list of NAICS industries that comprise the space economy. As a starting point for the SESA, BEA will look to the OECD space economy definition and specified NAICS industries to develop the initial framework for the new statistics. To ensure the growing commercial aspect of the space economy is captured, BEA will

also incorporate the NAICS industries identified in a recent paper in the journal *Space Policy*, “The Economic Impacts of the Commercial Space Industry” (George 2019). These NAICS sectors are listed in table 2, along with examples of space-related products for each sector. BEA will continue to add any relevant commodities to this list and potentially revise the definition of space economy as we move forward with research and outreach with stakeholders.

Table 2. Industry Sectors Identified as Part of the Space Economy, Current and Future

NAICS Sector	Sector Name	Examples of Space-related Goods and Services
23	Construction	Satellite receiving stations
31-33	Durable and nondurable manufacturing	Space vehicle manufacturing
42	Wholesale trade	Space propulsion units and parts merchant wholesalers
51	Information	Satellite telecommunications
54	Professional, scientific, and technical services	Aerospace engineering services
90	Government	Space research and technology
NAICS Sector	Possible Future Industries	Examples of Possible Space-related Goods and Services
48	Passenger air travel	Transportation by spacecraft
72	Accommodations and food services	Space accommodations

Sources: OECD (2012), George (2019)

Next Steps for the BEA Space Economy Satellite Account

The prototype SESA estimates of GDP, gross output, employment, and compensation by industry are expected to be released in late 2020, pursuant to available resources. BEA asks for feedback from data users and interested stakeholders (email SpaceEconomy@bea.gov) regarding the definitions and industries used in the SESA, plus any other comments users think may be relevant to the development of these statistics. BEA is developing this account as a joint effort with the DOC Office of Space Commerce. After publishing the prototype estimates in late 2020, BEA will endeavor to produce other extensions to this satellite account subject to time, data, resources, and funding constraints.

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