SCB SURVEY OF CURRENT BUSINESS

The Journal of the U.S. Bureau of Economic Analysis

New and Revised Statistics for the U.S. Space Economy, 2012–2021

By Tina Highfill and Chris Surfield | June 27, 2023

This article summarizes new, updated, and expanded U.S. space economy statistics for 2012–2021 released on June 27, 2023. These statistics build on previous estimates that were released in January 2022 by incorporating new source data and improved methods. These space economy statistics provide estimates of the space economy's contribution to U.S. current-dollar and chained-dollar ("real") gross output and gross domestic product (GDP) by industry, as well as estimates of private employment and compensation.[1] The updated and revised statistics show that, in 2021, the U.S. space economy accounted for $211.6 billion of gross output, $129.9 billion (0.6 percent) of GDP, $51.1 billion of private industry compensation, and 360,000 private industry jobs. See the U.S. Bureau of Economic Analysis (BEA) space economy website for detailed data tables.

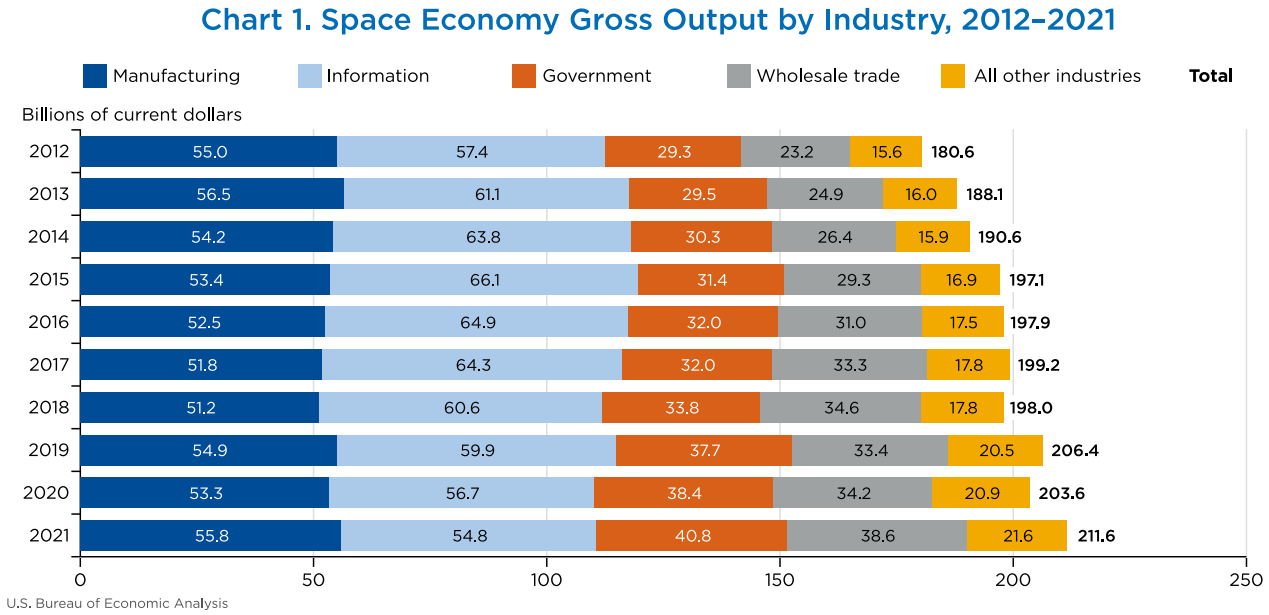
The U.S. space economy statistics are built using BEA's comprehensive supply and use tables (SUTs) and National Income and Product Accounts (NIPAs), which provide insight into the internal workings of the U.S. economy and detail the contribution of specific industries and products to GDP. The SUTs measure 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 product. The NIPA data present the value and composition of U.S. GDP, the types of incomes generated in its production, and its associated employment. The goal of the space economy statistics is to highlight the space-related production and spending that are already present in the SUTs and NIPAs. In practice, these statistics represent a rearrangement of existing data to isolate spending and production for the space economy. A more detailed description of the methodology and source data, including background information on BEA concepts and general national accounting methods, is available in the December 2020 *Survey of Current Business*.

This report first presents a summary of major findings from the updated statistics, beginning with an analysis of gross output and value added by industry in recent years. A brief summary of the employment and compensation statistics is presented next, followed by a description of the revisions made to the previously published estimates for 2012–2019. The report concludes with a review of expected next steps for the space economy statistics.

Results

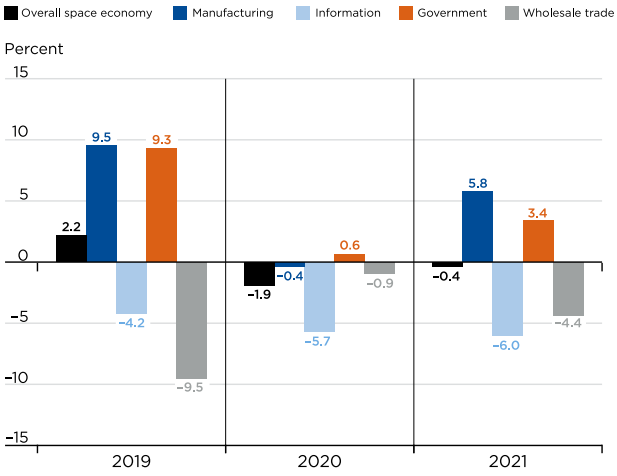
Gross output

Industry gross output represents the market value of the goods and services produced by an industry and is similar in concept to revenue. Chart 1 shows the industry distribution of current-dollar ("nominal") gross output for 2012–2021, which grew from $180.6 billion to $211.6 billion over the period. In 2021, manufacturing overtook information as the largest industry in the space economy.



Real estimates reflect quantities produced and exclude the effects of inflation.[2] Chart 2 shows growth rates for real gross output for 2019–2021 for the overall space economy and its four largest industries. In 2019, real gross output in the space economy increased 2.2 percent, more than the U.S. growth rate of 1.9 percent, reflecting increases in both manufacturing and government, partly offset by declines in information and wholesale trade. In 2020, real gross output decreased 1.9 percent, a smaller contraction than the 3.6 percent decrease for the overall U.S. economy; the decrease reflected widespread declines in most industries and was led by broadcasting and telecommunications within the information industry, which includes direct-to-home (DTH) satellite television. In 2021, real gross output in the space economy decreased 0.4 percent—reflecting continued decreases in information and wholesale trade—in contrast to the rebound in the overall economy, which increased 6.2 percent. For all three years, growth in real gross output was slower than growth in current-dollar gross output, reflecting price increases in the space economy over the period. Notably, in 2021, current-dollar gross output increased 3.9 percent, while real gross output decreased 0.4 percent.

Chart 2. Space Economy Real Growth in Gross Output, 2019–2021



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Manufacturing experienced its strongest two years of growth in real gross output over the 2012–2021 period in 2019 (9.5 percent) and 2021 (5.8 percent). Both major space-related manufacturing industries, computer and electronic products and other transportation equipment, increased in 2019 and 2021. The computer and electronic products manufacturing industry increased 10.6 percent in 2019 and 5.7 percent in 2021, much faster than the overall space economy. This industry comprises a variety of space-related items including satellites, ground stations, and Global Positioning System (GPS)/positioning, navigation, and timing (PNT) equipment, including research and development (R&D) associated with these products. Likewise, other transportation equipment manufacturing increased 11.5 percent in 2019 and 5.6 percent in 2021. This industry mostly consists of products related to space vehicles and space weapons systems (including associated R&D). Growth in current-dollar gross output for manufacturing was lower than growth in real gross output both years, reflecting price decreases. The prices used to calculate real gross output (and real value added) are adjusted for changes in quality over time. In the case of satellite equipment manufacturing, for example, prices are adjusted for changes in capacity over the period, among other quality indicators, as estimated by the Federal Reserve.[3]

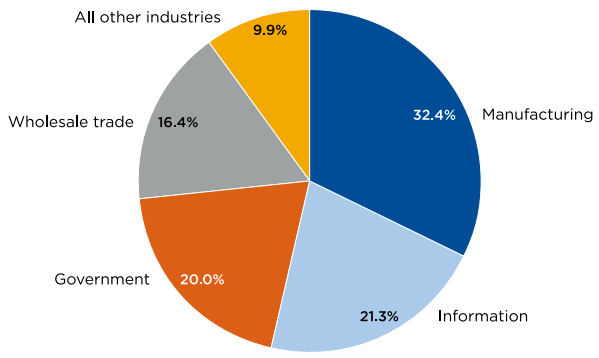
Government real gross output also increased in 2019 and 2021 (9.3 percent and 3.4 percent, respectively). Unlike most industries in the space economy, government did not decrease in 2020 and instead increased 0.6 percent. Government consists mostly of federal space-related government agencies, chiefly the National Aeronautical and Space Administration (NASA), the Air Force, the Space Force, and other agencies in the Department of Defense.[4] The government statistics do not include spending by government for space activities contracted to private industries; that spending is included in the private industry that makes the product for the government. This update of the space economy statistics provides the breakout of federal government into national defense and nondefense for the first time. The data show that while nondefense represented the majority of gross output for the federal government from 2012–2021, national defense has been growing much faster than nondefense in recent years, increasing 11.4 percent for 2019–2021, compared with 2.4 percent for nondefense.

Two of the largest industries in the space economy, information and wholesale trade, contracted throughout 2019–2021, dragging down growth in the overall space economy for those years. Real gross output in information decreased an average of 5.3 percent for 2019–2021, which continued the downward trend that began in 2016. Likewise, wholesale trade decreased an average of 4.9 percent. Wholesale trade consists of the margins or markups charged by wholesale distributors for space-related items, such as GPS transceivers and antennae, many of which are used as intermediate inputs into other products. Current-dollar gross output for wholesale trade increased 2.6 percent in 2020 and 12.9 percent in 2021, while real gross output decreased 0.9 percent and 4.4 percent, respectively. The opposing directions of growth in current-dollar and real wholesale trade gross output for 2021 reflect sizable price increases for the industry.

Value added

GDP, or value added, by industry represents the market value an industry adds to production, or the industry's gross output less the cost of its intermediate inputs. Chart 3 shows the industry distribution of space economy value added in 2021. As with gross output, manufacturing accounted for the largest share of 2021 space economy value added, followed by information. While manufacturing represented 26 percent of gross output, it represented almost one-third (32.4 percent) of value added, indicating the value of intermediate inputs used by the manufacturing industry is relatively less than those of other space industries.

Chart 3. Space Economy Value-Added Industry Shares, 2021



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As with real gross output, real value added reflects the removal of the impact of inflation. Real value added for the space economy increased 3.0 percent in 2019, decreased 0.4 percent in 2020, and decreased 3.6 percent in 2021. As with gross output, gains in manufacturing's share of value added were offset by contractions in information.

Other statistics

Private industry employment for the space economy was 360,000 in 2021, and compensation was $51.1 billion.[5] Manufacturing accounted for 35 percent of total private employment but 45 percent of compensation due to its relatively high average compensation level ($182,762). Information was the next-largest industry in terms of private employment and compensation in 2021, representing 23 percent of employment and 18 percent of compensation.

An addendum to the gross output and value-added statistics shows the value of the space economy without the following components: DTH satellite television, satellite radio, and educational services. This value represents a narrower definition of the "space economy" suggested by data users interested in understanding what the U.S. space economy would look like without the effect of these three components. Over the 2012–2021 period, the narrower definition of the space economy resulted in faster growth rates than for the broader definition for both real gross output (2.8 percent versus 1.2 percent) and real value added (3.8 percent versus 1.7 percent). The faster growth is mostly due to the removal of DTH satellite television, which has an outsized impact on the overall space economy.

Revisions

Revisions to the 2012–2019 preliminary space economy estimates fall into two categories: methodological improvements and updated source data. Methodological improvements include correcting for an underestimate of R&D spending of about $5 to $7 billion per year in terms of current-dollar gross output. While most industries were impacted by this revision because of the existence of space-related R&D across various industries, the largest revisions were in the professional and business services industry ($3.7 to 5.8 billion per year) and manufacturing industry ($1.2 to 1.5 billion per year). The other noteworthy methodological improvement relates to incorporating new insurance data from AXA XL. The new data from AXA XL show that the previous estimates underestimated rates in the early years (2012–2017) and overestimated rates in later years (2018–2019) as the space economy moved toward smaller and cheaper satellites, many of which are not insured.[6] The revisions to current-dollar gross output were less than $400 million each year and only impacted the finance, insurance, real estate, rental, and leasing industry.

Revisions from source data reflect updated gross output and value added by industry estimates from BEA's SUTs, which are mostly derived from new or updated receipts and shipments from the U.S. Census Bureau and Internal Revenue Service, and updated statistics for employment and compensation by industry from the NIPAs. These revisions were part of the regular "annual update" to BEA's national statistics.[7] Revisions varied by industry and tended to be mostly minor with two exceptions. Gross output for manufacturing and wholesale trade were each revised more than $1.5 billion in both 2017 and 2019. The upward revisions to 2017 and 2019, but not 2018, led to a revised current-dollar gross output growth rate of 4.3 percent for 2019, significantly higher than the previously published growth rate of 1.1 percent. The updated 2019 estimates also reflected the incorporation of new R&D spending data from the National Science Foundation (NSF) Business Enterprise Research and Development Survey, the NSF Survey of Federal Funds for Research and Development, data from the Federal Communications Commission on satellite internet usage, and updated information on federal defense spending on space weapons systems and related investment.[8]

Summary

BEA continues to expand and improve upon the space economy estimates with the intention of developing a time series of estimates with full industry detail aligning with BEA's other statistical releases. Additionally, research is underway to estimate space economic activity by categories that are more salient to space community users, such as launch and R&D, to provide an additional layer of understanding about the U.S. space economy. Currently, these activities are spread across multiple industries because they include production from manufacturing, government, wholesale trade, and others. The addendum to the current gross output and value-added statistics that show a narrower concept of the space economy (without DTH satellite television, satellite radio, and educational services) is a simple example of how the space economy statistics can be reorganized to meet the needs of various data users. Lastly, BEA is exploring the possibility of developing space economy estimates by state. BEA will endeavor to implement these changes and other extensions to this satellite account subject to time and data constraints. BEA asks for feedback from data users and other stakeholders that may be relevant to the development of this satellite account. Please send suggestions and comments to SpaceEconomy@bea.gov.

Measuring Space-Related Government Employment

Private industry employment and compensation for the space economy is derived from the relationship between an industry's gross output attributable to space activities and an industry's total gross output. Specifically, the ratio of an industry's space economy output to total output is applied to each industry's employment and compensation to calculate those estimates. As a simple example, if space products represented 10 percent of all manufacturing output, then 10 percent of employees within manufacturing would be classified as space employment. This method is suitable because BEA's SUTs and industry data contain very detailed information on goods and services produced by private industries. However, BEA's industry data do not have detailed employment and compensation data on the myriad of space-related government services provided by government agencies. As a result, the method used to estimate private employment and compensation is not suitable for estimating space-related government employment and compensation.

To find an alternative method for estimating government employment and compensation of space-related activity (both federal defense and nondefense, as well as state and local), a variety of public budget reports and proposals for government agencies, subagencies, and other public data sources were used. Documenting the available data was done manually by searching for any tables or direct mentions of employees or compensation by activity, as the location of the data within each agency's budget documents is not standardized. A significant portion of state and local employment was estimated by using the National Center for Education Statistics data and applying a ratio of graduation rates by degrees that are space related to total public university and college employment.

Several challenges to this methodology emerged throughout this process. In addition to budget documents not being standard across agencies, even within an agency or bureau, the format of annual budget reports would often change from year to year, adding more effort to locate the required data. Federal agency budgets often had the most reliable breakouts of employment, directly reporting annual full-time-equivalent figures by activity, while state and local reporting of similar activity was less detailed and harder, if not impossible, to locate. Compensation figures were often not reported at the same detail level as employment, making it infeasible to estimate government space-related compensation using this method. Defense-related federal government data were difficult to identify as well, as many of the budgets did not explicitly state personnel figures broken out by activity or assignment. The recently created Space Force was one of the few federal defense categories for which it was feasible to estimate an accurate measure of space-related employment in 2021, as the entire agency is captured as related activity and does not need to be broken out.

As a result of these challenges, initial estimates of space-related government employment in table I (below) are incomplete. However, given that NASA provides direct estimates of space-related employment, and this is expected to be the largest space-related government agency, these estimates likely cover the majority of federal nondefense government employment. Still, additional work is necessary to determine total employment for government space-related employment and to calculate related compensation.

Table I shows total available nondefense government employment increased from 18,840 in 2018 to 19,111 in 2021. The largest agency with available space-related employment was NASA, whose employment increased slightly between 2018 and 2021, from 15,455 to 15,762. The National Oceanic and Atmospheric Administration had the second-largest nondefense workforce in 2021, with 2,030 employees identified as working on space-related activities. Not shown in the table are space-related defense employment figures, including the 9,979 employees in Space Force for 2021, the first year it was broken out from Air Force total personnel figures.

Table I. Preliminary Estimates of Available Space-Related Nondefense Government Employment

	2018	2019	2020	2021
Nondefense federal, state, and local space total[1]	18,840	18,935	19,133	19,111
Nondefense federal space total	17,871	17,877	18,074	18,065
Department of the Interior—U.S. Geological Survey (National Land Imaging Program/Land Remote Sensing (Landsat and operations))	180	132	135	169
Federal Aviation Administration—Office of Commercial Space Transportation	97	97	91	104
NASA space total (excludes aeronautical employment)	15,455	15,654	15,871	15,762
NOAA space total	2,139	1,994	1,977	2,030
National Environmental Satellite Data and Information Service	851	752	727	784
National Ocean Service (Navigation, Observations, and Positioning)	549	563	568	579
National Weather Service (Observations)	739	679	682	667
State and local space total	969	1,058	1,059	1,046
Oklahoma Space Industry Development Authority	6	6	6	6
Estimated state universities' space-related faculty	963	1,052	1,053	1,040

NASA National Aeronautics and Space Administration

NOAA National Oceanic and Atmospheric Administration

1. Missing from this list are state and local spaceports and administration (aside from Oklahoma) and National Science Foundation R&D centers and observatories.

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Acknowledgments

We wish to thank the following BEA employees for their assistance in preparing this report: Peter Beall, Jennifer Bennett, Ryan Byrne, David Curtis, Connor Franks, Alexis Grimm, Danielle Helta, Tom Howells, Billy Jolliff, Pam Kelly, Jen Lee, Mark Ludwick, Lisa Mataloni, Ted Morgan, Farouk Nabourema, Wade Petty, Andy Pinard, Marina Rouleau, Shelly Smith, Ricky Stewart, David Sullivan, and Dave Washhausen.

Footnotes

1. In Bureau of Economic Analysis (BEA) estimates, the space economy consists of space-related goods and services, both public and private. This includes goods and services that are used in space, or directly support those used in space; require direct input from space to function, or directly support those that do; and are associated with studying space. This definition is derived from previous research and feedback from subject matter experts and data users. See BEA's December 2020 *Survey of Current Business* article for additional details about the definition and general methodology.
2. Chained-dollar estimates are calculated by taking the current-dollar level of a series in the reference period and multiplying it by the change in a chained-type quantity index number for the series since the reference period. Chained-dollar estimates correctly show growth rates for a series, but are not additive in periods other than the reference period.
3. For details on methodology, see David M. Byrne and Carol A. Corrado, "Prices for Communications Equipment: Rewriting the Record" (Finance and Economic Discussion Series working paper 2015–069, Board of Governors of the Federal Reserve System, Washington, DC, September 2015). The Federal Reserve's quality-adjusted price indexes for communications equipment, as of January 2021, are available on their website.
4. See table 7 from "Preliminary Estimates of the U.S. Space Economy, 2012–2018" for a list of space-related government agencies. This table does not reflect space-related agencies founded after 2018, such as U.S. Space Force and Space Development Agency, that are included in the new estimates.
5. Additional research is underway to estimate space-related government employment and compensation (see "Measuring Space-Related Government Employment"). Government production values are included in the gross output and value-added estimates.
6. Previous estimates of space-related insurance were based on insurance rates taken from a MITRE research paper on launch demand, coupled with Federal Aviation Administration data on type of launch.
7. See "Information on Updates to the National Economic Accounts."
8. Since the space economy value-added, employment, and compensation estimates stem from the same process as gross output, the revisions to gross output are also reflected in these estimates. See the December 2020 *Survey* article for more details on methodology.