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Preliminary Results From a New R&D Satellite Account

Experimental National and State-Level R&D Value Added, Employment, and Compensation Statistics, 2017–2021

By Ledia Guci, Dirk van Duym, Gabriel Medeiros, Christian Awuku-Budu, and Francisco Moris | August 30, 2024

Earlier this year, the U.S. Bureau of Economic Analysis (BEA) released new experimental national and state-level statistics on research and development (R&D) value added and corresponding R&D employment and compensation.[1] These statistics are part of a collaborative effort with the National Center for Science and Engineering Statistics (NCSES) of the National Science Foundation (NSF) on a new R&D Satellite Account that measures domestic R&D production in the same manner as gross domestic product (GDP).

The new R&D Satellite Account builds on decades of collaborative research between BEA and NSF on a prior R&D Satellite Account that focused on measuring R&D investment. This laid out the foundation for BEA to expand its asset boundary within its core accounts by changing the treatment of R&D from an intermediate cost of production to investment, consistent with international guidance and with similar changes across Organisation for Economic Co-operation and Development countries.[2] This change recognized the long-lasting contribution of R&D to the U.S. economy and was implemented during the 2013 comprehensive update of the National Income and Product Accounts (NIPAs).

The new R&D Satellite Account focuses on measuring R&D production separate from measures already published by BEA on R&D investment. Specifically, the experimental statistics combine R&D performance data from NSF's R&D surveys with the framework that BEA uses to estimate GDP. While the economic activity measured in the R&D Satellite Account is already included in aggregate statistics such as GDP, this effort expands BEA's R&D measures at the national level and, for the first time, provides state-level statistics, as R&D is not separately shown in the GDP by state statistics.[3]

The new statistics show that R&D activities generated $542.7 billion in value added and accounted for 2.3 percent of U.S. GDP in 2021. Across states, the R&D value-added share of each state's GDP ranged from 0.3 percent in Louisiana and Wyoming to 6.3 percent in New Mexico, home to federally funded Los Alamos National Laboratory and Sandia National Laboratories. Additional highlights for 2021 include the following:

- Nationally, R&D employment accounted for 2.2 percent of total U.S. wage and salary employment, while R&D compensation accounted for 3.9 percent of total U.S. compensation. The corresponding R&D employment state share ranged from 0.4 in Louisiana to 9.8 in the District of Columbia, while the R&D compensation share ranged from 0.6 percent in Louisiana to 10.8 percent in New Mexico.
- Massachusetts, Washington, and California, in addition to New Mexico, were among the states with the largest R&D shares of state GDP, employment, and compensation.
- The distribution of R&D production is highly concentrated geographically. California alone accounted for nearly a third of the nation's R&D value added.
- R&D production is highly concentrated in the business sector. This sector generated 85 percent of the nation's R&D value added.

As these highlights show, the new R&D statistics can be used with other BEA statistics to provide a better understanding of the role and contribution of R&D activities to the national and state economies. Expanded R&D statistics consistent with GDP benefit economic development, government planning at all levels, business investment, and other decision-making.

This article introduces the new statistics, provides a high-level overview of concepts, source data, and methodology used to prepare these statistics, and presents preliminary results to illustrate some of the insights these new data can offer.

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Data Availability

With the new R&D Satellite Account, BEA released annual statistics for 2017–2021 on R&D value added, compensation, and employment at the national level as well as for each of the 50 states and the District of Columbia.

For each geography, R&D activity (value added, employment, and compensation) is presented at the aggregate level and by producing sector—business, nonprofit institutions serving households (NPISHs), and government.[4] The statistics show the R&D activity of economic units (e.g., business establishments, academic institutions, government agencies) located in each state.

The statistics for the business sector show the R&D activity of all for-profit enterprises. The nonprofit statistics show the R&D activity of private universities and colleges and nonacademic nonprofits. The statistics for the government sector show the R&D activity of federal and state and local governments including public universities. The R&D activity of the federally funded research and development centers (FFRDCs) is attributed to the sector of the administrator of the FFRDC.[5] Thus, the R&D activity of the business-administered FFRDCs is assigned to the business sector, while the R&D activity of the FFRDCs administered by private nonprofit higher education institutions and nonprofit nonacademic institutions is assigned to the nonprofit sector.[6]

R&D employment and compensation statistics are published separately for the manufacturing and nonmanufacturing sectors. The satellite account also provides additional industry detail for R&D value added. For data users interested in R&D production by higher education institutions as whole, an addendum combines private nonprofit universities and colleges and public universities and colleges under state and local government.

Experimental Methodology

Overview

Estimating R&D production requires identifying the performers of R&D from NSF's R&D surveys and valuing R&D output based on NIPA methodology. At the state level, an additional requirement is identifying the location of the R&D-performing unit, so the value generated through R&D activities is attributed to the producing (or performing) geography. This section covers key concepts relevant to the measurement of R&D activity in the R&D Satellite Account.

Market versus nonmarket economic activity. BEA's standard approach to measuring output is to value it at market prices. For nonmarket production, the standard approach is to use the costs of production as a proxy. In the NIPAs, most of the production of NPISHs and of government agencies is considered nonmarket production.

Own-account R&D versus for-sale R&D. In addition to nonmarket activity, a sum of production costs approach is also used for valuing output from own-account activity. Own-account production refers to production by an entity for its own final use (own final consumption or capital accumulation). In the context of R&D production, the market-based approach applies to valuing output of R&D that is produced for sale, i.e., for the R&D that is funded by one entity but produced by another entity. A sum of production costs approach is used for valuing own-account R&D output and the output of the R&D performed by NPISHs and government.

Measurement of value added. In the R&D Satellite Account, the featured measure of output is value added. Value added is defined as the difference between gross output—a measure of an industry's sales or receipts—and the total cost of intermediate inputs that were used in production. These include energy, materials, and services purchased from other businesses. As an unduplicated measure of output, value added measures the contribution of each industry to GDP.

Value added can also be measured as the sum of factor incomes earned in production, which is the approach used for the R&D Satellite Account. With this approach, value added is measured as the sum of an industry's compensation of employees, gross operating surplus (GOS), and taxes on production and imports less subsidies (TOPI).

Compensation of employees consists of the income accruing to employees as remuneration for their work for domestic production. It includes wages and salaries and supplements to wages and salaries. GOS consists of profits and the consumption of fixed capital (CFC), which is the depreciation in the value of capital due to wear and tear, obsolescence, accidental damage, and aging. TOPI consists primarily of excise, sales, and property taxes less subsidies, which are production-related monetary grants paid by government agencies to businesses.

For government and NPISHs, CFC serves as a measure of the value of the current service of the capital (fixed assets) owned and used by these entities. Thus, the value added in the government and nonprofit sectors consists only of compensation of employees and CFC.

R&D value added versus R&D investment. There is an important conceptual distinction between R&D value added and R&D investment. R&D investment measures total spending on R&D and is based on R&D funding. R&D value added measures the economic activity generated by R&D performance. Further, value added, as a net measure of R&D output, excludes intermediate inputs used in the production of R&D but includes the value added of R&D exports. In contrast, R&D investment includes intermediate inputs used in the production of R&D but excludes net R&D exports.

Given these conceptual distinctions, R&D production and R&D investment are attributed differently to sectors of the economy. For R&D production, BEA attributes the activity to the sector that performed the R&D. For R&D investment, BEA attributes the activity to the sector that funded the R&D.[7] For example, the R&D performed by businesses but funded by the federal government would be attributed to the private sector on a production (or performance) basis but to the federal government on an investment (or funding) basis.

Geography of R&D. One important feature of the measures in the R&D Satellite Account is their geographical dimension. Satellite account R&D statistics by state are based on the state in which the R&D is performed. For example, the R&D activity of a multiunit pharmaceutical company that is headquartered in New Jersey but has R&D facilities in Pennsylvania is attributed to Pennsylvania. R&D performed in U.S. territories is not included.

Source data and adjustments

This section provides a high-level overview of the source data and methods used to prepare the experimental national and state-level statistics. A summary of the principal source data for each R&D measure is presented by R&D-producing sector in table 1. Table 1 also shows how R&D performers in the NSF surveys align with BEA's R&D-producing sectors. A detailed description of the methodology is available in the technical document accompanying the release of the experimental statistics.

Table 1. Summary of Principal Source Data

RDSA R&D-producing sector	R&D-producing sector composition	Data used to develop national statistics	Data used to allocate national statistics to states
R&D employment			
Business	Businesses (including for-profit private universities and colleges)	R&D employment headcounts from BERD and ABS. OEWS data for the employment adjustment. QCEW employment data and R&D gross output ratios for the company-to-establishment adjustment.	Special tabulations of R&D employment by state and industry from BERD. ABS expenditure data for small businesses. OEWS-based national ratio for the employment adjustment. EC employment for auxiliary establishments. QCEW employment data for the company-to-establishment adjustment.
	FFRDCs administered by businesses	FFRDC costs for business-administered FFRDCs from the FFRDC R&D survey and employment-to-costs ratios from the BERD survey.	FFRDC costs for business-administered FFRDCs from the FFRDC R&D survey and employment-to-costs ratios from the BERD survey.
NPISHs	Private nonprofit universities and colleges	R&D personnel headcounts and FTE employment from the HERD survey. FTE-to-headcount ratio for student adjustment.	R&D personnel headcounts by state from the HERD survey.
	Nonacademic nonprofits	Employment headcounts from the 2021 NPRA survey. BEA's SUTs data on R&D output in nonprofits for extrapolation of estimates back to 2017. Same OEWS-based employment adjustment as the business estimates.	A national average compensation rate for the nonprofit scientific R&D services establishments applied to the state-level compensation estimates (see description below).
	FFRDCs administered by academic institutions	FFRDCs costs for academic-administered FFRDCs from the FFRDC R&D survey and employment-to-costs ratios from the HERD survey.	FFRDCs costs for academic-administered FFRDCs from the FFRDC R&D survey and national employment-to-cost ratios from the HERD survey.
	FFRDCs administered by nonacademic nonprofits	FFRDCs costs from the FFRDC R&D survey and employment-to-costs ratios from the NPRA survey.	Nonprofit-administered FFRDCs costs from the FFRDC R&D survey and national employment-to-cost ratios from the NPRA survey.
Government	Federal	Personnel costs for intramural performers (federal obligations) from the Survey of Federal Funds for R&D and employment-to-compensation ratios from the 2021 NPRA.	A national average compensation rate for the nonprofit NAICS 5417 applied to the federal compensation estimates (see description below).
	State and local	State intramural employment headcounts for 2021 from SGRD extrapolated back to 2017 using state intramural expenses adjusted for inflation using the CPI.	A national average compensation rate for the nonprofit hospitals applied to the corresponding state and local compensation estimates.
	Public universities and colleges	R&D personnel headcounts and FTE employment from the HERD survey. An FTE-to-headcount ratio applied to remove students from the headcounts.	Headcounts of R&D personnel at higher academic institutions by state from the HERD survey. National FTE-to-headcount ratio to remove students.
R&D compensation			
Business	Businesses (including for-profit private universities and colleges)	Wages, salaries, and fringe benefits and stock-based compensation from BERD and ABS. OEWS data for employment adjustment. QCEW wage data and R&D gross output ratios from BEA's SUTs to breakdown total R&D compensation by detailed R&D commodity and industry and for the company-to-establishment adjustment.	For own-account R&D, special tabulations of R&D compensation (wages, salaries, and fringe benefits and stock-based compensation) for R&D paid for and performed by the company, by state and industry from BERD. For for-sale R&D, compensation-to-expenditures ratios by industry and state for own-account R&D applied to corresponding for-sale R&D expenditures from BERD. State-level ratios based on ABS expenditures to account for small businesses. OEWS-based national ratio for employment adjustment. State-level EC payroll for auxiliary establishments. QCEW state-level wage data for the company-to-establishment adjustment.
	FFRDCs administered by businesses	Business-administered FFRDCs costs from the FFRDC R&D survey and compensation-to-costs ratios from the BERD survey.	Business-administered FFRDCs costs from the FFRDC R&D survey and compensation-to-costs ratios from the BERD survey.
NPISHs	Private nonprofit universities and colleges	Salaries, wages, and fringe benefits data from HERD.	R&D compensation (salaries, wages, and fringe benefits) by academic institution from the HERD survey.
	Nonacademic nonprofits	Salaries, wages, and fringe benefits data from the 2021 NPRA survey extrapolated back to 2017 using change in employment (to account for quantity change) and change in the CPI (to account for a price change). Same OEWS-based adjustment for employment as the business estimates.	National compensation-to-expenditures ratio for the nonprofit NAICS 5417 applied to state R&D expenditures.
	FFRDCs administered by academic institutions	Academic-administered FFRDCs costs from the FFRDC R&D survey and compensation-to-costs ratios from the HERD survey.	Academic-administered FFRDCs costs from the FFRDC R&D survey and compensation-to-costs ratios from the HERD survey.
	FFRDCs administered by nonacademic nonprofits	Nonprofit-administered FFRDCs costs from the FFRDC R&D survey and compensation-to-costs ratios from the NPRA survey.	Nonprofit-administered FFRDCs costs from the FFRDC R&D survey and national compensation-to-costs ratios from the NPRA survey.

RDSA R&D-producing sector	R&D-producing sector composition	Data used to develop national statistics	Data used to allocate national statistics to states
Government	Federal	Personnel costs for intramural performers (federal obligations) from the Survey of Federal Funds for R&D.	A national compensation-to-expenditures ratio for the nonprofit NAICS 5417 applied to R&D obligations by state from the Survey of Federal Funds for R&D.
	State and local	State intramural expenses and a compensation-to-cost ratio derived from the 2021 NPRA survey.	A national compensation-to-expenditures ratio for the nonprofit hospitals from the NPRA survey applied to the R&D expenditures data by state from the SGRD.
	Public universities and colleges	Salaries, wages, and fringe benefits data from HERD.	R&D compensation (salaries, wages, and fringe benefits) by academic institution from the HERD survey.
R&D value added[1]			
Business	Businesses (including for-profit private universities and colleges)	*Compensation*: as described above. *GOS*: GOS-to-compensation ratios from BEA's SUTs for for-sale R&D. For own-account or auxiliary R&D, a capital services-to-CFC ratio based on internal research data for the capital services charge and BERD data on depreciation of property, plant, equipment, and intangible assets for CFC. *TOPI*: TOPI-to-compensation ratios from BEA's SUTs.	*Compensation*: as described above. *GOS* and *TOPI*: state-level R&D expenditures from the BERD survey.
	FFRDCs administered by businesses	*Compensation*: as described above. *GOS*: GOS-to-compensation ratios from BEA's SUTs.	*Compensation*: as described above. *GOS*: FFRDC R&D expenditure data for FFRDCs administered by businesses.
NPISHs	Private nonprofit universities and colleges	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratio from the HERD survey.	*Compensation:* as described above. *CFC:* HERD expenditures by academic institution.
	Nonacademic nonprofits	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratio from the 2021 NPRA survey.	*Compensation:* as described above. *CFC:* R&D expenditure data by state from the NPRA survey.
	FFRDCs administered by academic institutions	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratio from the HERD survey.	*Compensation:* as described above. *CFC:* FFRDC R&D expenditure data for FFRDCs administered by academic institutions.
	FFRDCs administered by nonacademic nonprofits	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratio from the 2021 NPRA survey.	*Compensation:* as described above. *CFC:* FFRDC R&D expenditure data for FFRDCs administered by nonacademic nonprofits.
Government	Federal	*Compensation:* as described above. *CFC:* average depreciation-to-compensation ratio from the BERD survey (applied to federal defense compensation portion) and the average depreciation-to-compensation ratio for other nonprofits from the NPRA survey (applied to federal nondefense compensation portion). The defense-nondefense split based on gross output ratios from BEA SUTs data.	*Compensation:* as described above. *CFC:* federal obligations data by state from the Survey of Federal Funds for R&D.
	State and local	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratios for nonprofit hospitals from the NPRA survey.	*Compensation:* as described above. *CFC:* R&D expenditures data from SGRD.
	Public universities and colleges	*Compensation:* as described above. *CFC:* depreciation-to-compensation ratio from the HERD survey.	*Compensation:* as described above. *CFC:* HERD expenditures by academic institution.

ABS Annual Business Survey
BERD Business Enterprise Research and Development
CFC Consumption of fixed capital
CPI Consumer Price Index
EC Economic Census
FFRD Federally funded research and development centers
FTE Full-time equivalent
GOS Gross operating surplus
HERD Higher Education Research and Development
NAICS North American Industry Classification System
NIPA National Income and Product Accounts
NPISH Nonprofit institutions serving households
NPRA Nonprofit Research Activities
OEWS Occupational Wage and Employment Statistics
QCEW Quarterly Census of Employment and Wages
R&D Research and development
RDSA Research and Development Satellite Account
SGRD Survey of State Government Research and Development
SUTs Supply and use tables
TOPI Taxes on production and imports less subsidies

1. Value added is measured for the business sector as the sum of compensation, TOPI, and GOS. For NPISHs and government, value added is measured as the sum of compensation and CFC.

U.S. Bureau of Economic Analysis

Source data

For the experimental R&D production statistics, BEA relies primarily on NSF's annual R&D surveys. These surveys cover all major R&D-performing and funding sectors in the United States. They consist of the Business Enterprise Research and Development Survey (BERD), the Annual Business Survey (ABS), the Higher Education Research and Development Survey (HERD), the Survey of Federal Funds for Research and Development, the FFRDC Research and Development Survey, the Nonprofit Research Activities Survey (NPRA), and the Survey of State Government Research and Development (SGRD).

NSF's R&D surveys collect detailed information on personnel and R&D expenditures, and for some sectors, data on types and fields of R&D.[8] The BERD survey collects data on R&D expenditures and R&D employees of for-profit nonfarm businesses with 10 or more employees. R&D data for businesses with less than 10 employees are collected in the ABS. The HERD survey collects data on R&D expenditures at U.S. colleges and universities that spent at least $150,000 in separately accounted for R&D in the fiscal year. The FFRDCs survey collects data on separately accounted for R&D expenditures at FFRDCs. The SGRD survey collects data on state agency R&D expenditures. The Federal Funds survey collects Federal R&D obligations (funding). The NPRA survey collects information on R&D performed by 501(c) (3) nonprofit organizations.

In addition to the R&D surveys, BEA also uses supplemental data from several other sources. These include the U.S. Census Bureau Economic Census, the U.S. Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) and Occupational Employment and Wage Statistics (OEWS), and BEA's supply and use tables (SUTs) and regional data on compensation and employment.

Adjustments to source data

To estimate R&D value added, employment, and compensation, BEA adjusts the NSF R&D expenditure and personnel data for coverage, scope, and alignment with the NIPA framework. The main adjustments are as follows:

Fiscal year to calendar year adjustment. For the HERD, NPRA, and the government R&D surveys that report data on a fiscal year basis, an adjustment is made to convert the data to a calendar year basis.

Employment adjustment. To align the R&D survey data with BEA's measures of employment and compensation, an adjustment is made to the reported BERD R&D employment and compensation to account for employees indirectly related to the production of R&D. This adjustment uses BLS OEWS data on a selection of non-R&D occupations (such as cafeteria workers and cleaning staff) that are employed by the scientific R&D services (North American Industry Classification System (NAICS) 5417) establishments. The same adjustment is also applied to R&D employment and compensation of nonacademic nonprofit institutions. Additionally, HERD employment headcounts are adjusted to remove students. For this adjustment, the headcounts are converted to a full time equivalent (FTE) basis using an average headcount-to-FTE ratio over the period of available data.

Company-to-establishment adjustment. Because the BERD survey collects data on an enterprise basis, an adjustment is made to reclassify the enterprise data on an establishment basis to align the industry estimates based on these data with BEA's industry accounts. Furthermore, an establishment-based approach reflects more accurately the industry performing the R&D by accounting for R&D activities in different types of establishments including manufacturing plants, company headquarters, R&D laboratories, and other facilities. In contrast, the company-based approach assigns all R&D to the company's primary industry.

The company-to-establishment adjustment for the experimental R&D production statistics is based on a reconciliation of NSF BERD employment and compensation data for the scientific R&D services (NAICS 5417) industry with corresponding establishment-based data from the QCEW. First, QCEW employment and wages are adjusted to align with the employment and compensation that is in scope for the BERD survey. This step effectively sets the levels of R&D employment and compensation for NAICS 5417. Second, differences between the adjusted NAICS 5417 QCEW employment and compensation from the respective BERD-based measures for this industry are computed. These are the amounts of R&D employment and R&D compensation that need to be moved from the primary industries (manufacturing and other non-5417 services industries) to NAICS 5417. Lastly, the amounts in the second step are taken out proportionally from each primary industry and moved to NAICS 5417.[9]

General methodology

At the national level, detailed R&D estimates by R&D commodity and industry were prepared for each R&D-performing sector in the NSF R&D surveys.[10] R&D employment and compensation estimates use R&D employment, compensation, and other personnel information available from each R&D survey. Value added is measured additively from its components—compensation, GOS, and TOPI. GOS and TOPI are estimated separately based primarily on BEA's SUTs data and then added to the compensation estimate as applicable to derive value added.

At the state level, source data with state detail are used to develop allocator series to distribute detailed national estimates of R&D employment, compensation, and value added to states. An important aspect of this methodology is closely aligning the detail in the national estimates with the detail available in the state source data.[11]

The detailed national and state-level estimates are then aggregated to the three major R&D-producing sectors reported in BEA's statistics: (1) business, (2) NPISHs, and (3) government. These three sectors also include R&D by higher education institutions and FFRDCs. Private for-profit academic institutions are included in the business sector, private nonprofit academic institutions are included in the NPISHs sector, and public universities and colleges are included in state and local government. Business-administered FFRDCs are included in the business sector, while the FFRDCs administered by private nonprofit higher education institutions and nonprofit nonacademic institutions are included in the NPISHs sector.

Selected Results

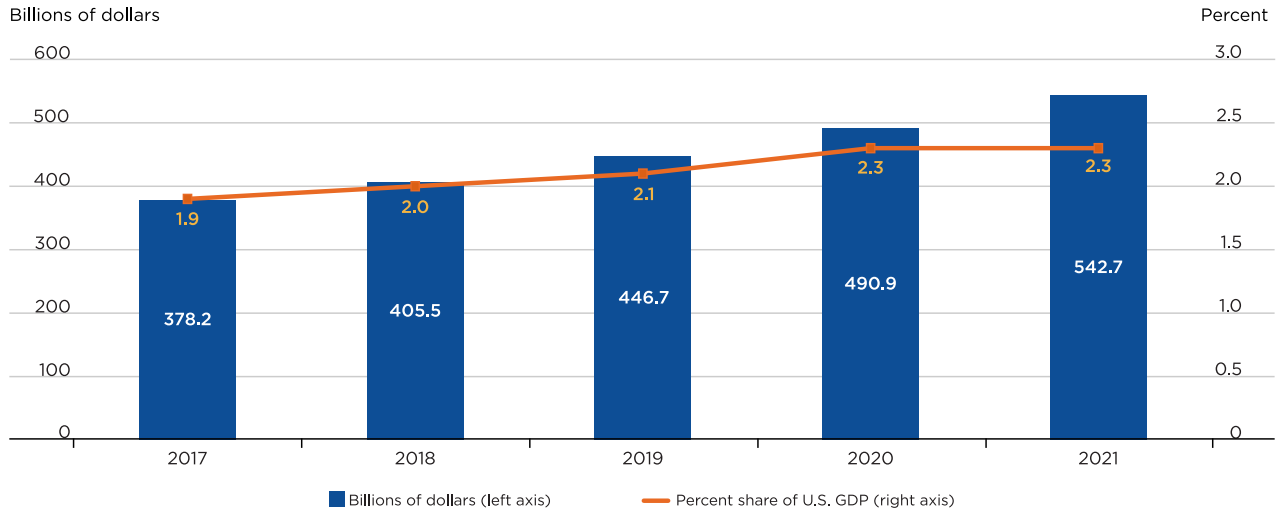
This section provides discussion and analysis of the experimental R&D production statistics, beginning with the national statistics and followed by a discussion of the state-level statistics.

National statistics

R&D activities generated $542.7 billion in value added, accounting for 2.3 percent of U.S. GDP in 2021 (chart 1 and table 2). This marks an over 40 percent increase from $378.2 billion of R&D value added in 2017. R&D value added has increased more rapidly than value added in other sectors of the economy over this period, in large part due to the intensified R&D efforts in response to the COVID–19 pandemic.

R&D compensation was $487.8 billion with a corresponding R&D employment of 3.3 million jobs in 2021 (table 2). R&D compensation accounted for 3.9 percent of total compensation, whereas R&D employment accounted for 2.2 percent of total U.S. wage and salary employment in 2021. The higher R&D compensation share of the economy relative to the R&D employment and value-added shares indicates that R&D employees are highly compensated.

Chart 1. R&D Value Added, United States: 2017–2021



GDP Gross domestic product
R&D Research and development
U.S. Bureau of Economic Analysis

Table 2. R&D Value Added, Compensation, and Employment, United States: 2017–2021

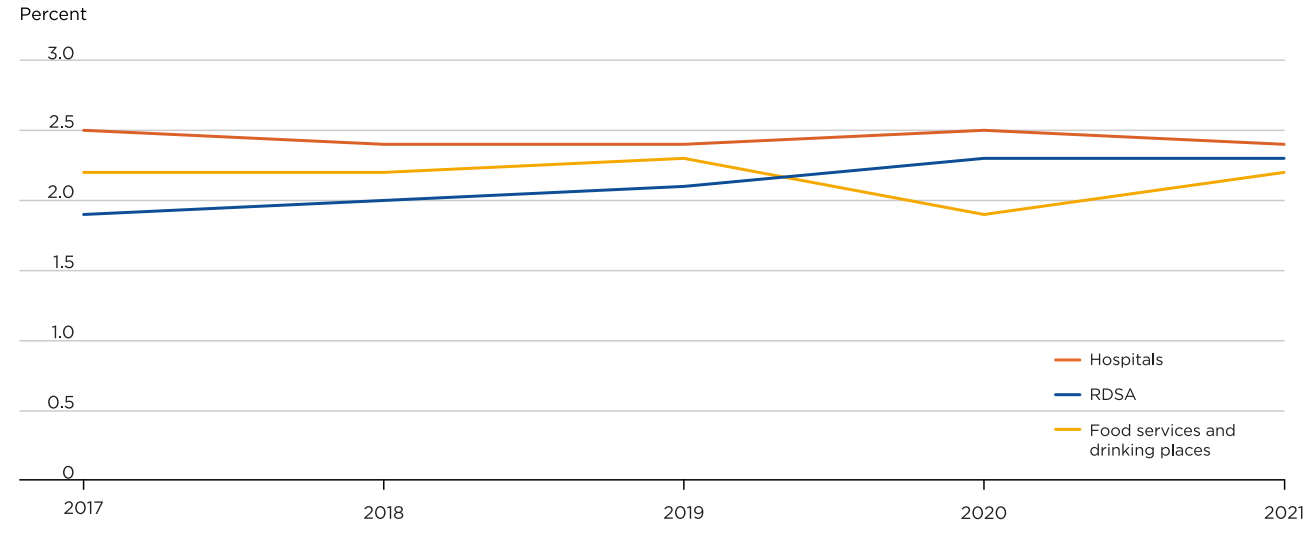
	2017	2018	2019	2020	2021
R&D value added (billions of dollars)	378.2	405.5	446.7	490.9	542.7
R&D compensation (billions of dollars)	335.9	360.3	397.6	441.8	487.8
R&D employment (millions of jobs)	2.6	2.8	2.9	3.0	3.3
R&D value-added share of GDP (percent)	1.9	2.0	2.1	2.3	2.3
R&D compensation share of total compensation (percent)	3.2	3.3	3.5	3.8	3.9
R&D employment share of total wage and salary employment (percent)	1.7	1.8	1.9	2.1	2.2

GDP Gross domestic product
R&D Research and development

U.S. Bureau of Economic Analysis

A major advantage to measuring R&D production within the GDP framework is that R&D value added can be compared not only to GDP overall, but also to the value added of other sectors and industries in BEA's industry statistics. It is important to note, however, that there can be overlap between the value added measured in the R&D Satellite Account and the value added from other industries, as the R&D Satellite Account essentially aggregates the R&D activity across all NAICS industries.[12] Chart 2 shows this comparison with two NAICS industries: food service and drinking places and hospitals. Before the pandemic, the R&D share of GDP was smaller compared to both industries. In 2020, however, R&D value added exceeded that of food services and drinking places and came close to that of hospitals in 2021.

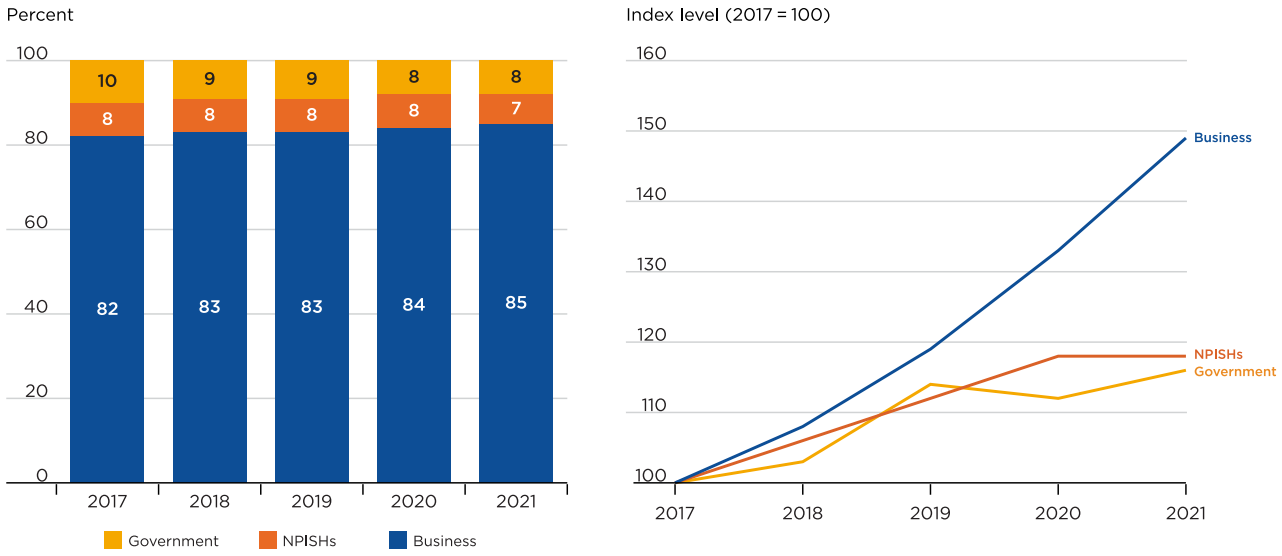
Chart 2. Value-Added Share of U.S. GDP, 2017–2021



GDP Gross domestic product
RDSA Research and Development Satellite Account
U.S. Bureau of Economic Analysis

The next two charts break down R&D value added by R&D-producing sector and industry. The business sector is by far the largest producer of R&D (chart 3). In 2021, 85 percent of R&D value added was generated by this sector. The business sector has also increased the fastest during the 2017–2021 period as evidenced by its increasing share of business R&D value added from 82 percent in 2017. The government and nonprofit sectors generated 8 percent and 7 percent of R&D value added, respectively, in 2021.

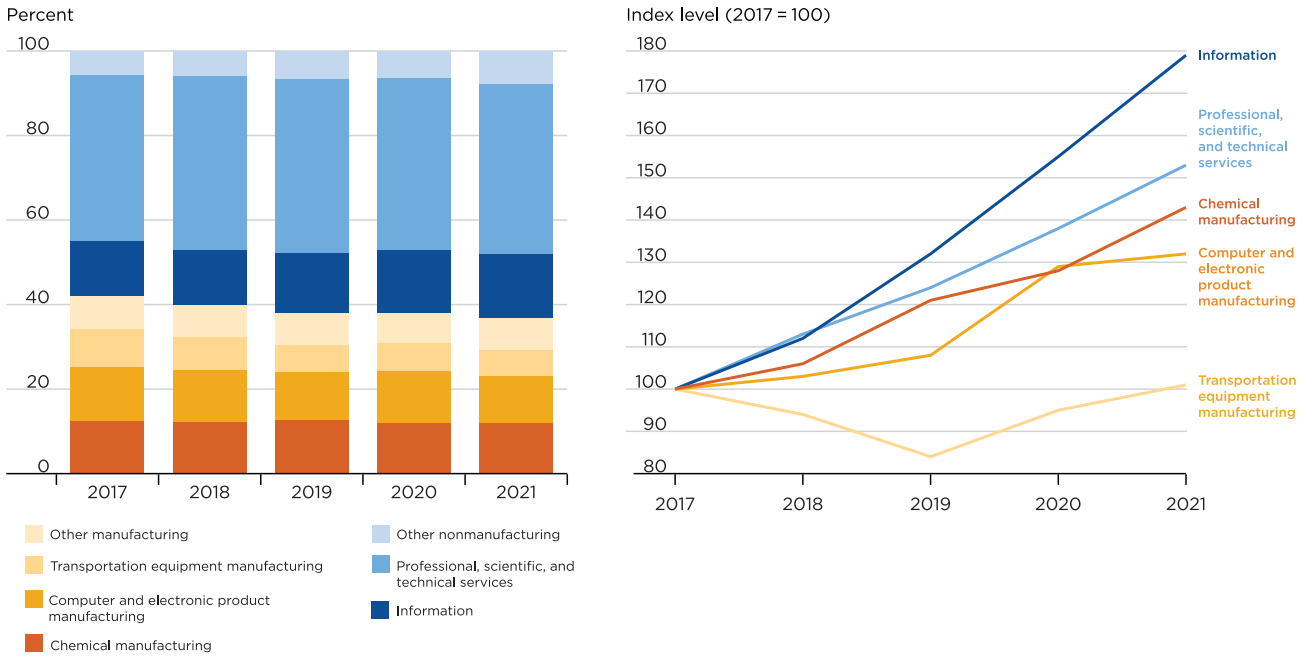
Chart 3. R&D Value Added by Producing Sector, United States: 2017–2021



NPISHs Nonprofit institutions serving households
R&D Research and development
U.S. Bureau of Economic Analysis

Professional, scientific, and technical services is the largest industry within the business sector, accounting for 40 percent of business R&D value added in 2021 (chart 4). This industry includes the scientific R&D services industry (NAICS 5417); however, a large share of R&D is performed outside of NAICS 5417. Information is the next largest industry with 15 percent of business R&D value added, followed by chemical manufacturing, which includes pharmaceutical and medicine manufacturing (12 percent) and computer and electronic products manufacturing (11 percent). From 2017–2021, R&D value added increased the fastest in information, followed by professional, scientific, and technical services and chemical manufacturing. The increase in R&D value added was slowest in transportation equipment manufacturing.

Chart 4. Business R&D Value Added by Industry, United States: 2017–2021



R&D Research and development

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Lastly, interesting insights can also be gleaned by comparing the new value-added R&D statistics with BEA's existing data on R&D investment (chart 5 and table 3). This comparison highlights both the conceptual and sectoral differences between the two measures. R&D investment was $837.1 billion in 2021, approximately $300 billion higher than R&D value added. This difference is mostly due to the intermediate inputs used in the production of R&D. Smaller portions of the difference are due to net exports of R&D.

The business sector is the predominant sector in both R&D production ($463.5 billion in R&D value added in 2021) and R&D investment ($608.7 billion). The federal government plays a much larger role in funding R&D ($172.4 billion in R&D investment) than producing R&D ($12.1 billion in R&D value added). The R&D value added for NPISHs and state and local government sectors is larger than their R&D investment, reflecting the sizable external R&D funding they receive, particularly from the federal government.

Chart 5. R&D Value Added and R&D Investment, United States: 2017–2021

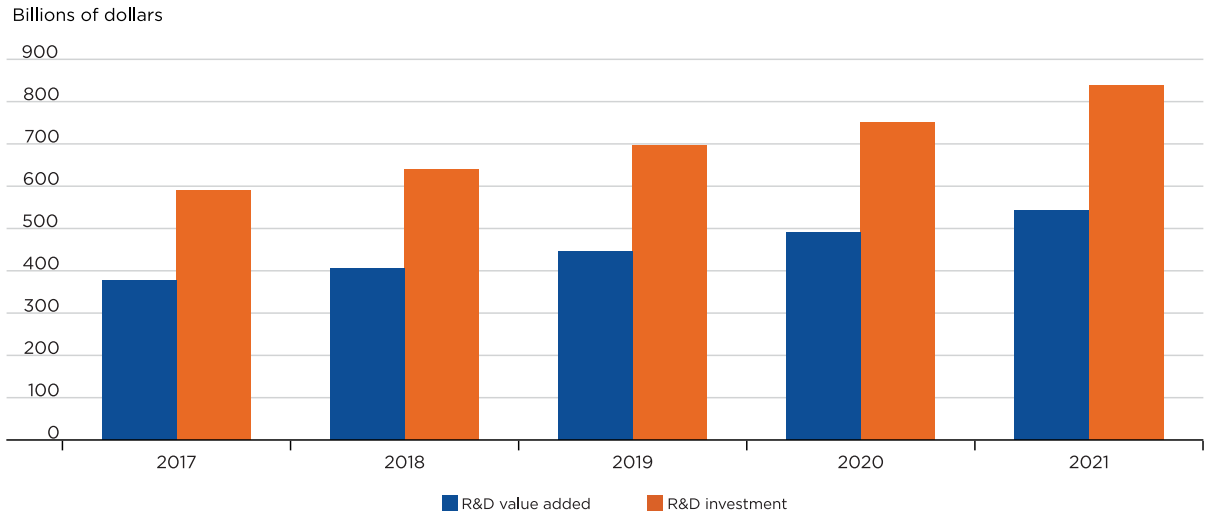

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Table 3. R&D Value Added and R&D Investment, United States: 2021

[Billions of dollars]

Sector	R&D value added (RDSA)	R&D investment (NIPA)
R&D	542.7	837.1
Private	500.6	642.1
Business	463.5	608.7
Nonprofit institutions serving households	37.1	33.5
Government	42.1	194.9
Federal	12.1	172.4
State and local	30.0	22.6

NIPA National Income and Product Accounts
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RDSA Research and Development Satellite Account

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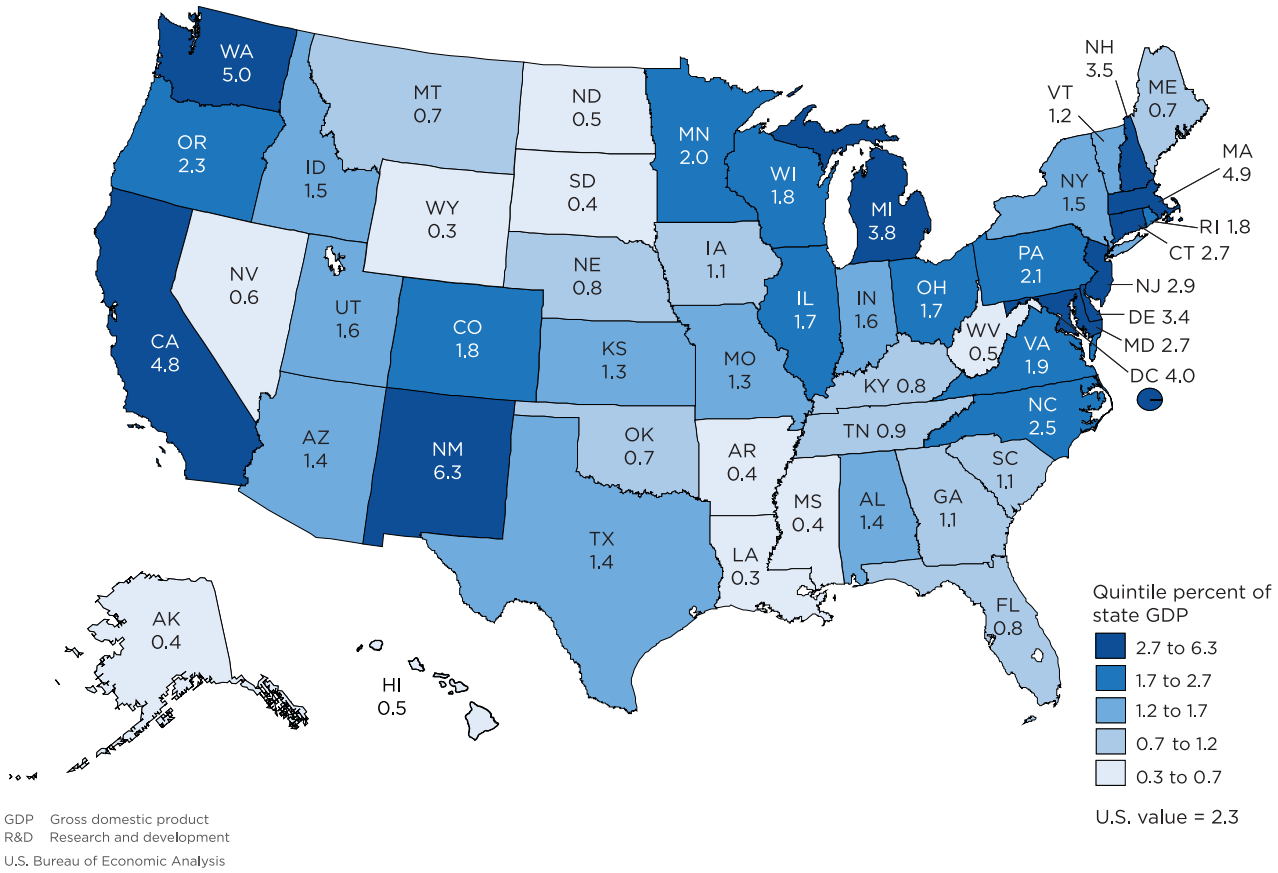
State statistics

Most of the analysis provided at the national level can also be conducted at the state level. An exception is the comparison with R&D investment, as BEA does not currently publish R&D investment statistics by state. Like the national statistics discussed above, the state R&D statistics are prepared to be comparable to other state-level statistics produced by BEA.

The contribution of R&D value added to the state economies varies widely across states (chart 6). In 2021, R&D value added as a share of state GDP ranged from 0.3 percent in Louisiana and Wyoming to 6.3 percent in New Mexico. Washington, Massachusetts, and California, in addition to New Mexico, were among the states with the largest R&D share of state GDP.

Chart 6. State R&D Value Added as a Percent of State GDP: 2021



GDP Gross domestic product
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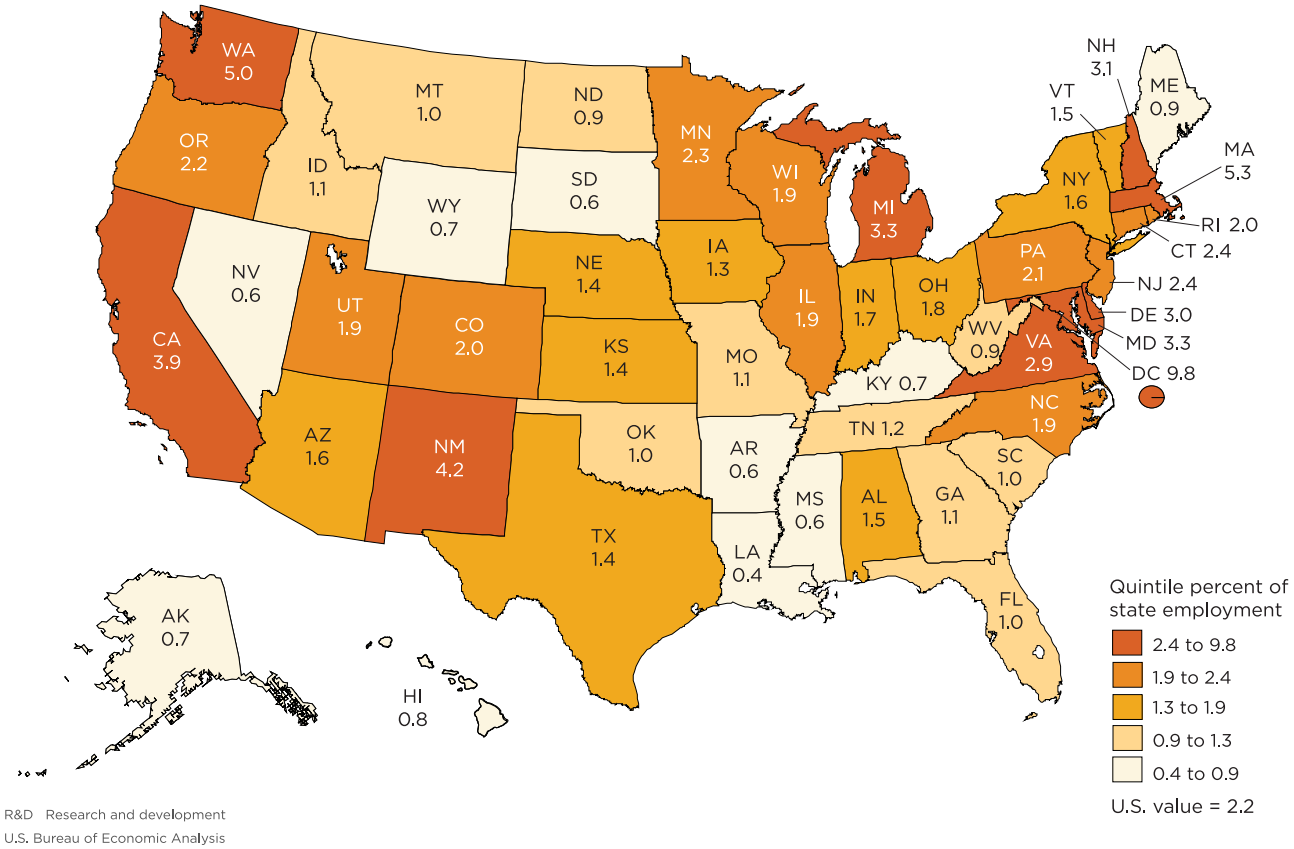
Similar metrics for R&D employment and compensation show similar state rankings. These rankings generally hold in other years for which data are available. R&D employment as a share of total state wage and salary employment ranged from 0.4 in Louisiana to 9.8 in the District of Columbia (chart 7). The R&D employment share for the District of Columbia was particularly high in 2021, due in large part to the pandemic-related medical R&D performed by the federal government.

Chart 7. State R&D Employment as a Percent of State Wage and Salary Employment: 2021



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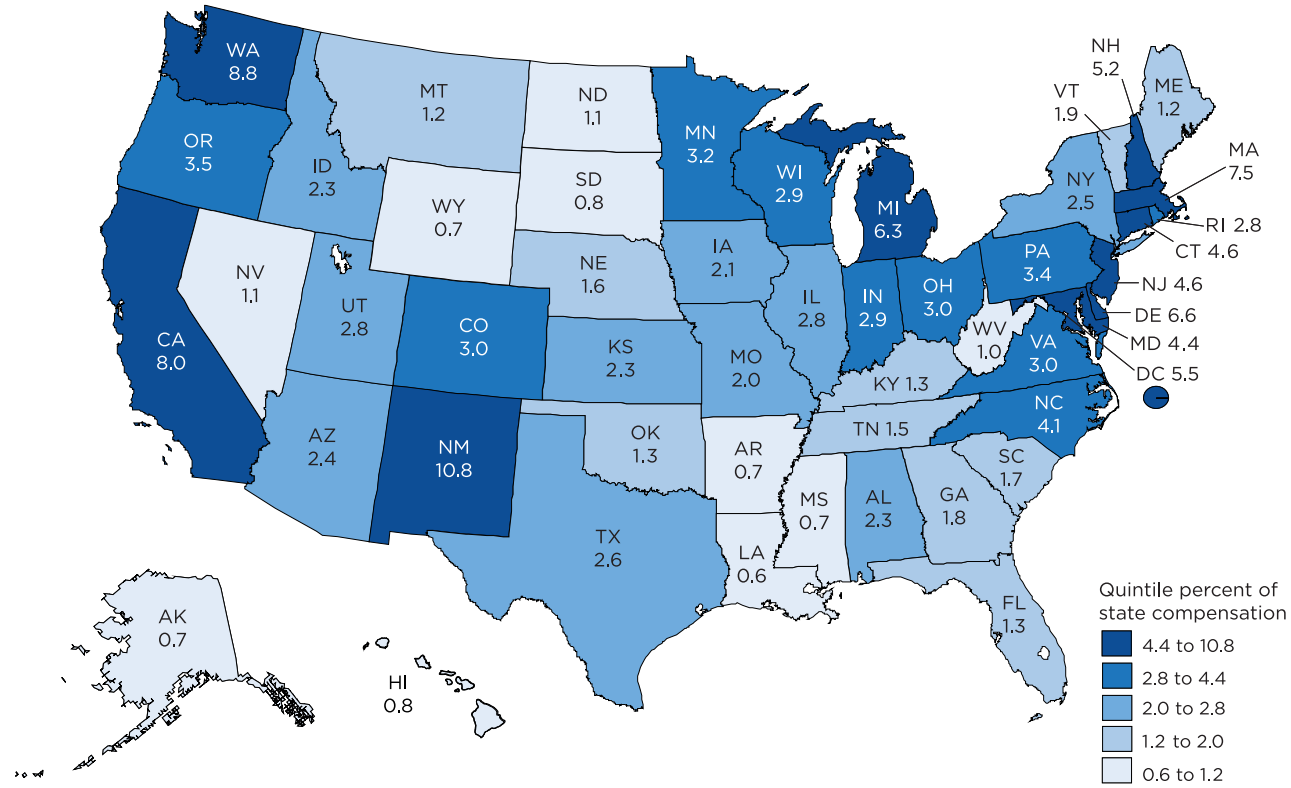
Massachusetts, Washington, and California are among the states with the largest R&D shares of state employment and compensation. R&D compensation as a share of total state compensation ranged from 0.6 percent in Louisiana to 10.8 percent in New Mexico (chart 8). As in the national statistics, the R&D share of compensation is greater than that of value added and employment, indicating that R&D jobs at the state level are higher paid. This pattern is more pronounced in some states than others. In New Mexico, for instance, there is a larger discrepancy between these shares, suggesting that the non-R&D jobs in the state pay less, while in states like Massachusetts and New York, the non-R&D jobs receive closer to average compensation.

Chart 8. State R&D Compensation as a Percent of State Compensation: 2021



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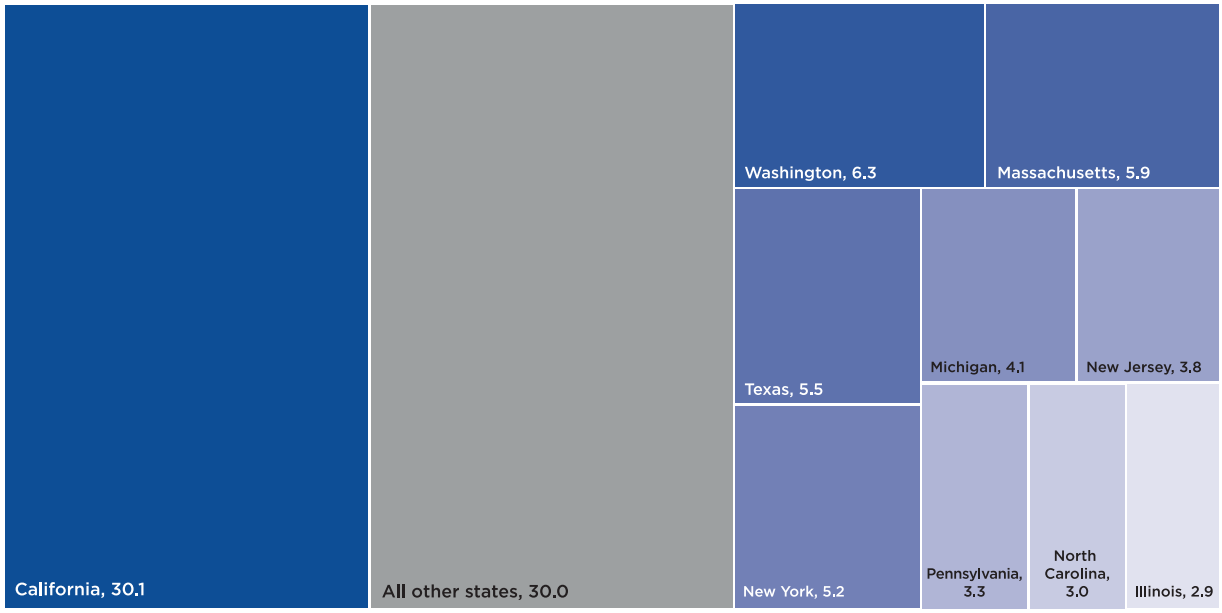
The distribution of R&D production is highly concentrated geographically (chart 9). California alone accounted for 30 percent of the nation's R&D value added in 2021. The top 5 states (California, Washington, Massachusetts, Texas, and New York) accounted for over half, and the top 10 states accounted for more than two-thirds of total R&D value added in 2021. The more populous states with larger economies are higher because this measure is not normalized by the size of the state. The distribution of R&D production, however, is more concentrated than the overall economic activity in these states. In 2021, California's GDP accounted for 14 percent of U.S. GDP, the top 5 states accounted for 41 percent, and the top 10 states accounted for 57 percent of the U.S. GDP.

Chart 9. State Percent Share of U.S. R&D Value Added, 2021



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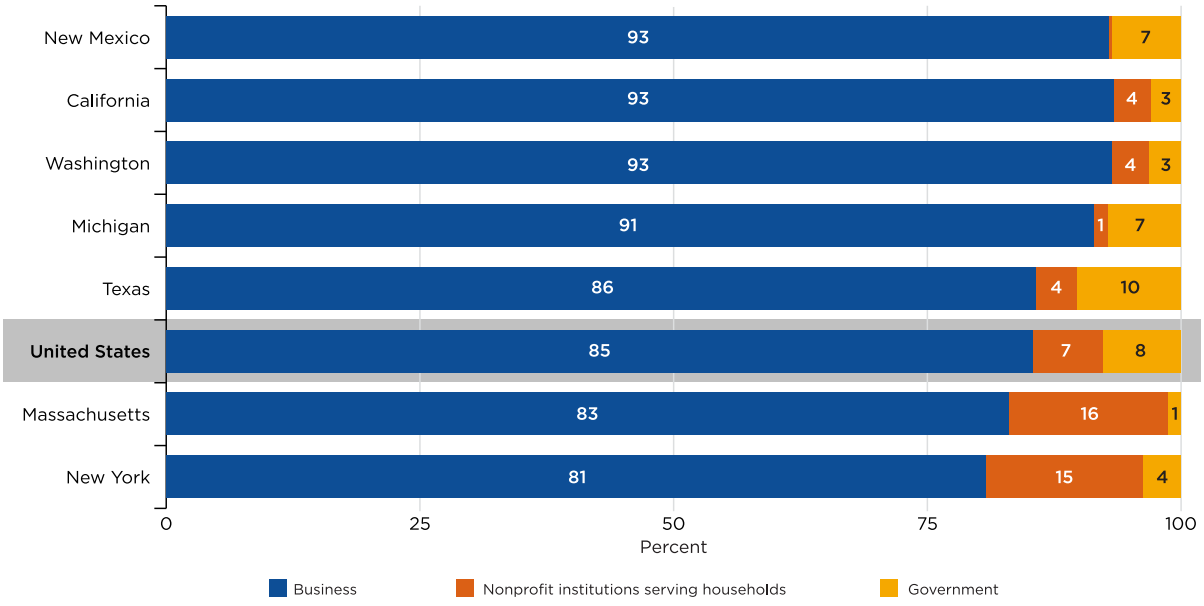
The business sector accounts for the largest share of state R&D value added in most states (chart 10). Interesting differences arise in the nonprofits and government shares, in part due to the treatment of higher education institutions in BEA's classification. Private universities are included in the nonprofits sector; this explains the relatively high share in Massachusetts and New York, both of which have prominent private universities. Public universities on the other hand are considered part of state and local government. This accounts for the relatively high share in Texas and to a lesser extent Michigan and New Mexico.

Chart 10. Composition of R&D Value Added by Sector, United States and Selected States: 2021



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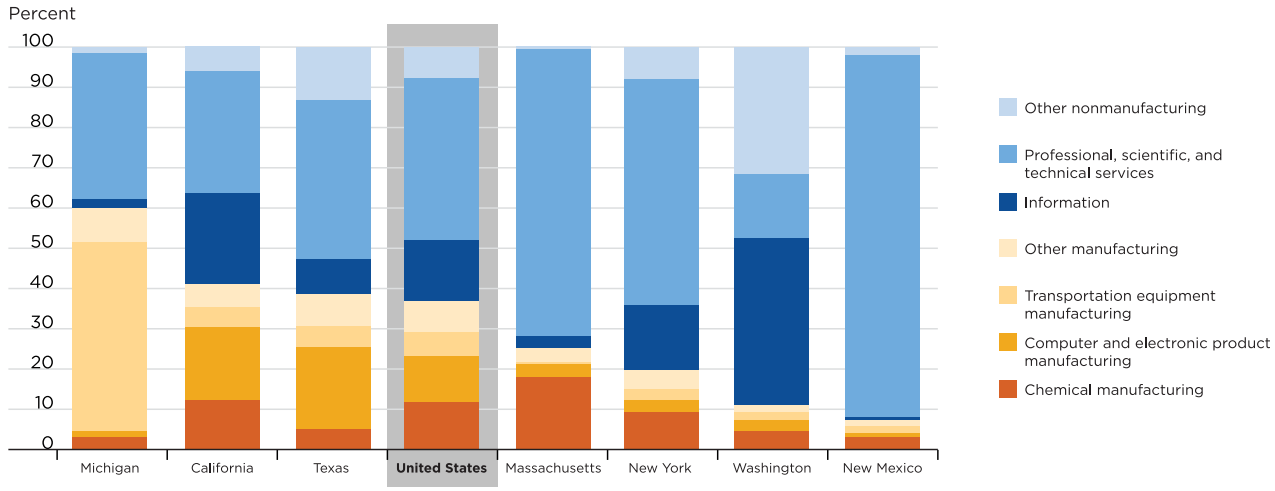
Lastly, there are large but sensible differences in the industry composition of business R&D value added, like transportation equipment manufacturing (which includes automobile manufacturing) in Michigan and information (which includes a variety of tech-focused industries) in Washington (chart 11). Also of note is the professional, scientific, and technical services industry (which includes scientific R&D labs and business-administered FFRDCs) in Massachusetts and New Mexico.

Chart 11. Industry Composition of Business R&D Value Added, United States and Selected States: 2021



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Conclusion

BEA, in partnership with NCSES, recently published experimental national and state-level statistics on R&D value added, employment, and compensation. Planned work will continue to improve and refine the methodology of these experimental statistics by incorporating additional source data. BEA is also looking to expand the time series of these statistics and potentially offer alternative aggregations of the data. BEA is seeking comments on the current methodology as well as on potential uses and enhancements of the data that would be most beneficial to data users. All feedback should be sent to RandD@bea.gov.

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1. More information can be found on the R&D Satellite Account page on the BEA website.
2. A series of working papers on the first R&D Satellite Account are available on the BEA website. For a summary of BEA's prior work on R&D investment, see Carol E. Moylan and Sumiye Okubo, *The Evolving Treatment of R&D in the U.S. National Economic Accounts*, methodology paper (Washington, DC: BEA, March 2020).
3. With the 2007 R&D Satellite Account, BEA released some experimental state-level estimates of the impact of treating R&D as investment on GDP by state. For more information, see Carol A. Robbins and Carol E. Moylan, "Research and Development Satellite Account Update: New Estimates for Industry, Regional, and International Accounts," *Survey of Current Business* 87 (October 2007): 49–92.
4. In the new BEA R&D production statistics, the sector represents the producer (performer) of R&D, not the R&D funder as in the R&D investment statistics in the NIPAs. R&D production is measured in value-added terms consistent with other BEA value-added statistics.
5. FFRDCs are research institutions that are funded by the federal government but administered by businesses, universities, and other nonprofit organizations.
6. All of the activity of an FFRDC is assigned to the state identified in NSF's FFRDC survey.
7. To measure R&D investment, BEA assigns ownership to the R&D funder. For a more detailed discussion of R&D ownership, see Marissa J. Crawford, Jennifer Lee, John E. Jankowski, and Francisco A. Moris, "Measuring R&D in the National Economic Accounting System," *Survey* 94 (November 2014).
8. More information on the scope and design of each survey is available on the NCSES website.
9. There are differences in the implementation of the last step of the company-to-establishment adjustment between the national and state-level statistics. The adjustment in the last step, however, is conceptually similar in that the amounts that are moved to NAICS 5417 are taken out proportionally from the primary industries. See the R&D technical note for details.
10. An example of an R&D commodity would be the R&D performed by private universities and funded by the federal government.
11. Because the public data from some of the R&D surveys are more limited at the state level compared to the national level, the state-level estimates also rely on selected restricted-use data available only to authorized users.
12. In BEA's value added by industry statistics, value added is only explicitly measured for R&D performed by establishments classified in the scientific R&D services industry (NAICS 5417). R&D value added generated by establishments that are not classified as NAICS 5417 establishments is included in the total value added of the industry of the establishment. For example, the R&D value added generated by pharmaceutical and medicine manufacturing establishments (NAICS 3254) is included in the total value added generated by the pharmaceutical and medicine manufacturing industry.