



The Economic Impact of the U.S. Biopharmaceutical Industry:

2020 National and State Estimates



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March 2022

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Executive Summary

The innovative and critical nature of the U.S. biopharmaceutical industry was reinforced by the across-industry response to develop new vaccines and treatments for COVID-19. While the pandemic serves as a highly visible example of the biopharmaceutical industry's societal and economic value, the industry has long been a critical driver of the nation's economic growth and a key contributor to state and regional economies. As this study documents, every U.S. state, the District of Columbia, and Puerto Rico has some level of industry employment which drives regional economic activity.

Over the past 30 years, the U.S. has solidified its place as the preeminent nation in biopharmaceutical innovation world-wide. Today, that global leadership is built upon a robust foundation of innovation-led U.S. companies that perform and support advanced R&D and sustain a diverse and large-scale supply chain for the development, production, and distribution of biopharmaceuticals.

The innovation-led U.S. biopharmaceutical industry and its closely-integrated supply chain represents a significant national employer and economic driver for the U.S. economy. To measure the economic contributions that the biopharmaceutical industry is making, the Pharmaceutical Research and Manufacturers of America (PhRMA) engaged TEconomy Partners, LLC, to develop an independent estimate of the current size and structure of the U.S. biopharmaceutical industry and its total economic impact on the U.S. economy—including the 50 states, the District of Columbia, and Puerto Rico. A full methodology is included in Appendix A.

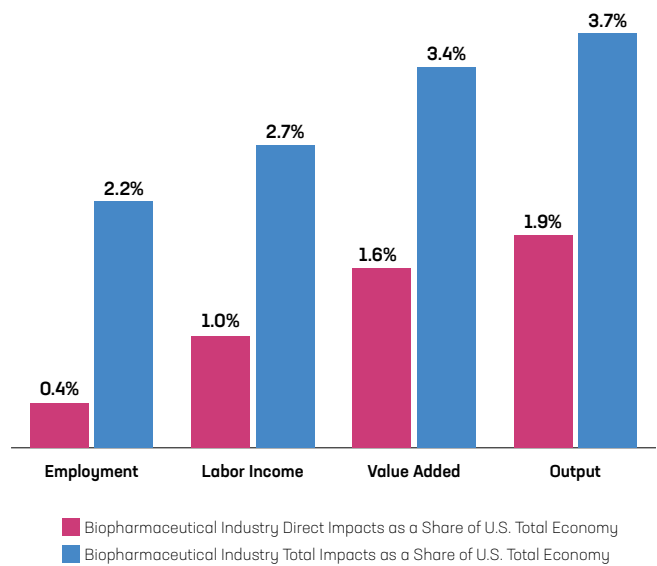
Key findings from this examination of the broad biopharmaceutical value-chain include the following:

- The U.S. biopharmaceutical industry directly employed more than 903,000 workers, and with its substantial employment multiplier of 4.92, the industry supports more than 3.5 million additional U.S. jobs for a total employment impact of more than 4.4 million jobs supported across the U.S. economy in 2020.
- The industry has been able to weather economic downturns providing important stability to both the production of life saving medicines and to the U.S. and regional economies in which it operates.
- With average annual wages and benefits of more than \$145,000—nearly \$60,000 more than the average U.S. manufacturing job, and more than twice the U.S. average across all industries—biopharmaceutical industry jobs are both high-wage and high-quality.
- From an overall productivity perspective, the research and productive nature of the U.S. biopharmaceutical industry generates a productivity level of nearly \$381,000 per employee—more than twice that of the U.S. average manufacturing worker and more than three and half times the average worker.
- The U.S. biopharmaceutical industry exceeded \$710 billion in direct output in 2020, and with the ripple effect of this production throughout the U.S. economy, supported an additional \$700 billion in output through its suppliers and other sectors of the economy, for a total of more than \$1.4 trillion. This combined, total output impact represents 3.7 percent of total U.S. output.



- Through its research, production, and overall operations, the U.S. biopharmaceutical industry directly accounts for 1.6 percent of U.S. GDP (i.e., its “value added”). Including the impacts it supports in other sectors of the economy, the industry supports \$720 billion in value added to the economy, or 3.4 percent of U.S. GDP.
- A notable characteristic of the U.S. biopharmaceutical industry’s workforce is the reliance on strong science, technology, engineering, and math (STEM) skills and training. STEM-related occupations, as defined by the U.S. Bureau of Labor statistics, account for 36 percent of the biopharmaceutical industry’s workers—more than five times higher than the private sector average.

Biopharmaceutical Industry’s Contributions to the U.S. Economy



Source: TEconomy data, calculations and analysis; IMPLAN U.S. model.

Introduction:

An Industry Defined by Innovation

Among U.S. industries, the biopharmaceutical industry is defined by and stands out as a leader in research and innovation (see text box). Never was this more apparent than in 2020 and the ongoing response to the global COVID-19 pandemic as the nation's biopharmaceutical industry members worked to develop critical vaccines, therapies, and diagnostic capabilities. Additionally, numerous biopharmaceutical industry members opened their laboratory operations to provide much needed testing capacity across the country. Indeed, much will be written regarding the role industry-developed vaccines and therapeutics have played and will play in getting the U.S. and global economies back on track following the economic and social disruptions caused by the pandemic.

While developments throughout the pandemic provide a highly visible example of the biopharmaceutical industry's innovative nature, it has long been a critical driver of the nation's economic growth, and a key differentiator among state and regional economies. As this study documents, while some states have sizable employment in the biopharmaceutical industry, **every U.S. state, the District of Columbia, and Puerto Rico has some level of industry employment which drives regional economic impact.**

With its high levels of investment in R&D, broad skill and occupational requirements, and national footprint, the U.S. biopharmaceutical industry reflects significant employment and economic impacts across the country. To measure the size and extent of the U.S. biopharmaceutical industry, PhRMA engaged TEconomy Partners, LLC, to develop an independent estimate of the size of the U.S. biopharmaceutical industry and its total economic impacts on the U.S. and individual state economies (including the

Biopharmaceuticals—A Leader in Research and Innovation

The biopharmaceutical industry is a major component of the U.S. innovation-driven industrial base, which also includes industries such as aerospace, automotive, semiconductors, and others. The biopharmaceutical industry is among the most R&D-intensive, with a heavy concentration of STEM workers involved in all phases of the R&D and manufacturing processes.

Analyzing the most recent (2019 data) NSF survey results and additional estimations performed by TEconomy (2020 data) provides insights into the position of the biopharmaceutical industry's R&D activities in comparison to overall U.S. medical and health R&D investment and overall U.S. industrial R&D.

The biopharmaceutical industry is a leader in U.S. medical and health R&D activities and investments.*

- The biopharmaceutical industry's estimated domestic R&D investment of \$122.2 billion accounts for 75.5 percent of all U.S. industry-funded medical and health R&D in 2020.
- This investment accounts for 49.9 percent of all U.S. medical and health R&D investment in 2020.

The domestic biopharmaceutical industry is also a leader in overall U.S. industrial R&D activities and investments.**

- The U.S. biopharmaceutical industry accounted for 24.6 percent of all domestic U.S. business R&D performance in 2019.
- The biopharmaceutical industry, at more than 169,000 domestic R&D employees in 2019 had the largest number of R&D workers of any U.S. industry, including the aerospace, automotive, and semiconductor industries.
- The U.S. biopharmaceutical industry devotes 21.4 percent of its total domestic employment to R&D, nearly two and half times larger than the U.S. industry average.
- In 2019, the U.S. federal government funded less than 1 percent of domestic biopharmaceutical industry R&D, compared to 46 percent for the aerospace industry.
- The U.S. biopharmaceutical industry invests 84 percent of its global R&D spending in the U.S., a higher share than other U.S. industries such as computer equipment and automotive.
- Biopharmaceutical internal (self-funded) investment in domestic R&D in 2019 was more than twice that of the semiconductor industry, and exceeded the automotive industry by 282 percent and the aerospace industry by 796 percent.

Note: For these data the biopharmaceutical industry is captured using a combination of the pharmaceutical manufacturing and biotechnology NAICS codes. Domestic includes the combination of U.S. and Puerto Rico and U.S. operations of foreign-based biopharmaceutical firms.

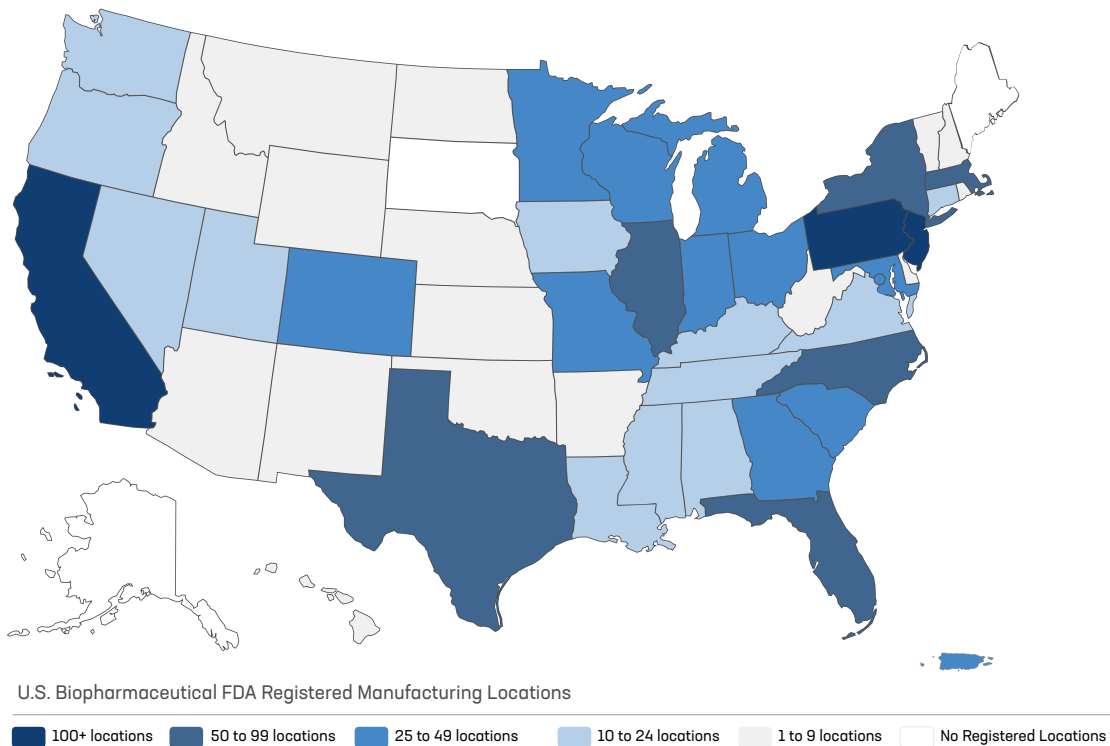
Source: * Research!America, *U.S. Investments in Medical and Health Research and Development*, January 2022; ** National Center for Science and Engineering Statistics, National Science Foundation, Business Enterprise Research and Development Survey, 2019; TEconomy Partners analysis.

District of Columbia and Puerto Rico). This report provides estimates of the total number of biopharmaceutical industry jobs in the U.S. in 2020—the most recent year for which complete employment data are available. The report also develops a number of economic impact measures of the U.S. biopharmaceutical industry, including total economic output, wages and benefits, and taxes. These measures capture the direct economic impacts of the biopharmaceutical industry and the indirect economic impacts of other sectors of the economy that are supported by the biopharmaceutical industry through its broad supply chain and the induced economic activity of its workforce. The economic impact assessment is developed using proprietary models from IMPLAN.¹

Nearly All States are Involved in the Manufacturing of FDA-Approved Medicines


Beyond employment, another approach to examining the geographic footprint of the biopharmaceutical industry is by assessing the number of locations in each state that are manufacturing one or more FDA-approved drug or pharmaceutical.

In 2020, the U.S. biopharmaceutical industry operated 1,561 facilities across the country that are manufacturing FDA-approved human-use products under current Good Manufacturing Practice regulations.



- These facilities are spread across 47 states, the District of Columbia and Puerto Rico.
- 40 states and Puerto Rico have 5+ facilities manufacturing FDA- approved medicines.
- The states with the most establishments are New Jersey, California, and Pennsylvania, with 180, 174, and 104 registered establishments, respectively.

Source: Biopharmaceutical Manufacturing Across America, Analysis of the U.S. Food and Drug Administration’s Drug Establishments Current Registration Site. September 2021. <https://ndpanalytics.com/biopharmaceutical-manufacturing-acrossamerica/>.



The Size and Complexity of the U.S. Biopharmaceutical Industry

Defining the Biopharmaceutical Industry

The U.S. biopharmaceutical industry is a highly complex industry that employs a high wage and occupationally diverse workforce.

Companies within the industry include, for example, large, vertically integrated biopharmaceutical companies with their own research and manufacturing facilities; small and start-up companies that have not yet had a medicine approved by the Food and Drug Administration; clinical development and research organizations that provide a range of services to support drug development and manufacturing; a broad-ranging set of suppliers providing basic and high-value added inputs; and distributors who provide logistics support to deliver prescription medicines.

The activities that define the core (or direct) U.S. biopharmaceutical industry—biopharmaceutical research and development, manufacturing, and distribution—are used to define and produce estimates of the size and structure of the U.S. industry. These activities are found in U.S. federal data sources within all or parts of three “sectors” of the U.S. economy as defined by the federal government in the North American Industrial Classification System (NAICS). A fourth sector, biopharmaceutical corporate administration captures significant and identifiable standalone corporate administrative operations (e.g., executive offices, financial, marketing, legal, etc.) not already captured in the other sectors. Estimates were developed by carefully identifying and estimating the share of each of the sectors’ employment attributable to the biopharmaceutical industry. Appendix A provides the specific NAICS codes used to define the industry sector, and describes the data and methodology used to produce the U.S. and state-level employment estimates included in this report.

Total employment in the U.S. biopharmaceutical industry reached 903,258 jobs in 2020 (Table 1) with biopharmaceutical manufacturing accounting for 37 percent of total employment. Biopharmaceutical R&D, the second largest sector, reached 314,297 jobs in 2020 and accounts for nearly 35 percent of the industry’s total employment. Biopharmaceutical distribution accounts for 25 percent of the industry’s employment at 229,218 jobs. Biopharmaceutical corporate administration employment accounts for just 3 percent or 28,913 jobs in 2020.



Table 1. U.S. Biopharmaceutical Industry Employment by Sector, 2020

Sector	Biopharmaceutical Sector Employment	Share of Total Biopharmaceutical Industry Employment
Biopharmaceutical Manufacturing	330,830	36.6%
Biopharmaceutical R&D	314,297	34.8%
Biopharmaceutical Distribution	229,218	25.4%
Biopharmaceutical Corporate Administration	28,913	3.2%
Total	903,258	100.0%

Note: “Sector” is based on the NAICS category assigned to the particular establishment (i.e., the business location) captured in the BLS data, and is assigned based on the predominant activity at that location. Because all jobs within an establishment are assigned to the establishment’s NAICS, sector-based job counts may over- or under-state job *functions* to the extent multiple activities occur at a single establishment (e.g. co-located R&D and manufacturing). The total employment estimate is not affected, however.

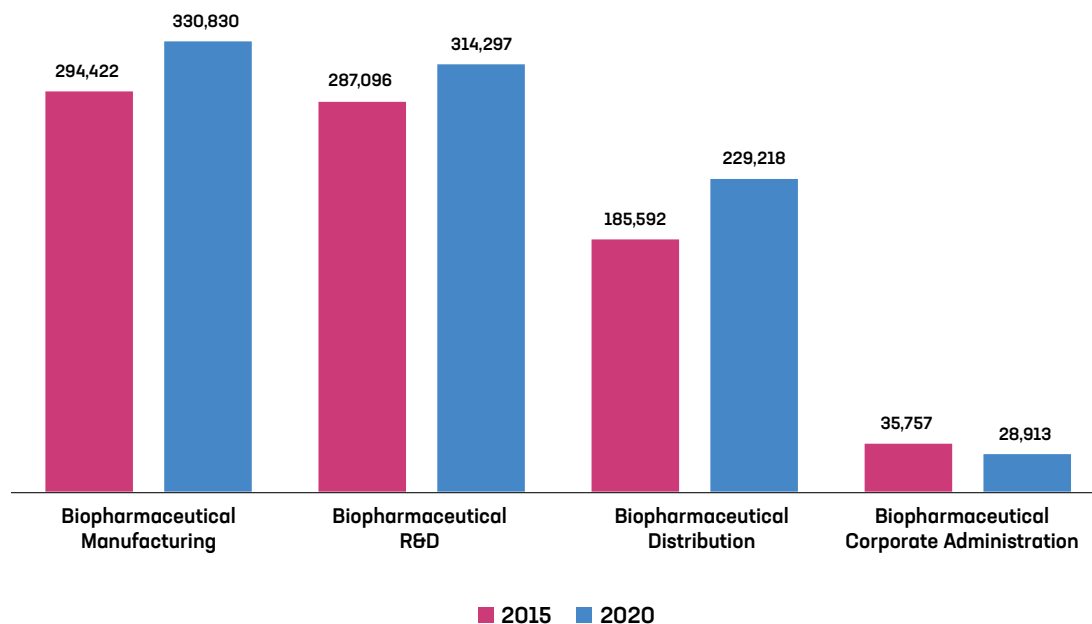
Source: 2020 BLS QCEW and CPS Employment Data; TEconomy analysis, calculations, and estimations. Data include the 50 States, the District of Columbia, and Puerto Rico.

Three of these biopharmaceutical sectors have shown a significant level of employment growth over the last five years (Figure 1). The biopharmaceutical manufacturing and biopharmaceutical R&D sectors' employment increased substantially since 2015; manufacturing employment increased by more than 23,000 jobs while biopharmaceutical R&D increased by more than 21,000 jobs.

Meanwhile, employment in the biopharmaceutical distribution sector increased by nearly 50,000 workers. While some of this growth is attributed to the expansion of the overall biopharmaceutical industry, a significant, though undefinable, share of this increase is due to a U.S. Bureau of Labor Statistics (BLS) industry reclassification. In 2018, a large number of individual/small office sales and product representatives and logistical employees were reclassified by BLS from a generic, all encompassing NAICS wholesale code into the wholesale distribution NAICS code their activities were aligned with, including biopharmaceutical distribution.

The decline in the biopharmaceutical corporate office employment is primarily due to industry M&A and consolidation activities over this period.

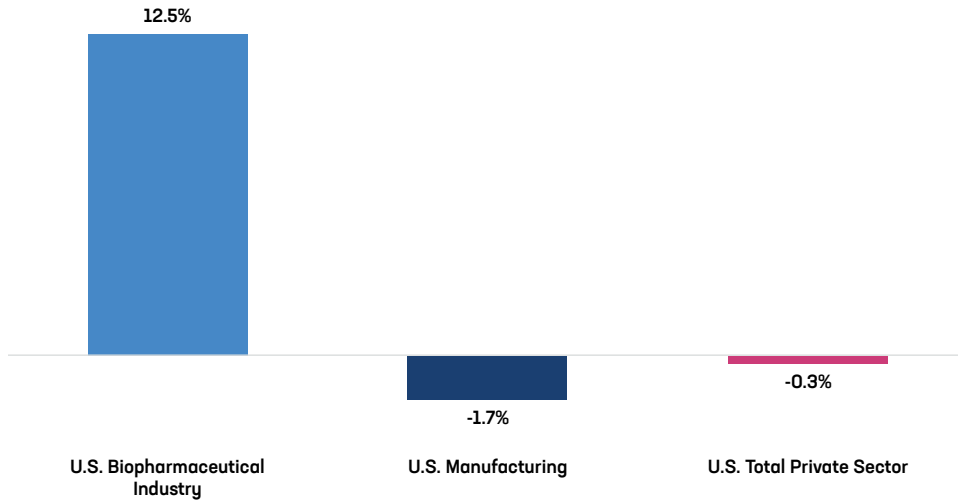
Figure 1. Changes in Biopharmaceutical Industry Sector Employment, 2015 - 2020



Source: TEconomy data, calculations and analysis; IMPLAN U.S. models.

An important and defining characteristic of the U.S. biopharmaceutical industry has been its ability to weather economic downturns providing important stability to both the production of life saving medicines and to the U.S. and regional economies in which they operate. Figure 2 provides a comparison among the U.S. biopharmaceutical industry, overall U.S. manufacturing, and the overall U.S. private sector employment from 2015 to 2020 reflecting the significant impacts the COVID-19 pandemic has had on the U.S. economy—where the job losses in one year, 2020, more than offset any growth from 2015 - 2020.

Figure 2. Comparative Industry Employment Change, 2015 - 2020

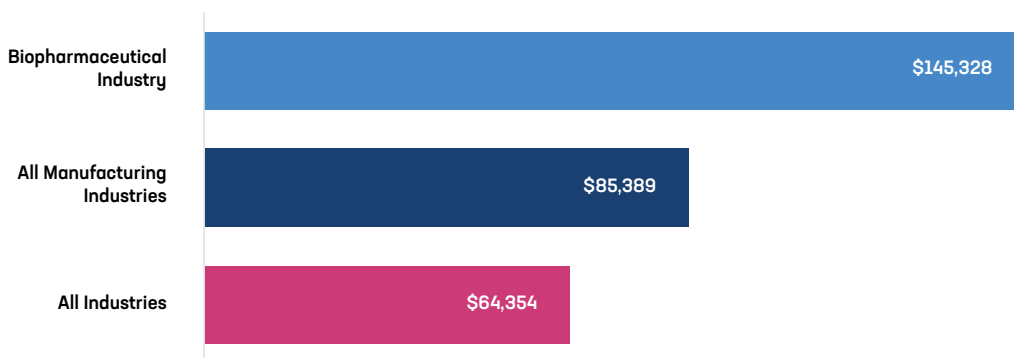


Source: TEconomy analysis, calculations, and estimations.

High-Quality and High-Performing Jobs

The biopharmaceutical industry, whether in its R&D, manufacturing, distribution, or corporate office functions, is a generator of high-quality and high-performing jobs. For 2020 the 903,000 U.S. biopharmaceutical industry jobs generated more than \$131 billion in personal income (including both wages and benefits or total compensation)—averaging more than \$145,000 in annual compensation per worker (Figure 3). This is more than twice the national average of \$64,000 and significantly higher than the U.S. manufacturing average of \$85,000—a strong indication of the quality of jobs that the biopharmaceutical industry provides to U.S. workers. This biopharmaceutical industry compensation premium has existed since at least 2015 (and likely for many years prior).

Figure 3. Average Annual Employee Compensation (including Wages and All Benefits), U.S. Biopharmaceutical Industry, Manufacturing Industries, and All Industries, 2020



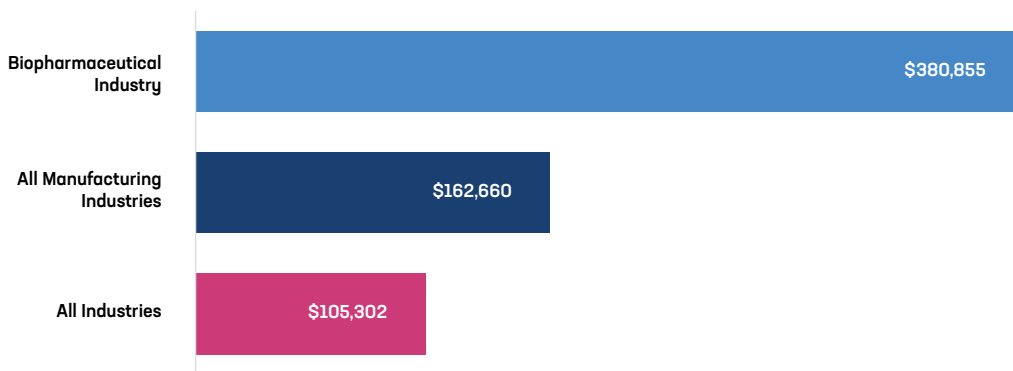
Note: Compensation (Labor Income) includes salaries, wages, and the full cost of benefits for both employees and proprietors.

Source: U.S. IMPLAN Model and TEconomy estimations of 2020 Employment and Total Labor Income.

This high value-added nature of the U.S. biopharmaceutical industry is also reflected in an extremely high productivity measure for the industry, exceeding \$380,000 in value added per worker, compared to a value-added per worker of nearly \$163,000 for overall U.S. manufacturing and a measure of \$105,000 per worker across all U.S. industries (Figure 4).²



Figure 4. Average Productivity, U.S. Biopharmaceutical Industry , Manufacturing Industries, and All Industries, 2020



Source: U.S. IMPLAN Model and TEconomy estimations of 2020 Employment and Total Value Added.

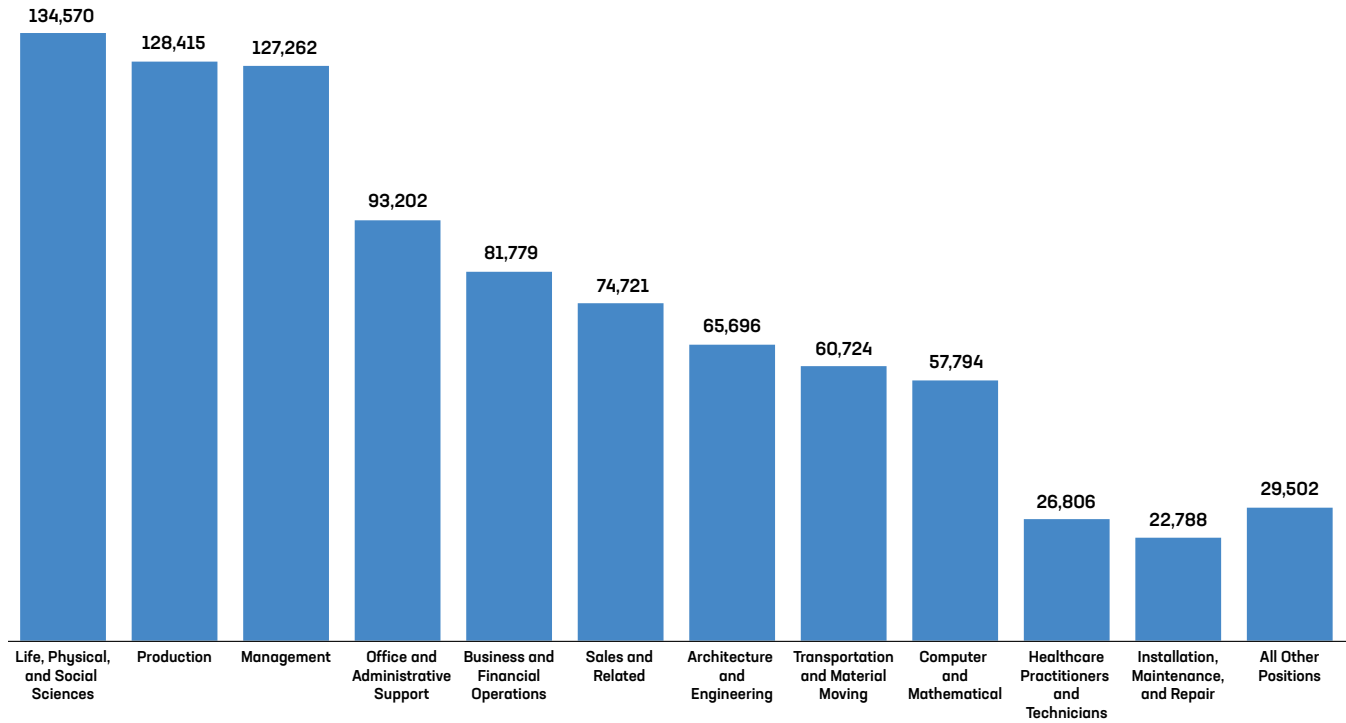
Highly-Skilled Talent

The U.S. biopharmaceutical industry relies on highly-skilled talent across a range of occupational categories and educational levels, including those with skills, education, and training in science, technology, engineering, and math (STEM). An array of STEM-related jobs are required by this industry and can range from those requiring an advanced college degree such as positions in R&D and senior management to jobs in skilled labor positions such as manufacturing technicians and other production, logistics, and support personnel.

Using NAICS-specific occupational information related to the four biopharmaceutical sectors, a composite 2020 occupational profile is developed for the overall U.S. biopharmaceutical industry. Figure 5 shows the estimated biopharmaceutical industry employment across key occupational categories and Figure 6 compares the occupational structure of the U.S. biopharmaceutical industry against the overall U.S. manufacturing profile, and the average private sector occupational profile.³

As shown in Figure 5, the biopharmaceutical industry employs more than 125,000 workers in each of three occupational categories: Life, Physical, and Social Science (134,570), Production (128,415), and Management (127,262).

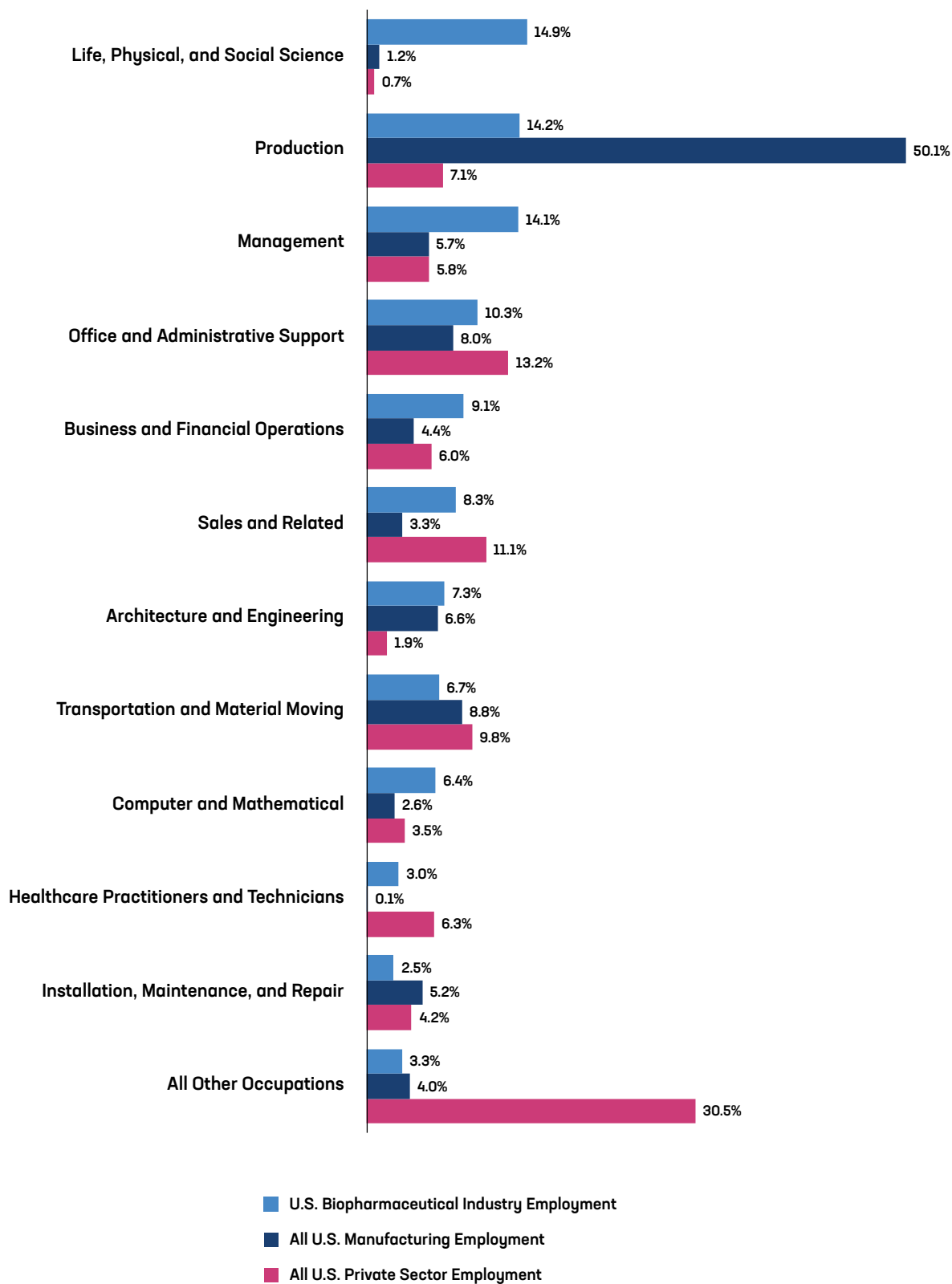
Figure 5. U.S. Occupational Profiles - Biopharmaceutical Industry Employment by Major Occupational Category, 2020



Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2020, and TEconomy estimations.

Comparatively, Figure 6 shows that nearly 15 percent of biopharmaceutical industry employment is in the life, physical and social science occupations, a significantly higher proportion than both manufacturing and overall private sector employment. Production occupations, occurring primarily within the biopharmaceutical manufacturing sector, account for 14 percent of the biopharmaceutical industry's total employment. The biopharmaceutical industry also provides significant employment in other broad areas with diverse educational and skill requirements. Management and financial-related occupations are spread throughout the four subsectors and account for over 23 percent of the biopharmaceutical industry's employment. Engineering and computer science combine for an additional 14 percent of the industry's employment. Office and administrative workers spread across the industry account for 10 percent of the workforce. Transportation and material moving occupations related to receiving supplier inputs and shipping finished products account for 5 percent of total employment. Details of key occupational shares, by state, for the biopharmaceutical industry are provided in Appendix B.

Figure 6. U.S. Occupational Profile Comparison - Biopharmaceutical Industry, Total Manufacturing, and Total Private Sector (Percent of Jobs), 2020



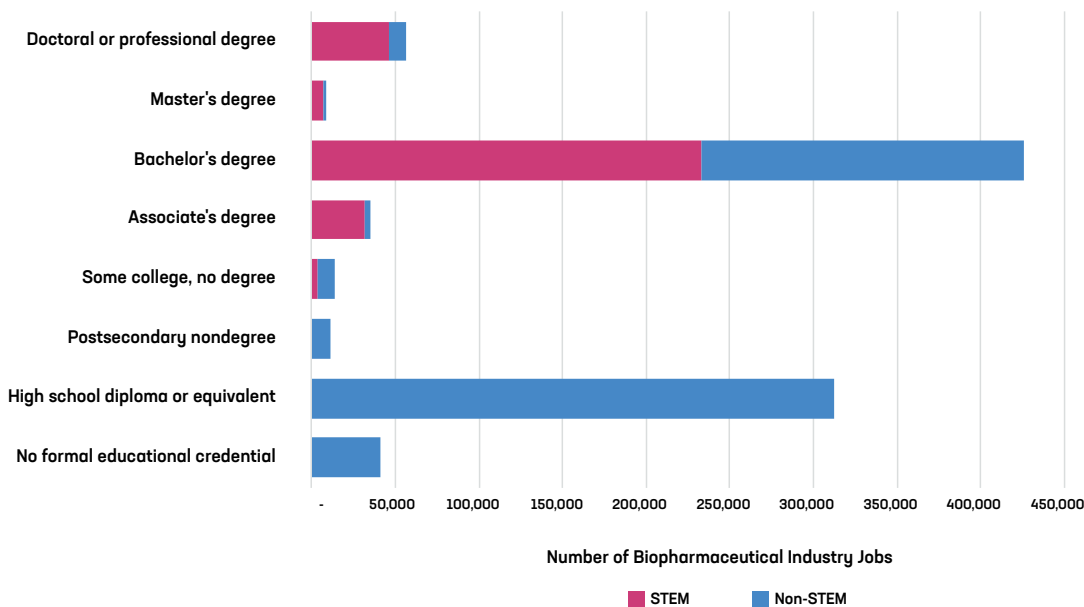
Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2020, and TEconomy estimations. "All Other Occupations" includes Arts & Design, Healthcare Support, Legal and more.

From a state industry perspective, life, physical, and social science occupations account for 15 percent or more of the biopharmaceutical workforce in 18 states, production workers account for 15 percent or more of the biopharmaceutical workforce in 24 states and Puerto Rico, and management occupations accounts for 10 percent or more of biopharmaceutical industry employment in every state and Puerto Rico. Details of key occupational shares, by state, are provided in Appendix B.

A notable characteristic of the biopharmaceutical industry workforce is the reliance on a strong STEM workforce. STEM-related occupations, as defined by the U.S. Bureau of Labor statistics, account for 36 percent of the biopharmaceutical industry's workers (i.e., life, physical and social sciences; architecture and engineering; and computer and mathematical occupations and STEM-related occupations within the management (e.g., quality control managers) and sales (e.g., technical/scientific sales))—**more than five times higher than the private sector average.**

A detailed examination of these broad occupational categories provides a perspective into the variety of employment opportunities found within the U.S. biopharmaceutical industry. Figure 7 shows U.S. biopharmaceutical STEM and non-STEM jobs categorized by the typical entry-level educational requirements of these jobs. While the industry is a high tech and innovation leader, a substantial portion of its overall employment fall into a Bachelor's degree level or below.

Figure 7. Entry-level Educational Requirements Across STEM and Non-STEM Biopharmaceutical Employment



Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2020, Emsi Occupational data and TEConomy estimations.

To provide further details, Table 2 shows key detailed occupations by educational requirements and estimated employment levels across the U.S. biopharmaceutical industry as a whole and the three major sectors. As shown, the biopharmaceutical industry provides significant employment opportunities across the spectrum of educational levels and occupational types.

Table 2. Key Detailed Occupational Estimates by Biopharmaceutical Sector

Entry Level Degree Requirement	Detailed Occupation	Total Industry	Biopharma R&D	Biopharma Manufacturing	Biopharma Distribution
Doctoral or professional degree	Medical Scientists, Except Epidemiologists	▲▲▲▲▲	▲▲▲▲	▲▲	
	Biochemists and Biophysicists	▲▲▲	▲▲	▲▲	
	Pharmacists	▲▲		▲	
	Lawyers	▲	▲		
Master's degree	Statisticians	▲	▲▲	▲	
	Computer and Information Research Scientists	▲	▲		
Bachelor's degree	Scientific and Technical Sales Representatives	▲▲▲▲▲	▲	▲▲	▲▲▲▲
	General and Operations Managers	▲▲▲▲	▲	▲	▲
	Chemists	▲▲▲▲	▲▲	▲▲▲	▲
	Natural Sciences Managers	▲▲▲▲	▲▲▲	▲▲▲	
	All Other Project and Business Operations Specialists	▲▲▲▲	▲▲▲	▲▲	▲
	Software Developers	▲▲▲	▲▲▲	▲	▲
	Biological Technicians	▲▲▲	▲▲▲	▲▲	
	Managers, All Other	▲▲▲	▲▲	▲▲	▲
	Industrial Engineers	▲▲▲	▲	▲▲	
	Accountants and Auditors	▲▲▲	▲	▲	▲
Associate's degree	Chemical Technicians	▲▲	▲▲		
	All Other Life, Physical, and Science Technicians	▲▲	▲▲		
	Industrial Engineering Technologists and Technicians	▲		▲	
	Calibration and All Other Engineering Technicians	▲	▲		
Some college, no degree	Bookkeeping, Accounting, and Auditing Clerks	▲▲	▲	▲	▲▲
	Computer User Support Specialists	▲	▲		
Postsecondary nondegree	Heavy and Tractor-Trailer Truck Drivers	▲▲			▲▲
High school diploma or equivalent	Packaging and Filling Machine Operators and Tenders	▲▲▲▲▲		▲▲▲▲▲	▲
	Non-Technical Sales Representatives	▲▲▲▲		▲	▲▲▲▲
	Inspectors, Testers, Sorters, Samplers, and Weighers	▲▲▲▲	▲	▲▲▲	▲
	Customer Service Representatives	▲▲▲	▲	▲	▲▲▲
	Chemical Equipment Operators and Tenders	▲▲▲		▲▲▲	
	First-Line Supervisors of Production and Operating Workers	▲▲▲		▲▲▲	▲
	Mixing and Blending Machine Operators	▲▲▲		▲▲▲	▲
	Office Clerks, General	▲▲▲	▲	▲	▲▲
No formal educational credential	Laborers and Freight, Stock, and Material Movers, Hand	▲▲▲▲		▲▲	▲▲▲
	Packers and Packagers, Hand	▲▲	▲	▲	
Estimated Number of Jobs: ▲ = 1,000+ ▲▲ = 5,000+ ▲▲▲ = 10,000+ ▲▲▲▲ = 20,000+ ▲▲▲▲▲ = 30,000+					

Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry, 2020, Emsi Occupational data and TEconomy estimations.



Critical Driver of U.S. Economic Growth

The U.S. biopharmaceutical industry is not only a world leader in the development of new medicines, vaccines, and diagnostics and one of the nation's top performing industry innovation drivers, but is also a highly valuable industry in terms of its contributions to the overall U.S. economy.

The economic impacts, or more precisely the revenue and expenditure impacts, of the U.S. biopharmaceutical industry can be measured using the well-established regional economic analysis technique of input-output (I-O) analysis, which tracks the revenues of a sector and the related economic activity of its suppliers and its personnel. For this analysis a customized IMPLAN I-O model is used to quantify and estimate the interrelationships between the U.S. biopharmaceutical industry and the remaining sectors of the U.S. economy.

Economic impacts consist of three types: **direct effects** (the specific impact of the initial biopharmaceutical industry expenditures reflected in purchases from supplier sectors), **indirect effects** (the impact of these expenditures by suppliers to the biopharmaceutical industry as they purchase inputs to meet the biopharmaceutical industry's demand), and **induced effects** (the additional economic impact of the spending of biopharmaceutical industry employees and suppliers' employees in the overall economy that can be attributed to the direct biopharmaceutical industry expenditures). Taken together, these three impact effects combine to form the **total impacts** of the U.S. biopharmaceutical industry. In other words, the I-O analysis models the "ripple effect" throughout the economy that originates from direct biopharmaceutical industry expenditures, flows through industry suppliers as they buy additional inputs, and through industry and supplier workers who spend their wages.

Definition of Impact Variables

Employment: The number of individuals whose employment is due, totally (direct employment) or in part (indirect or induced employment) to the economic effects of the industry.

Labor (Personal) Income: Salaries, wages, and the full cost of benefits including non-cash payments received by individuals in the economy. Includes employee compensation and sole proprietor income.

Value-Added: The difference between an industry's total output and the cost of its intermediate inputs (including labor income); sometimes referred to as the industry's "Contribution to GDP".

Output: The dollar value of industry production (e.g., sales or revenue).

Personal Tax Revenue: The dollar value of taxes generated due to the creation of personal income; includes both individual and company paid portion of social security.

The Economic Impact of the U.S. Biopharmaceutical Industry

The biopharmaceutical industry's total output impact, often referred to as the "total economic impact" on the U.S. economy, totaled more than \$1.4 trillion in 2020.⁴ This total industry impact includes \$717 billion of biopharmaceutical businesses sales (direct output effect) and \$705 billion in indirect and induced output effects. These values generate

a biopharmaceutical industry output multiplier of 1.98—meaning that every \$1.00 in output produced by the biopharmaceutical industry supports an additional \$0.98 in output in other sectors of the U.S. economy (Table 3).

The operations and sales revenue of the biopharmaceutical industry is responsible for supporting more than 4.4 million jobs throughout the U.S. economy. These jobs consist of the more than 903,000 U.S. biopharmaceutical industry jobs and the more than 3.5 million indirect and induced jobs supported by the industry in 2020. For every one biopharmaceutical industry job, the industry supports an additional 3.92 jobs in the U.S. economy, for a total employment multiplier of 4.92. Together, the biopharmaceutical industry and the workforce of its suppliers and other impacted segments of the U.S. economy received \$359 billion in wages and benefits (labor income) in 2020.

Table 3. Economic Impacts of the U.S. Biopharmaceutical Industry, 2020 (\$ in billions)

Impact Type	Employment	Labor Income	Value Added	Output	State/Local Personal Tax Revenue	Federal Personal Tax Revenue
Direct Effect	903,258	\$131.27	\$344.01	\$717.15	\$3.89	\$24.38
Indirect Effect	1,579,112	\$117.73	\$182.17	\$358.70	\$3.26	\$21.52
Induced Effect	1,961,000	\$110.36	\$194.88	\$346.75	\$3.07	\$20.25
Total Impacts	4,443,370	\$359.36	\$721.06	\$1,422.59	\$10.22	\$66.16
Multiplier	4.92	2.74	2.10	1.98		

Source: TEconomy data, calculations and analysis; IMPLAN U.S. model.

Through these wages and benefits (labor income) the employees and supplier employees of the biopharmaceutical industry are an important generator of federal, state, and local government tax revenues. The impact analysis estimates that the incomes of biopharmaceutical industry workers and supported employees generate more than \$76 billion in personal taxes in 2020 – more than \$10 billion in state and local tax revenues from personal taxes and more than \$66 billion in federal tax revenues from personal taxes.

The biopharmaceutical industry's direct value added represented 1.6 percent of U.S. Gross Domestic Product (GDP) in 2020. The total value added supported by the industry, including supported sectors beyond the biopharmaceutical industry itself, totaled more than \$720 billion, or 3.4 percent of total U.S. GDP.⁵

The Biopharmaceutical Industry Supply Chain and Breadth of Impacts

The biopharmaceutical industry requires a vast array of inputs and suppliers for research, operations, production, and distribution. The demand interrelationship with the industry's supply chain is captured within the indirect effects aspect of the overall multiplier effect. The I-O analysis assesses the product and service input demands of the biopharmaceutical industry on every other sector in the economy and provides industry-specific impact estimates for suppliers to the biopharmaceutical industry. Table 4 provides a detailed characterization of the major supply chain inputs (using grouped IMPLAN industry sectors for simplicity and clarity) to the U.S. biopharmaceutical industry as determined by the size of the indirect output effects. The table is ordered by the size of the supplier output or value of what that sector supplies to the biopharmaceutical industry. For example, the biopharmaceutical industry purchased more than \$36 billion in miscellaneous purchased inputs. Miscellaneous purchased inputs, accounting for more than 10 percent of the value of all inputs, includes those purchases from various industries' corporate offices, and hence, captured in the corporate and administrative headquarters NAICS code 5511. These purchases required more than 148,000 employees to produce and supply these inputs. The industry also purchased more than \$31 billion in various organic/inorganic chemical inputs (such as raw materials, excipients, or in some instances active pharmaceutical ingredients).

Table 4. Supply Chain Inputs to the U.S. Biopharmaceutical Industry - Sectors, Jobs, and Sales, 2020

Biopharmaceutical Industry Key Supplier Sectors	Supplier Jobs	Supplier Sales (\$B)
Miscellaneous Purchased Inputs	148,170	\$36.44
Organic/Inorganic Chemical Inputs	14,339	\$31.06
Real Estate Services (incl. facility leasing)	122,597	\$25.05
Software, Computer Services, and Internet	61,820	\$23.50
Insurance Services	34,151	\$14.67
Electric Utilities	9,389	\$11.30
Wholesale - Miscellaneous Nondurable Goods	34,404	\$10.58
Financial Services	32,294	\$9.84
Other R&D Services	36,460	\$9.18
Broadcasting & Subscription Programming	11,641	\$8.94
Facility & Operational Services	94,579	\$8.84
Employment Services	95,063	\$8.49
Legal Services	38,394	\$8.25
Management Consulting Services	51,602	\$8.07
Advertising & Public Relations Services	38,459	\$7.10
Telecommunication Services	9,152	\$6.33
Architectural & Engineering Services	35,072	\$6.19
Business Support & Related Services	76,713	\$5.68
Truck Transportation	36,734	\$5.67
Plastics/Plastic Packaging	9,471	\$5.62
Paper/Cardboard Packaging	9,516	\$5.53
Couriers & Express Parcel Delivery	60,650	\$5.05
Printing	27,257	\$4.80
Warehousing & Storage	49,482	\$4.57
Key Food-Related Inputs (e.g., starches, whey, protein, cellulose)	6,790	\$4.54
Wholesale - Commercial/Industrial Equipment	12,000	\$3.99
Logistics & Support Activities	24,818	\$3.86
Accounting Services	22,869	\$3.64
Marketing, Advertising, & Public Relations Services	11,456	\$3.04
Wholesale - Electronic Markets/Brokers	19,549	\$2.79
Commercial/Industrial Equipment Repair	26,022	\$2.67
Facility Repair/Remodel Construction Services	11,490	\$2.52
Wholesale - Other Durable Goods	8,179	\$2.29
Intellectual Property Management & Licensing	1,007	\$2.26
Wholesale - Miscellaneous Machinery & Equipment	7,595	\$2.21
Industrial, Processing, & Control Equipment	4,329	\$1.85
Wholesale - Electric/Electronic Equipment	3,486	\$1.75
Commercial/Industrial Equipment Leasing	4,789	\$1.74
Environmental & Other Technical Services	9,729	\$1.38
Natural Gas, Water, & Other Utilities	1,589	\$1.32
Other Packaging	1,339	\$0.60
All Other Suppliers	264,664	\$45.52
Total Indirect (Supply Chain) Impacts	1,579,110	\$358.70

Source: TEconomy Partners data, calculations and analysis; IMPLAN U.S. Model. See text for definition of Miscellaneous Purchased Inputs.

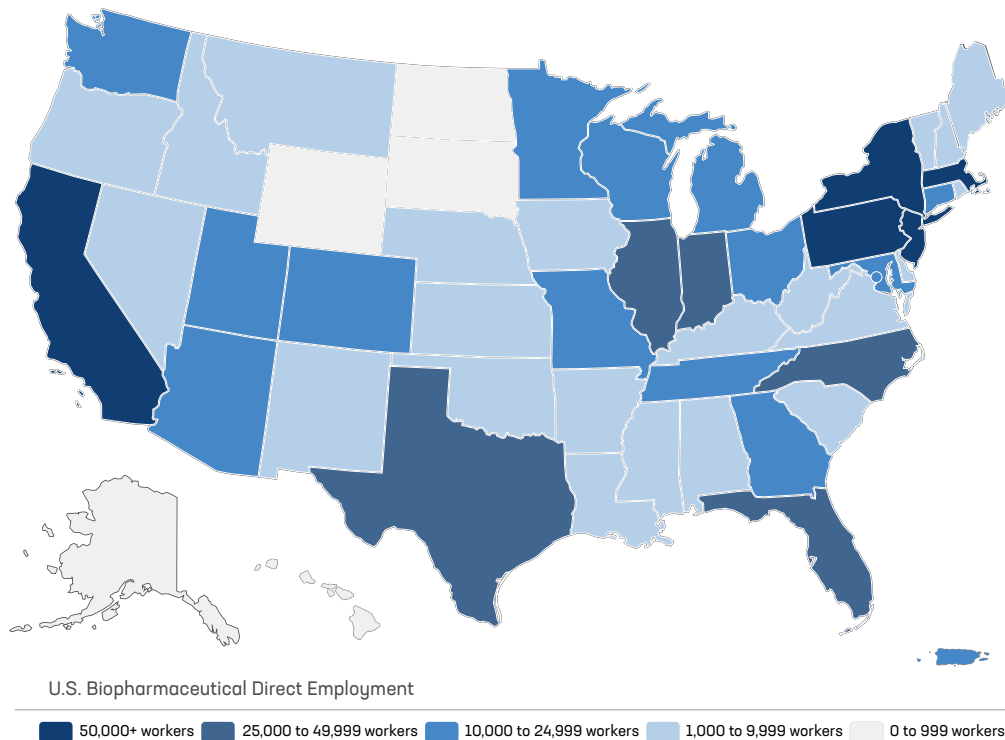
The Direct and Total Impacts of the U.S. Biopharmaceutical Industry Across the Nation

The U.S. biopharmaceutical industry, as with many industries, has certain states with significant direct employment levels, sometimes driven by size of population, by historical centers of innovation, or by natural resources. A key measure of the importance and significance of the U.S. biopharmaceutical industry, however, is its diverse geographic representation—with every state, the District of Columbia, and Puerto Rico having some direct biopharmaceutical industry employment and experiencing some level of economic impact from the industry.

Figure 8 illustrates direct biopharmaceutical industry employment across all 50 states, the District of Columbia, and Puerto Rico. Five states—California, New Jersey, Massachusetts, New York, and Pennsylvania—each have more than 50,000 biopharmaceutical industry workers. In total, 23 states and Puerto Rico, have more than 10,000 biopharmaceutical industry workers, with six more states having between 5,000 and 10,000 industry jobs.

Within this distribution of states one measure of importance, the size of the state’s biopharmaceutical industry as a share of total private sector employment, can vary dramatically. For example, the biopharmaceutical industry accounts for 2.7 percent of Puerto Rico’s total private sector employment, the largest share across the U.S. The biopharmaceutical industry also accounts for 2.0 percent or more of total private sector employment in Massachusetts (2.5 percent) and New Jersey (2.0 percent). The biopharmaceutical industry accounts for 1.0 percent to 1.9 percent of total private sector employment in an additional eight states, including states with smaller populations such as Maine, Utah, and Delaware and larger states such as California, Pennsylvania, and Indiana. While sizeable and important within the state of California, the state’s nearly 140,000 direct biopharmaceutical industry jobs account for 1 percent of total private sector employment. In contrast, Delaware’s nearly 5,000 biopharmaceutical industry jobs account for 1.3 percent of total private sector employment in that state.

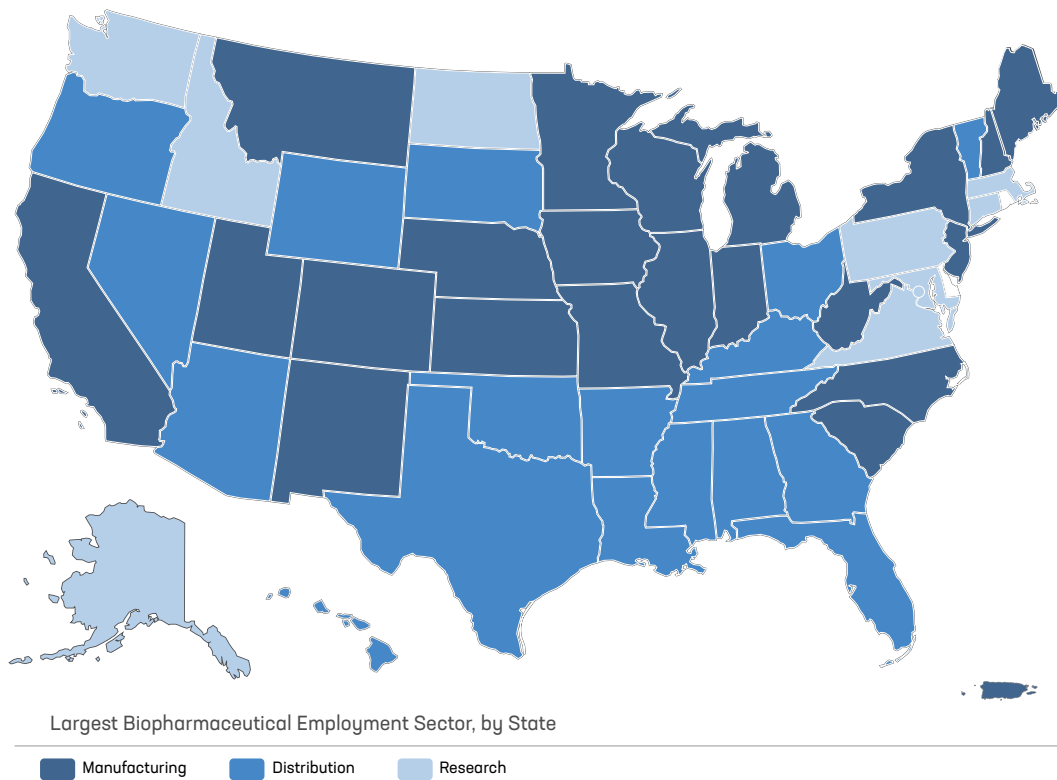
Figure 8. Geographic Distribution of U.S. Biopharmaceutical Industry Total Direct Employment, 2020



Source: TEconomy Partners data, calculations and analysis.

As the total size of the U.S. biopharmaceutical industry varies by state, the diversity of the industry is also shown by its sectoral distribution. While many of the leading overall states have significant employment in all four biopharmaceutical industry sectors, the largest single sector shows much geographic variation (Figure 9).

Figure 9. Geographic Distribution of Largest Biopharmaceutical Industry Sector by Direct Employment, 2020



Source: TEconomy Partners data, calculations and analysis.

Note: Employment in the Biopharmaceutical Corporate Administration sector was not the largest sector in any state and is therefore not included in the map above.

The distribution of the U.S. biopharmaceutical industry's total employment impacts reflects, in part, the large-scale, geographically-dispersed supply chain. For suppliers (indirect employment), there are nine states where the industry supports at least 70,000 supplier jobs, and another thirteen states with at least 20,000 supplier jobs. Combining direct, indirect, and induced employment, the biopharmaceutical industry supports more than 100,000 jobs in 12 states, with more than 200,000 jobs in nine states—California, New Jersey, Massachusetts, Pennsylvania, Illinois, New York, Texas, Florida, and North Carolina. Overall, 30 states and Puerto Rico each have more than 20,000 jobs supported by the biopharmaceutical industry. Appendix B provides employment and economic impact estimates by state, while broad geographic patterns are described below.

From a total economic impacts perspective (direct, indirect, and induced output combined), California is by far the largest source of U.S. biopharmaceutical economic impact—accounting for more than \$230 billion, or 17 percent of the U.S. total output impacts. Nine states—New Jersey, Illinois, New York, Pennsylvania, Massachusetts, North Carolina, Texas, Florida, Indiana—and Puerto Rico, have total biopharmaceutical industry economic impacts of more than \$50 billion. Fully 46 states, and Puerto Rico, exceed \$1 billion in economic impact.



Discussion

The industry's varied occupational base and extensive research, manufacturing, and distribution infrastructure generates and supports significant impacts on economies across the country.

The strength and ingenuity of the U.S. biopharmaceutical industry and innovation-based policies have resulted in the nation being the global leader in biopharmaceutical innovation and production. The following economic metrics reflect this global and national leadership position:

Sizeable and Stable Employment

- Direct employment of more than 903,000 workers and a substantial employment multiplier of 4.92, the U.S. biopharmaceutical industry supports more than 3.5 million additional U.S. jobs for a total employment impact of more than 4.4 million jobs in 2020.
- As an industry, the U.S. biopharmaceutical industry has outpaced U.S. manufacturing and the overall U.S. private sector in employment growth over the 2015-2020 period demonstrating a combination of growth, stability, and economic resilience that makes the industry a key driver of the U.S. economy.

High Skills, High Wage, and High Productivity

- The complexity of current biopharmaceutical production—driven by significant levels of research and development—requires a high proportion of STEM jobs and a significant share of employment in high skill/advanced degree occupations.
- Yet, as a critical manufacturing industry also requiring a significant distribution infrastructure, the U.S. biopharmaceutical industry offers significant employment opportunities and careers for individuals with less than a Bachelor's degree.
- This unique employment mix benefits all workers with average annual wages and benefits of more than \$145,000—nearly \$60,000 more than the average U.S. manufacturing job, and more than twice the U.S. average across all industries—biopharmaceutical industry jobs are both high-wage and high-quality.
- From an overall productivity perspective, this employment mix, combined with the research and productive nature of the U.S. biopharmaceutical industry, generates a productivity level of nearly \$381,000 per employee—more than twice that of the U.S. average manufacturing worker and more than three and half times the average worker.

Significant Economic Driver

- The U.S. biopharmaceutical industry exceeds \$710 billion in direct output in 2020, and with the ripple effect of this production throughout the U.S. economy, supports an additional \$700 billion in output through its suppliers and other sectors of the economy. This combined, total output impact represents 3.7 percent of total U.S. output.



- Through its research, production, and overall operations, value added from the U.S. biopharmaceutical industry directly contributes 1.6 percent of U.S. GDP, and including indirect and induced effects supports more than \$720 billion in value added, or 3.4 percent of U.S. GDP.

The nation's biopharmaceutical industry is a major driver of innovation and economic growth both within the U.S. and globally. The integrated nature of its activities, and the flexibility and responsiveness this structure provides, allows the U.S. biopharmaceutical industry to respond effectively in times of national and global crisis, while also consistently providing jobs for significant numbers of highly skilled, highly productive, and highly paid workers across the country.

But this unique industry and its substantial workforce cannot be taken for granted. To sustain this important driver of the U.S. economy, the biopharmaceutical industry must be supported by robust innovation policies starting with strong intellectual property protections, a well functioning and evidence-based regulatory system, research and development incentives, and other policies that recognize the value of medical innovation.

Appendix A: Methodology

The following narrative provides an overview of the approach used to develop the 2020 biopharmaceutical industry employment and economic impact estimates at the national and state levels. This approach is mostly similar to those used by TEconomy Partners for prior similar studies for PhRMA.

Data Sources

Estimates of biopharmaceutical industry employment were derived by combining several widely used public and private data sources.

2020 Quarterly Census of Employment and Wages: Employment data for all relevant components of the biopharmaceutical industry were obtained from the U.S. Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) for 2020. QCEW establishment, employment, and wage data is captured by each state as part of corporate unemployment insurance data collection efforts performed by their Labor Market Information (LMI) office, and coordinated with and reported nationally to the BLS. QCEW employment data are categorized into industry sectors and subsectors using the North American Industrial Classification System (NAICS), which is the standard used by Federal statistical agencies to classify business establishments.

A single company in the biopharmaceutical industry can have many establishments (locations) throughout the U.S., and that company's establishments can be classified into different NAICS categories. For example, a biopharmaceutical company may have a manufacturing facility in one location, an R&D facility in another location, and corporate administration in a third location. At the same time, companies often have these functions co-located, for example R&D and manufacturing in the same location. In these co-location cases the establishment is generally assigned to the NAICS category associated with the primary activity at that location.

U.S. and state-level (including the District of Columbia and Puerto Rico) biopharmaceutical industry employment is estimated by aggregating employment across all establishments determined to belong to the biopharmaceutical industry based on their NAICS classification, with refinements, using the approach described later in this Appendix.

2020 Current Population Survey: The BLS Current Population Survey (CPS) is a national-level survey that estimates the total employment spectrum of the U.S. including public and private sector wage and salary employees, corporate and self-employed workers, and unpaid family workers. While the QCEW data captures nearly all industry employment (approximately 98 percent of all U.S. jobs), it does not capture sole proprietors, consultants, contract employees, representatives, and other "non-corporate" or "self-employed" private sector employment. CPS data were used to adjust the QCEW data upwards to estimate the full spectrum of biopharmaceutical industry employment.

2017 Economic Census: Every five years the U.S. Census Bureau performs the national economic census to examine the detailed economic activities of U.S. industry, with the most recent survey occurring in 2017. These data are collected at the NAICS code level across a set of North American Product Classification System codes. Some broader NAICS codes include a combination of biopharmaceutical industry jobs and non-biopharmaceutical industry jobs. To determine the share of these sectors attributable to the biopharmaceutical industry, U.S. and state-level data from U.S. Economic Census were used to estimate the biopharmaceutical-relevant economic activity within these NAICS codes.

Dun & Bradstreet: With specific corporate examples to work from, individual biopharmaceutical-related Dun & Bradstreet (D&B) establishment records identified as "headquarters" were examined. For those establishments that appeared to be dedicated to management activities only, additional work was performed including examination of corporate websites for

additional location and employment information for these administrative locations. Based upon this analysis, employment was estimated for a number of key establishments and locations, for inclusion as part of the overall biopharmaceutical industry. While every attempt is made to identify these corporate and administrative locations, the values used in this analysis are likely conservative in nature.

2019 IMPLAN Models: The wider economic impact of the biopharmaceutical industry was estimated using the well-established regional economic analysis technique of input-output analysis (I-O), using custom I-O models from IMPLAN. The I-O analysis produces estimates of the economic impacts of the biopharmaceutical industry on output in the U.S. economy, on jobs, personal income, and federal, state, and local taxes.

The IMPLAN models' data matrices track the flow of commodities to industries from producers and institutional consumers within the nation or within individual states. The data also model consumption activities by workers, owners of capital, and imports. The inter-industry trade flows built into the model permit estimating the impacts of one sector on all other sectors with which it interacts within the specified geography. The 2019 models are the most current available at the time of this analysis. Impact results are generated and reported in 2020 dollars.

The Structure of the U.S. Biopharmaceutical Industry

The biopharmaceutical industry's wide range of activities is spread across a set of different NAICS codes reflecting its presence within the U.S. economy. For purposes of this analysis, these NAICS codes are grouped into four industry subsectors: biopharmaceutical manufacturing, biopharmaceutical distribution, biopharmaceutical R&D, and biopharmaceutical corporate administration (Table A1).

Table A1. 2017 NAICS Structure Relevant to Biopharmaceutical Industry

Biopharmaceutical Manufacturing
325411 Medicinal and botanical manufacturing
325412 Pharmaceutical preparation manufacturing
325413 In-vitro diagnostic substance manufacturing
325414 Biological product (except diagnostic) manufacturing
Biopharmaceutical Distribution
424210 Drugs and druggists' sundries merchant wholesalers*
Biopharmaceutical R&D
541713 R&D in nanotechnology (including nanobiotechnology)*
541714 R&D in biotechnology (except nanobiotechnology)
541715 R&D in the physical, engineering, and life sciences (except nanotech and biotech)*
Biopharmaceutical Corporate Administration
551114 Corporate, subsidiary, and regional managing offices*

*Indicate NAICS codes that include both biopharmaceutical and non-biopharmaceutical employment, and therefore require additional refinement and specification.

Biopharmaceutical Manufacturing

Biopharmaceutical manufacturing is defined to include 100 percent of the employment within NAICS 3254. While a very small portion of the manufacturing activity of companies falling into these codes may be for products not considered drugs or pharmaceuticals, the intent of these codes is to capture the manufacturers of medicines, vaccines, diagnostics, and related-biopharmaceuticals.

Biopharmaceutical Distribution

The increasing importance of firms involved in the logistics and distribution of biopharmaceutical products, both in managing large and complex supply chains and as a source for industry innovation is acknowledged through their inclusion in this value-chain approach to estimating the size and impacts of the biopharmaceutical industry.

To more succinctly specify biopharmaceutical industry-related estimate from NAICS 424210 (Drugs and druggists' sundries merchant wholesalers), estimates are made of the size of these non-biopharmaceutical activities (e.g., "druggist sundries", miscellaneous medical equipment, and other retail product distribution) using data from the 2017 Economic Census. The resulting estimate of biopharmaceutical distribution employment for all of the U.S. represents 94.8 percent of this six-digit NAICS. This factor was applied to the U.S. and each state's employment values for NAIC 424210.

Biopharmaceutical R&D

Changes in the 2017 Economic Census, both in terms of the data collected and the data made public required some modifications from previous years' estimation of biopharmaceutical R&D employment.

The 2017 Economic Census used, for the first time, a new "product coding" schema called the North American Product Classification System (NAPCS). This coding system in some ways mimic the 2012 Economic Census product codes, however, the 2017 codes are significantly reduced in number and detail, with a similar set of product codes available across many NAICS sectors. For 2017 an additional underlying data structure was used to collect the information to bridge the changes between the product codes used in the 2012 Economic Census and the NAPCS codes used in the 2017 Economic Census. However, some of these data are limited in terms of public availability, especially at the state level.

Furthermore, discrepancies between the Economic Census (U.S. Census) and the QCEW data (U.S. BLS) in terms of size of the six digit NAICS industries 541713, 541714, 541715, and 541720 required additional adjustments to the estimation process.

NAICS 541714 (R&D in biotechnology except nanobiotechnology) is included in its entirety, as the vast majority of work in this sector is of a biomedical nature or directly applicable to biopharmaceutical development, and therefore did not require any data sharing procedures.

For two NAICS codes (NAICS 541713 - R&D in nanotechnology including nanobiotechnology and NAICS 541715 -R&D in the physical, engineering, and life sciences [except nanotechnology and biotechnology]) information from the 2017 U.S. Economic Census is used to estimate and capture a biopharmaceutical "share" of the employment.

Table A2. Overview of NAICS-level detail within 2017 Economic Census, Total Establishment and Receipts

NAICS 5417XX Code and Description		Industry Total Estabs., 2017	Industry Total Receipts 2017 (\$1000)
541713	R&D in nanotechnology	4,375	\$34,648,992
541714	R&D in biotechnology (except nanobiotechnology)	3,154	\$24,559,814
541715	R&D in physical, engineering, & life sciences (except nanotechnology and biotechnology)	9,248	\$94,104,643
541720	R&D in the social sciences and humanities	1,921	\$7,048,738

Source: U.S. Bureau of the Census, Economic Census 2017

Table A3 provides the key biopharmaceutical-related NAPCS code structure established for NAICS 54171-R&D in the physical, engineering, and life sciences. The adjustments made assume the product codes most relevant to capturing the size of the biopharmaceutical R&D sector are the basic and applied research in biotechnology product code (7009675012), the basic and applied research performed in biological sciences product code (7009675015), and the basic and applied research in pharmacology and pharmaceutical science product code (7009750003). These three detailed product codes are used to capture a biopharmaceutical-related share of the R&D performed in each of the three NAICS codes.

Table A3. Key Biopharmaceutical R&D-related NAPCS Product Codes

Key Product Codes and Descriptions (Major and Detailed Subcategories)	
7009675000	Basic and applied research in natural and exact sciences, including biological sciences
7009675012	Basic and applied research in biotechnology
7009675015	Basic and applied research in biological sciences
7009750000	Basic and applied research in medical and health sciences
7009750003	Basic and applied research in pharmacology and pharmaceutical sciences

Notes: Establishments can be counted in more than one product code. Not all product codes are shown in this table.

Source: U.S. Bureau of the Census, Economic Census 2017

Using a similar procedure, a very small share of the employment in NAICS 541720 (R&D in the social sciences and humanities) was also included as biopharmaceutical industry employment due to the inclusion of biopharmaceutical-related product code details in this NAICS at the U.S. level. This procedure added approximately 1,000 biopharmaceutical R&D jobs to the U.S. estimate.

Combining the four components of scientific R&D services, this procedure estimates that 44 percent of the encompassing NAICS 5417 is classified as belonging to the U.S. biopharmaceutical industry. This percentage captures employment involved in distinct biotechnology activities, pharmaceutical sciences research including CRO activities, and other medical and health related R&D. R&D activities performed within locations classified as biopharmaceutical manufacturing, distribution, or corporate administration are captured within the employment estimates for those particular sectors.

Biopharmaceutical Corporate Administration

A characteristic at the core of the NAICS classification scheme is to allow for the classification of individual establishments based upon the functions occurring within a particular establishment. As with all large, multinational industries such as automotive and aerospace, a meaningful share of biopharmaceutical industry employment is captured within Management of Companies and Enterprises (NAICS 5511). To assess the level of this biopharmaceutical industry employment a special estimation effort is required to assess these locations' impacts. With specific corporate information to work from, individual biopharmaceutical-related Dun & Bradstreet (D&B) establishment records identified as biopharmaceutical "headquarters" were examined to ascertain whether any significant manufacturing or R&D activities were occurring within these establishments that would allow these locations to be classified by public sector data collection agencies as either NAICS 3254 - Pharmaceutical and medicine manufacturing; or NAICS 5417 - Scientific research and development (R&D) services. For those establishments that appeared to be dedicated to management activities only, additional work was performed including examination of corporate websites for additional location information to determine if this employment would most likely be classified in NAICS 5511 by public sector data collection agencies. Based upon this analysis, employment was estimated for a number of key establishments and locations, for inclusion as part of the overall biopharmaceutical industry. Headquarters employment for key firms in the biopharmaceutical distribution sector is also estimated in this fashion, consistent with the value chain approach used in this report to estimate the size of the biopharmaceutical industry. Of the total 2020 employment in U.S. establishments that are classified as corporate administration, this approach leads to a conservative estimate that 1.3 percent should be considered biopharmaceutical industry employment.

It is important to recognize that the employment within these four defined biopharmaceutical sectors are based on establishment-level data collection where a single NAICS code is assigned to the establishment (i.e., the physical business location). The specific NAICS code is determined by the predominant or primary business activity occurring within the location, and is typically determined by factors such as relative share of production costs, revenue, value of shipments, and in some instances employment. Since within the BLS QCEW data all jobs within an establishment are assigned to the establishment's single NAICS code, sector-based job counts may over- or under-state actual employment by function to the extent multiple activities occur at a single establishment (e.g., collocated R&D and manufacturing). The total employment estimate is not affected, however.

Additional Refinements

For three of the four biopharmaceutical sectors - biopharmaceutical manufacturing, biopharmaceutical distribution, and biopharmaceutical R&D - CPS data are used to adjust the employment estimates to reflect the inclusion of self-employed workers. The CPS provides an estimate of the ratio of "self-employed" workers to the number of "private sector wage and salary workers" or corporate employment for each biopharmaceutical sector's grouping of NAICS codes. This share ranges from 1.0 percent in biopharmaceutical manufacturing to 2.1 percent in biopharmaceutical distribution in 2020. This share ratio is applied to the QCEW-based biopharmaceutical sector employment to arrive at a final biopharmaceutical sector employment estimate. Biopharmaceutical corporate office employment is not adjusted in a similar fashion as because CPS survey respondents identify their employment based upon more traditional industry sectors (e.g., process consultants would identify with the biopharmaceutical manufacturing sector, not the biopharmaceutical corporate administration sector).

Final Biopharmaceutical Industry and Sector Employment Estimates

A summary of the NAICS-based employment for the components of the biopharmaceutical industry are provided in Table A4. The data entries show the estimated share of employment within that sector (four-digit NAICS code) that is attributed to the biopharmaceutical industry, the 2017 employment estimate, and the subsector's share of total biopharmaceutical industry employment.

Table A4. U.S. Biopharmaceutical Industry Sector Estimates, 2020

Biopharmaceutical Subsector	NAICS Codes (4 Digit)	U.S. NAICS Total Employment	Biopharma Share of Sector	Biopharma-Related Sector Employment	Share of Total Biopharma Employment
Biopharmaceutical Manufacturing	3254 Pharmaceutical and medicine manufacturing	330,830	100.0%	330,830	36.6%
Biopharmaceutical Distribution	4242 Drug and druggist sundries wholesale	239,961	94.2%	229,218	25.4%
Biopharmaceutical R&D	5417 Scientific research and development (R&D)	717,033	43.8%	313,925	34.8%
Biopharmaceutical Corporate Administration	5511 Management of companies and enterprises	2,235,547	1.3%	28,913	3.2%
Total U.S. Biopharmaceutical Industry				903,258	100.0%

Source: TEconomy Partners analysis, calculations and estimations using 2020 BLS QCEW and CPS Employment Data. Data include the 50 States, the District of Columbia, and Puerto Rico.

Total Economic Impact of the Biopharmaceutical Industry

The economic impact of the biopharmaceutical industry was estimated using the well-established economic analysis technique of input-output analysis (I-O), using custom I-O models from IMPLAN for each state, the District of Columbia, and Puerto Rico, as well as a U.S. national model. The IMPLAN models' data matrices track the flow of commodities to industries from producers and institutional consumers within the specific region. The data also model consumption activities by workers, owners of capital, and imports. The inter-industry trade flows built into the models permit estimating the impacts of one sector on all other sectors with which it interacts.

The biopharmaceutical industry sector employment estimates described above serve as the inputs to and drive the resulting impacts within the U.S. and individual state I-O models. The models, using the additional data embedded within the IMPLAN models, convert these employment estimates into localized income and expenditures. The estimation of the ripple effect of these expenditures (including the spending of worker wages) generates the impact measures detailed in this report. These measures include the direct, indirect, and induced job creation, associated personal incomes, business value added and output, and associated personal tax revenues to federal, state and local taxing authorities.

Appendix B

State-Level Estimates

Table B1. U.S. and State Employment: Direct, Indirect, and Induced Effects and Total Impacts, 2020

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
U.S. Total (incl. District of Columbia & Puerto Rico)	903,258	1,579,112	1,961,000	4,443,370	4.92
Alabama	3,314	6,300	5,027	14,641	4.42
Alaska	358	383	365	1,106	3.09
Arizona	11,069	30,321	27,195	68,585	6.20
Arkansas	2,436	6,016	4,253	12,705	5.22
California	150,729	233,563	315,652	699,944	4.64
Colorado	12,983	26,765	29,725	69,473	5.35
Connecticut	10,111	12,781	22,282	45,175	4.47
Delaware	4,038	4,328	6,472	14,838	3.67
District of Columbia	2,064	1,722	1,374	5,160	2.50
Florida	36,137	109,390	99,426	244,952	6.78
Georgia	11,471	28,972	28,495	68,938	6.01
Hawaii	823	1,579	1,232	3,634	4.42
Idaho	2,038	3,201	2,881	8,120	3.98
Illinois	42,381	87,298	136,389	266,067	6.28
Indiana	25,723	39,941	64,700	130,364	5.07
Iowa	5,822	6,637	9,697	22,156	3.81
Kansas	8,114	14,104	13,488	35,706	4.40
Kentucky	6,060	13,017	11,788	30,865	5.09
Louisiana	2,513	6,528	5,592	14,633	5.82
Maine	5,622	11,981	13,485	31,087	5.53
Maryland	28,549	30,216	47,858	106,623	3.73
Massachusetts	72,147	78,194	138,249	288,590	4.00
Michigan	16,388	36,687	41,817	94,892	5.79
Minnesota	11,733	20,048	29,988	61,769	5.26
Mississippi	2,186	5,358	3,614	11,158	5.10
Missouri	14,549	28,089	32,696	75,334	5.18
Montana	1,338	1,617	1,691	4,645	3.47
Nebraska	4,009	6,603	7,629	18,241	4.55
Nevada	3,263	7,210	5,181	15,654	4.80
New Hampshire	3,154	4,151	5,660	12,966	4.11

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
New Jersey	63,415	102,826	174,510	340,751	5.37
New Mexico	2,198	2,622	2,480	7,300	3.32
New York	64,676	89,848	96,870	251,394	3.89
North Carolina	47,145	84,688	91,367	223,200	4.73
North Dakota	490	589	609	1,688	3.44
Ohio	23,479	48,824	50,538	122,841	5.23
Oklahoma	3,044	6,961	5,430	15,436	5.07
Oregon	4,404	10,807	9,784	24,995	5.68
Pennsylvania	51,895	78,038	141,360	271,293	5.23
Puerto Rico	17,128	34,965	17,198	69,291	4.05
Rhode Island	2,005	4,221	4,962	11,188	5.58
South Carolina	7,617	15,799	12,807	36,223	4.76
South Dakota	742	1,285	1,200	3,226	4.35
Tennessee	13,675	32,473	29,301	75,449	5.52
Texas	40,957	103,541	105,364	249,863	6.10
Utah	14,564	31,511	27,215	73,291	5.03
Vermont	1,370	2,490	2,384	6,243	4.56
Virginia	9,743	17,365	17,619	44,728	4.59
Washington	17,600	21,947	26,257	65,803	3.74
West Virginia	3,997	6,849	6,962	17,807	4.46
Wisconsin	11,800	18,177	22,702	52,679	4.46
Wyoming	192	284	182	657	3.42

Source: TEconomy Partners data, calculations and analysis; IMPLAN U.S. and state models.

Table B2. U.S. and State Output: Direct, Indirect, and Induced Effects and Total Impacts, 2020

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
U.S. Total (incl. District of Columbia & Puerto Rico)	\$717,145.2	\$358,696.1	\$346,751.7	\$1,422,593.0	1.98
Alabama	\$2,402.2	\$1,148.0	\$775.4	\$4,325.5	1.80
Alaska	\$123.3	\$80.2	\$63.1	\$266.6	2.16
Arizona	\$7,396.9	\$5,935.1	\$4,642.0	\$17,974.0	2.43
Arkansas	\$1,749.0	\$1,081.8	\$657.2	\$3,488.0	1.99
California	\$115,990.6	\$59,970.5	\$62,628.6	\$238,589.7	2.06
Colorado	\$8,491.3	\$6,064.2	\$5,218.5	\$19,774.0	2.33
Connecticut	\$6,646.5	\$2,979.1	\$4,202.0	\$13,827.5	2.08
Delaware	\$1,821.3	\$951.8	\$1,086.4	\$3,859.4	2.12
District of Columbia	\$948.3	\$470.5	\$267.2	\$1,686.0	1.78
Florida	\$26,805.1	\$21,042.3	\$16,495.2	\$64,342.5	2.40
Georgia	\$8,049.5	\$5,951.7	\$4,696.2	\$18,697.4	2.32
Hawaii	\$370.3	\$318.8	\$225.4	\$914.4	2.47

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
Idaho	\$933.6	\$602.8	\$453.6	\$1,990.0	2.13
Illinois	\$45,593.0	\$21,395.5	\$24,479.2	\$91,467.6	2.01
Indiana	\$37,313.7	\$8,797.6	\$10,242.4	\$56,353.8	1.51
Iowa	\$3,848.4	\$1,355.5	\$1,492.0	\$6,695.9	1.74
Kansas	\$6,053.6	\$3,016.5	\$2,229.6	\$11,299.7	1.87
Kentucky	\$4,254.8	\$2,410.7	\$1,829.5	\$8,494.9	2.00
Louisiana	\$1,996.1	\$1,182.0	\$852.7	\$4,030.7	2.02
Maine	\$3,345.7	\$2,684.7	\$2,106.2	\$8,136.5	2.43
Maryland	\$16,480.7	\$7,054.7	\$8,561.1	\$32,096.5	1.95
Massachusetts	\$35,610.6	\$19,932.7	\$25,540.2	\$81,083.5	2.28
Michigan	\$14,907.3	\$8,046.4	\$6,751.4	\$29,705.0	1.99
Minnesota	\$7,187.3	\$4,565.3	\$5,181.1	\$16,933.7	2.36
Mississippi	\$1,715.6	\$1,067.2	\$539.4	\$3,322.2	1.94
Missouri	\$9,949.7	\$5,911.6	\$5,287.0	\$21,148.3	2.13
Montana	\$589.0	\$288.4	\$252.1	\$1,129.5	1.92
Nebraska	\$3,056.9	\$1,400.7	\$1,234.4	\$5,692.0	1.86
Nevada	\$2,017.7	\$1,395.5	\$931.4	\$4,344.6	2.15
New Hampshire	\$1,851.0	\$901.6	\$979.8	\$3,732.4	2.02
New Jersey	\$51,369.1	\$24,494.9	\$32,414.3	\$108,278.3	2.11
New Mexico	\$1,262.1	\$522.8	\$389.5	\$2,174.4	1.72
New York	\$43,607.9	\$24,358.8	\$18,600.2	\$86,566.9	1.99
North Carolina	\$45,114.5	\$18,667.6	\$14,963.2	\$78,745.4	1.75
North Dakota	\$227.2	\$117.0	\$100.1	\$444.2	1.96
Ohio	\$16,490.1	\$9,876.6	\$8,349.8	\$34,716.5	2.11
Oklahoma	\$2,123.2	\$1,274.8	\$864.5	\$4,262.5	2.01
Oregon	\$2,900.3	\$2,181.5	\$1,629.4	\$6,711.1	2.31
Pennsylvania	\$40,087.9	\$18,697.6	\$23,892.7	\$82,678.2	2.06
Puerto Rico	\$45,081.4	\$5,461.7	\$1,902.4	\$52,445.5	1.16
Rhode Island	\$2,007.6	\$917.5	\$832.4	\$3,757.5	1.87
South Carolina	\$7,135.8	\$3,173.5	\$1,932.7	\$12,242.0	1.72
South Dakota	\$365.1	\$232.8	\$196.3	\$794.2	2.18
Tennessee	\$8,296.9	\$6,367.3	\$4,924.1	\$19,588.3	2.36
Texas	\$36,367.4	\$22,332.1	\$17,841.9	\$76,541.3	2.10
Utah	\$9,765.2	\$6,691.6	\$4,597.4	\$21,054.1	2.16
Vermont	\$850.0	\$474.8	\$369.7	\$1,694.5	1.99
Virginia	\$6,397.1	\$3,936.3	\$3,090.3	\$13,423.6	2.10
Washington	\$8,367.2	\$5,654.8	\$5,196.5	\$19,218.6	2.30
West Virginia	\$4,121.6	\$1,321.8	\$1,035.6	\$6,479.0	1.57
Wisconsin	\$7,576.1	\$3,884.8	\$3,699.8	\$15,160.7	2.00
Wyoming	\$132.9	\$52.2	\$29.1	\$214.2	1.61

Source: TEconomy Partners data, calculations and analysis; IMPLAN U.S. and state models.

Table B3. U.S. and State Occupational Share Estimates, 2020

State	Life, Physical, and Social Science	Production	Management	Office and Administrative Support	Business and Financial Operations	Sales and Related	Architecture and Engineering	Transportation and Material Moving	Computer and Mathematical	Healthcare Practitioners and Technical	Installation Maintenance and Repair	All Other Occupational Categories
U.S. Total (including District of Columbia & Puerto Rico)	15%	14%	14%	10%	9%	8%	7%	7%	6%	3%	3%	3%
Alabama	14%	14%	13%	11%	8%	10%	7%	8%	6%	3%	3%	3%
Alaska	17%	5%	15%	11%	9%	10%	9%	7%	9%	4%	2%	4%
Arizona	10%	15%	12%	13%	8%	14%	4%	12%	4%	4%	3%	3%
Arkansas	9%	11%	12%	14%	8%	16%	4%	13%	4%	5%	2%	3%
California	17%	12%	15%	10%	9%	7%	8%	6%	8%	3%	2%	4%
Colorado	14%	16%	13%	10%	8%	10%	6%	8%	5%	3%	3%	3%
Connecticut	13%	12%	14%	12%	10%	9%	7%	7%	7%	3%	2%	4%
Delaware	12%	6%	17%	14%	14%	6%	7%	4%	10%	3%	2%	5%
District of Columbia	21%	4%	16%	9%	10%	6%	11%	4%	11%	3%	1%	4%
Florida	10%	12%	13%	13%	8%	14%	5%	11%	4%	4%	3%	3%
Georgia	13%	12%	13%	12%	8%	12%	6%	10%	5%	4%	2%	3%
Hawaii	10%	5%	13%	14%	8%	16%	5%	13%	6%	5%	2%	3%
Idaho	18%	9%	15%	10%	9%	8%	9%	6%	8%	3%	2%	4%
Illinois	12%	19%	13%	11%	9%	9%	5%	8%	4%	3%	3%	3%
Indiana	14%	25%	13%	9%	9%	6%	6%	6%	4%	2%	4%	3%
Iowa	14%	21%	13%	9%	8%	8%	6%	7%	5%	2%	3%	3%
Kansas	14%	18%	13%	10%	8%	9%	6%	8%	5%	3%	3%	3%
Kentucky	10%	13%	12%	13%	8%	14%	5%	11%	4%	4%	3%	3%
Louisiana	7%	10%	11%	15%	7%	18%	3%	15%	3%	5%	2%	3%
Maine	15%	18%	14%	10%	8%	8%	7%	7%	5%	3%	3%	3%
Maryland	20%	13%	15%	8%	9%	4%	10%	3%	9%	2%	2%	4%
Massachusetts	21%	6%	16%	9%	10%	4%	11%	3%	11%	3%	2%	4%
Michigan	12%	21%	13%	10%	8%	9%	5%	8%	4%	3%	3%	3%
Minnesota	15%	15%	14%	10%	8%	9%	7%	7%	6%	3%	3%	3%
Mississippi	11%	17%	13%	12%	8%	12%	5%	10%	4%	4%	3%	3%
Missouri	14%	15%	14%	10%	8%	10%	7%	8%	6%	3%	3%	3%
Montana	15%	19%	14%	9%	8%	8%	7%	7%	5%	3%	3%	3%
Nebraska	13%	19%	13%	10%	8%	10%	6%	8%	4%	3%	3%	3%
Nevada	12%	14%	13%	11%	8%	12%	6%	10%	5%	4%	3%	3%
New Hampshire	15%	20%	14%	9%	8%	7%	7%	6%	5%	3%	3%	3%
New Jersey	14%	15%	14%	11%	9%	8%	7%	7%	6%	3%	3%	3%
New Mexico	16%	17%	14%	9%	9%	7%	7%	6%	6%	3%	3%	3%
New York	14%	14%	14%	11%	10%	8%	7%	7%	6%	3%	3%	3%
North Carolina	16%	18%	14%	9%	9%	6%	8%	5%	6%	2%	3%	3%
North Dakota	15%	8%	14%	11%	9%	10%	8%	8%	7%	4%	2%	3%
Ohio	11%	11%	14%	13%	10%	12%	5%	9%	6%	4%	2%	3%

State	Life, Physical, and Social Science	Production	Management	Office and Administrative Support	Business and Financial Operations	Sales and Related	Architecture and Engineering	Transportation and Material Moving	Computer and Mathematical	Healthcare Practitioners and Technical	Installation Maintenance and Repair	All Other Occupational Categories
Oklahoma	11%	13%	13%	12%	8%	14%	5%	11%	5%	4%	3%	3%
Oregon	10%	13%	12%	13%	8%	14%	5%	11%	4%	4%	3%	3%
Pennsylvania	16%	14%	15%	10%	9%	7%	8%	5%	7%	3%	2%	3%
Puerto Rico	13%	27%	13%	9%	8%	8%	5%	7%	3%	2%	4%	2%
Rhode Island	12%	23%	13%	10%	8%	9%	5%	8%	3%	3%	3%	2%
South Carolina	14%	24%	13%	9%	8%	8%	6%	7%	4%	2%	3%	3%
South Dakota	12%	6%	13%	13%	8%	14%	6%	11%	6%	5%	2%	3%
Tennessee	12%	9%	13%	12%	8%	13%	6%	10%	6%	4%	2%	3%
Texas	11%	14%	13%	12%	8%	13%	5%	10%	5%	4%	3%	3%
Utah	15%	18%	14%	10%	8%	8%	7%	7%	5%	3%	3%	3%
Vermont	10%	16%	12%	12%	8%	13%	5%	11%	4%	4%	3%	3%
Virginia	16%	13%	14%	10%	9%	8%	8%	7%	7%	3%	2%	3%
Washington	19%	9%	15%	9%	9%	6%	10%	4%	9%	3%	2%	4%
West Virginia	13%	22%	13%	10%	8%	9%	5%	8%	4%	3%	3%	3%
Wisconsin	16%	17%	14%	9%	9%	7%	7%	6%	6%	3%	3%	3%
Wyoming	10%	17%	12%	12%	8%	13%	4%	11%	3%	4%	3%	3%

Source: U.S. Bureau of Labor Statistics 2020 Occupational Employment Survey data; TEconomy Partners data, calculations, and analysis.

Endnotes

- 1 See Appendix A for a detailed discussion of data sources and methodology.
- 2 It should be noted that pharmaceutical manufacturing, part of the broader chemicals manufacturing sector, drives this biopharmaceutical industry's higher value-added per employee. Overall chemical manufacturing's productivity is \$417,000 per worker, with pharmaceutical manufacturing, by itself, reaching more than \$586,000 per worker.
- 3 Using U.S. Bureau of Labor Statistics 2020 Occupational Employment by Industry data and the individual biopharmaceutical subsector employment totals, weighted shares of U.S. total sector occupational employment are developed for this analysis.
- 4 2019 is the most current year available for the IMPLAN I-O data and models.
- 5 Total U.S. output and value-added as estimated by the 2019 U.S. IMPLAN model. Output does not correspond to U.S. GDP.



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