



PhRMA GOBOLDLY

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

2015 National and State
Estimates

Policy Impact Whitepaper

Prepared by TEconomy Partners, LLC
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and Manufacturers of America**

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Summary

At a time when the economic competitiveness at the national and state level is recognized to be strongly rooted in the capacity to advance innovation-based industries, the U.S.

biopharmaceutical industry stands out as a leading research and development (R&D) and advanced manufacturing industry. 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 life-saving and quality-of-life-improving therapeutics to patients.

The innovation-led biopharmaceutical industry and its closely-integrated supply chain represents a significant geographic footprint across the nation. 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. This examination fully examines the broad value-chain of the biopharmaceutical industry from R&D to clinical testing to manufacturing of biopharmaceuticals to final distribution.

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

- The U.S. biopharmaceutical industry contributes substantially to national, state, and local economies by employing more than 800,000 individuals in 2015. This industry also supports more than 3.9 million additional U.S. jobs through its varied supply base and from the additional economic impacts stemming from industry and worker spending. Altogether, the U.S. biopharmaceutical industry directly and indirectly supports nearly 4.8 million U.S. jobs in 2015, leading to a significant industry employment multiplier of 5.94.
- The overall economic impact of the biopharmaceutical industry on the U.S. economy is substantial. The industry accounted for more than \$1.3 trillion in economic output, representing 4.0 percent of total U.S. output in 2015. This total economic impact includes \$558 billion in revenues from biopharmaceutical businesses and \$659 billion from suppliers and worker spending.
- The overall value added of the U.S. biopharmaceutical industry, or its contribution to U.S. GDP is also substantial as its total value added impacts reach nearly \$700 billion, accounting for 3.7 percent of U.S. GDP.
- In 2015, the direct biopharmaceutical jobs generated \$104 billion in total wages and benefits—averaging \$129,527 per worker. This annual average compensation was more than twice the U.S. private sector average of \$58,688, which is an indication of the high-quality jobs the biopharmaceutical industry provides to U.S. workers.
- More than one-third of the U.S. biopharmaceutical industry's workers are in key science, technology, engineering, and math (STEM) occupations based upon 2015 estimates.

- The biopharmaceutical industry is also an important generator of government tax revenues through the wages and benefits provided to its employees. The analysis shows that the incomes of workers whose employment is supported by the biopharmaceutical industry—directly and through its suppliers or other affected sectors—generated more than \$77 billion in federal, state, and local personal tax revenues in 2015.

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. This report provides estimates for 2015—the most recent year for which full data are available—of the total number of biopharmaceutical industry jobs in the U.S. This size estimation relies primarily on publicly-available data from the U.S. federal government. The report also provides a number of economic impact measures of the U.S. biopharmaceutical industry, including total economic output, wages and benefits, and taxes. Estimates are provided for the U.S., each of the fifty states, the District of Columbia, and Puerto Rico. Estimates include both direct economic impacts of 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 economic activity of its workforce. The economic impact assessment is developed using proprietary models from the IMPLAN.¹

¹ See Appendix B for a detailed discussion of data sources and methodology.

The Broad Scope and Scale of the Biopharmaceutical Industry

The U.S. biopharmaceutical industry maintains a dynamic and integrated structure ranging from R&D to clinical testing to production of goods and services to final distribution. This structure continues to evolve, shaped by technological and scientific advancements and innovations that open up new opportunities.

Defining the Biopharmaceutical Industry

The U.S. biopharmaceutical industry is a diverse collection of establishments that together discover, develop, produce, and distribute prescription medicines. Companies in 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 product approved by the Food and Drug Administration; service companies, such as clinical research organizations that conduct or manage clinical trials; manufacturers that produce medicines under contract for other companies; and wholesalers and distributors specializing in prescription medicines.

A hallmark of the industry is its dynamic nature, both of its constituent companies and of the relationships among them. Just as biopharmaceutical companies collaborate and partner with academic and other public and private institutions to advance the science and develop new treatments, companies also partner with each other in a variety of innovative ways. For example, a larger company may collaborate with a CRO to advance a specific technology or product in development through a clinical trial, or a biopharmaceutical company may license or contract with another company to manufacture or market a medicine. Many biopharmaceutical companies also have corporate venture capital arms that provide early stage funding to a start-up with a promising project.

The core activities that define the biopharmaceutical industry nevertheless remain straightforward—biopharmaceutical R&D, biopharmaceutical manufacturing, and biopharmaceutical distribution—and it is these activities that were used to produce estimates of the size and structure of the U.S. biopharmaceutical industry. The three 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 offices, also captures some standalone corporate headquarters operations not captured in the other sectors. Estimates were developed by carefully identifying the share of each of the sectors attributable to the biopharmaceutical industry. Appendix A provides the specific NAICS codes used to define the industry sector, and describes the data and methods used to produce all the U.S. and state-level estimates included in this report.

The Biopharmaceutical Industry - A Generator of High-Quality Jobs

Direct employment in the biopharmaceutical industry reached 802,867 jobs across the U.S. in 2015 (Table 1). Biopharmaceutical manufacturing accounts for 37 percent of the total employment, with biopharmaceutical R&D of a similar size at 36 percent.

Table 1. U.S. Biopharmaceutical Industry Employment by Subsector, 2015

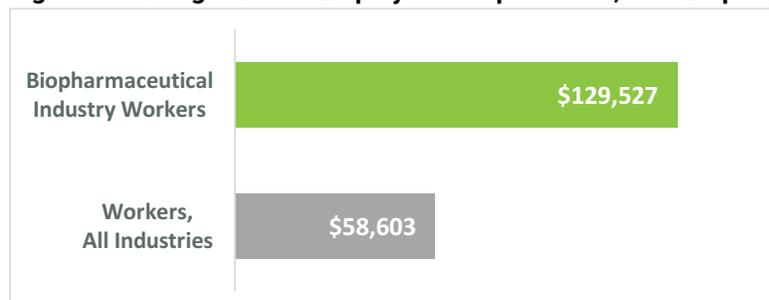
Sector	Estimated Biopharmaceutical Sector Employment	Share of Total Biopharmaceutical Industry Employment
Biopharmaceutical Manufacturing	294,422	36.7%
Biopharmaceutical R&D	287,096	35.8%
Biopharmaceutical Distribution	185,592	23.1%
Biopharmaceutical Corporate Offices	35,757	4.5%
Total	802,867	100.0%

Note: “Subsector” is based on the NAICS category assigned to the 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: 2015 BLS QCEW and CPS Employment Data; TEconomy Partners analysis, calculations, and estimations. Data include the 50 States, the District of Columbia, and Puerto Rico.

The biopharmaceutical industry, whether in its R&D, manufacturing, distribution, or corporate headquarters functions, is a generator of high-quality jobs. For 2015, the more than 800,000 direct biopharmaceutical industry jobs generated \$104 billion in personal income (including both wages and benefits or total compensation)—**averaging \$129,527 in personal income per worker** (Figure 1). This is more than twice the national average of \$58,603, a strong indication of the quality of jobs that the biopharmaceutical industry provides to U.S. workers, and of the high value-added activities within the industry. This biopharmaceutical wage and benefit premium extends across the U.S., with 47 states (including the District of Columbia and Puerto Rico) having an industry wage and benefit premium at least 50 percent higher than the state’s all industries’ average, and for 28 states (including Puerto Rico), this total compensation premium exceeds 75 percent.

Figure 1. Average Annual Employee Compensation, U.S. Biopharmaceutical Industry and All Industries,



2015

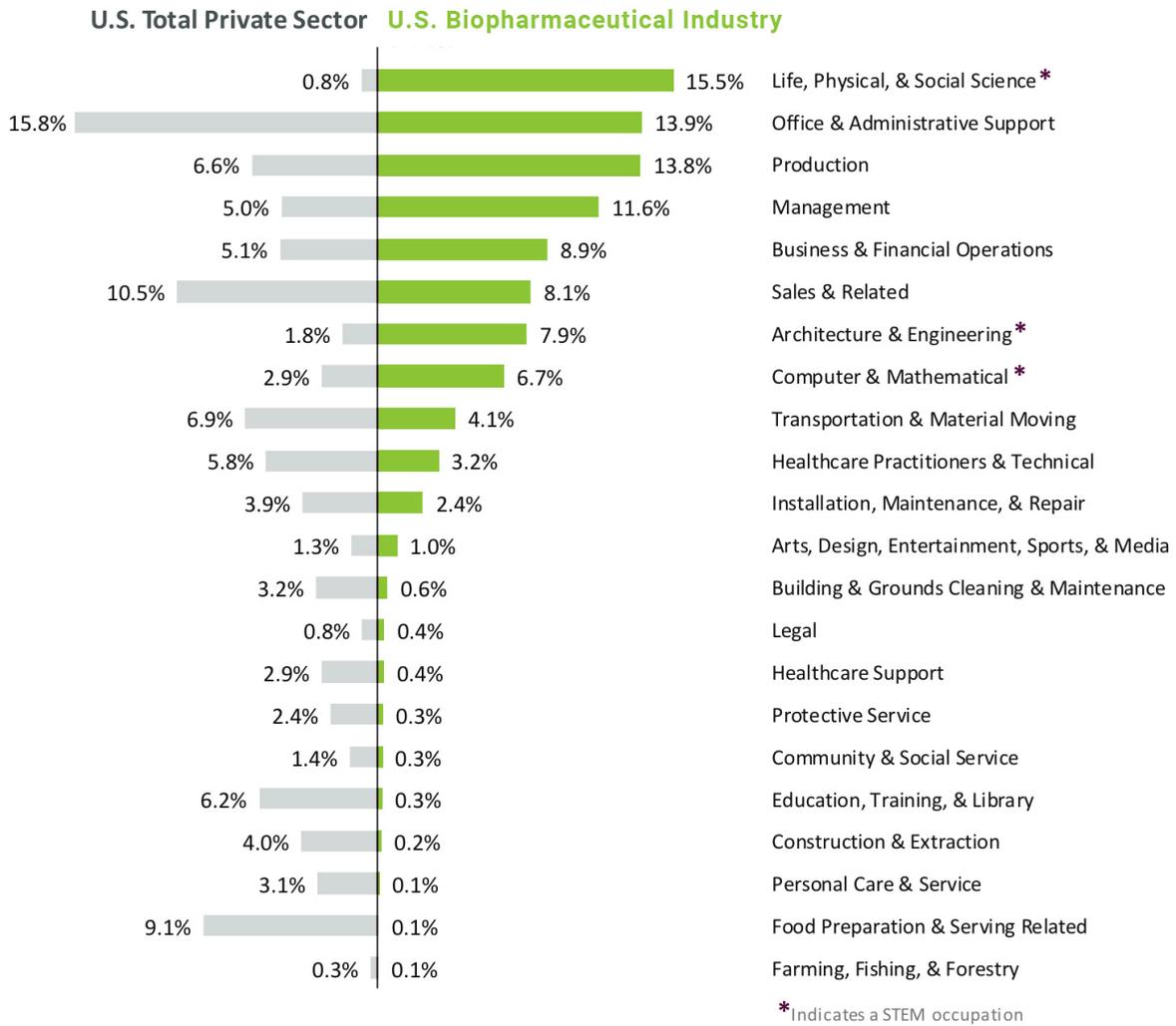
Source: 2015 U.S. IMPLAN Model and TEconomy Partners estimations of Employment and Total Labor Income.

The Biopharmaceutical Industry Demands Highly-Skilled Talent

The 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 college degrees such as advanced manufacturing jobs to blue collar positions such as highly-skilled technicians and other production personnel. Using occupational information for the four subectors, a composite occupational profile was developed for the U.S. biopharmaceutical industry. Figure 2 compares the occupational structure of the U.S. biopharmaceutical industry against the overall U.S. average private sector occupational profile.² Details of key occupational shares, by state, are provided in Appendix B.

Figure 2. Occupational Profiles of the U.S. Biopharmaceutical Industry and Total Private Sector Employment (Percent of Jobs), 2015



Note: Though not completely STEM-related, STEM-related occupations also exist within the Management and Sales & Related broad occupational classifications.

² Using U.S. Bureau of Labor Statistics 2015 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.

Source: U.S. Bureau of Labor Statistics (BLS) Occupational Employment by Industry for the U.S., 2015, and TEconomy Partners estimations.

Within the occupational structure of the biopharmaceutical industry, approximately one out of every six workers (16 percent) are in the life, physical and social science occupations, a significantly higher proportion than overall private sector employment. **In fact, STEM-related occupations account for more than one-third (33 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., Science Managers) and Sales & Related (e.g., Technical/Scientific Sales))—more than five times higher than the All Private Employment share of 5.5 percent. 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 more than 20 percent of the employment. Office and administrative workers spread across the industry account for nearly 14 percent of the workforce. Production occupations, occurring primarily within the biopharmaceutical manufacturing subsector, also account for nearly 14 percent of the biopharmaceutical industry's total employment. Transportation and material moving occupations related to receiving supplier inputs and shipping finished products account for 4 percent of total employment.

From a state industry perspective, life, physical, and social scientists account for at least 15 percent of the biopharmaceutical workforce in 26 states, production workers account for at least 15 percent of the biopharmaceutical workforce in 25 states, and management (administrative and production) accounts for 10 percent or more in every state except Alaska. Details of key occupational shares, by state, are provided in Appendix B.

The U.S. Biopharmaceutical Industry's Economic Impacts Drive National Growth

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

The economic impacts, or more precisely the revenue and expenditure impacts, of the biopharmaceutical industry are typically measured by 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 suppliers to the sector and its personnel. This analysis uses a custom IMPLAN I/O model to quantify 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 biopharmaceutical industry expenditures in the first round of spending), **indirect effects** (the impact of expenditures by suppliers to the biopharmaceutical industry), 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**. In other words, the I/O analysis models the "ripple effect" that originates from direct biopharmaceutical industry expenditures in the economy, flows through industry suppliers as they buy additional inputs, and through workers who spend their wages.

The Economic Impact of the U.S. Biopharmaceutical Industry on the Nation

The overall output impact, typically referred to as the "total economic impact" of the biopharmaceutical industry on the U.S. economy, totalled more than \$1.3 trillion in 2015.³ This total impact includes \$584 billion in direct effects of biopharmaceutical businesses sales and \$735 billion in indirect and induced effects—meaning that every \$1.00 in output generated by the biopharmaceutical industry generated an additional \$1.26 in output in other sectors of the economy (Table 2). This significant output multiplier of 2.26 is due to the high value-added nature of the industry, its extensive supply chain relationships, and the industry's higher wage

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; sometimes referred to as the industry's "Contribution to GDP".

Output: The dollar value of production (i.e., sales).

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

³ 2015 is the most current year available for the IMPLAN I/O tables.

jobs. This total biopharmaceutical industry economic impact represented 4.0 percent of total U.S. output.⁴ The total value added, also considered to be the contribution to U.S. Gross Domestic Product (GDP), of the biopharmaceutical industry reaches nearly \$670 billion and accounts for more than 3.7 percent of U.S. GDP.

Table 2. Economic Impacts of the U.S. Biopharmaceutical Industry, 2015 (\$ in billions)

Impact Type	Employment	Labor Income	Value Added	Output	State/Local Personal Tax Revenue	Federal Personal Tax Revenue
Direct Effect	802,867	\$104.0	\$270.0	\$584.4	\$3.2	\$20.5
Indirect Effect	1,817,358	\$139.0	\$211.6	\$392.1	\$3.9	\$26.4
Induced Effect	2,146,144	\$107.8	\$187.8	\$343.0	\$3.0	\$20.4
Total Impacts	4,766,368	\$350.8	\$669.4	\$1,319.5	\$10.1	\$67.3
<i>Multiplier</i>	<i>5.94</i>	<i>3.37</i>	<i>2.48</i>	<i>2.26</i>		

Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015 U.S. model.

The operations and sales revenue of the biopharmaceutical industry is responsible for supporting more than 4.7 million jobs throughout the U.S. economy. These jobs consist of the nearly 803,000 jobs directly in the industry and nearly 4.0 million indirect and induced jobs in 2015. For every one biopharmaceutical industry job, the industry supports an additional 4.94 jobs, for a total employment multiplier of 5.94. Together, the biopharmaceutical industry and the workforce of its suppliers and other impacted segments of the economy received \$351 billion in wages and benefits in 2015.

The biopharmaceutical industry also is an important generator of federal, state, and local government revenues through the wages and benefits provided to its employees. The impact analysis shows that the incomes of biopharmaceutical industry workers, directly and through the multiplier effect, generated more than \$77 billion in personal tax revenues—more than \$10 billion in state and local personal tax revenue and more than \$67 billion in federal personal tax revenues in 2015.

The Biopharmaceutical Industry Supply Chain and Breadth of Impacts

The multiplier effects of the biopharmaceutical industry (indirect and induced impacts) are of benefit to, and interrelated with, a broad range of U.S. economic sectors. The I/O analysis assesses the impact of the biopharmaceutical industry on every other sector in the economy and provides industry-specific impact estimates for the principal suppliers to the biopharmaceutical industry. Table 3 characterizes the major supply chain inputs (using grouped IMPLAN industry sectors) to the U.S. biopharmaceutical industry as determined by the size of

⁴Total U.S. output and value-added as estimated by the 2015 U.S. IMPLAN model. Output does not correspond to U.S. GDP.

the indirect output effects. For example, the biopharmaceutical industry purchased more than \$114 billion in wholesale and purchased goods inputs (which includes a wide variety of products and services that serve as inputs to biopharmaceutical R&D, production, and distribution). These purchases also generate an indirect employment impact of more than 466,000 jobs. Similarly, the U.S. biopharmaceutical industry purchased nearly \$40 billion in chemical/petrochemical inputs (e.g., raw materials, APIs, etc.).

Table 3. Supply Chain Inputs to the U.S. Biopharmaceutical Industry

Biopharmaceutical Industry Supply Chain Components	Supplier Employment (Indirect)	Supplier Output in \$Millions (Indirect)
Wholesale & Purchased Goods Inputs	466,341	\$114,075
Organic/Inorganic Chemical Inputs	24,452	\$39,984
Legal & Business Services	343,809	\$37,449
Marketing & Communications	113,004	\$34,376
Real Estate Services	94,894	\$19,515
Transportation & Logistics	117,528	\$17,905
Financial Services	70,559	\$17,284
Technical Services & Consulting	101,841	\$13,725
Utilities	11,530	\$12,892
Information Technology	48,361	\$10,438
Packaging	31,661	\$10,406
Production Equipment/Components	34,753	\$7,815
Facility & Operational Services	73,123	\$5,392
Maintenance & Repair Construction	30,831	\$4,891
Intellectual Property Management & Licensing	3,272	\$4,588
Printing	24,102	\$3,968
All Other Suppliers	227,297	\$37,445
Total Indirect (Supply Chain) Impacts	1,817,358	\$392,148

Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015U.S. model.

The Economic Impact of the U.S. Biopharmaceutical Industry on Individual States

As with all industries, the biopharmaceutical industry has certain leading states with significant employment levels (e.g., California and New Jersey). However, the industry is also diverse in 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. Appendix B provides detailed economic impact estimates by state, while broad geographic patterns are described below.

Figure 3 illustrates direct biopharmaceutical industry employment across all 50 states, the District of Columbia, and Puerto Rico. Four states—California, New Jersey, Massachusetts, and New York—each have more than 50,000 biopharmaceutical industry workers. **In total, 22 states, including Puerto Rico, have more than 10,000 biopharmaceutical industry workers**, with eight more states having between 5,000 and 10,000 industry jobs.

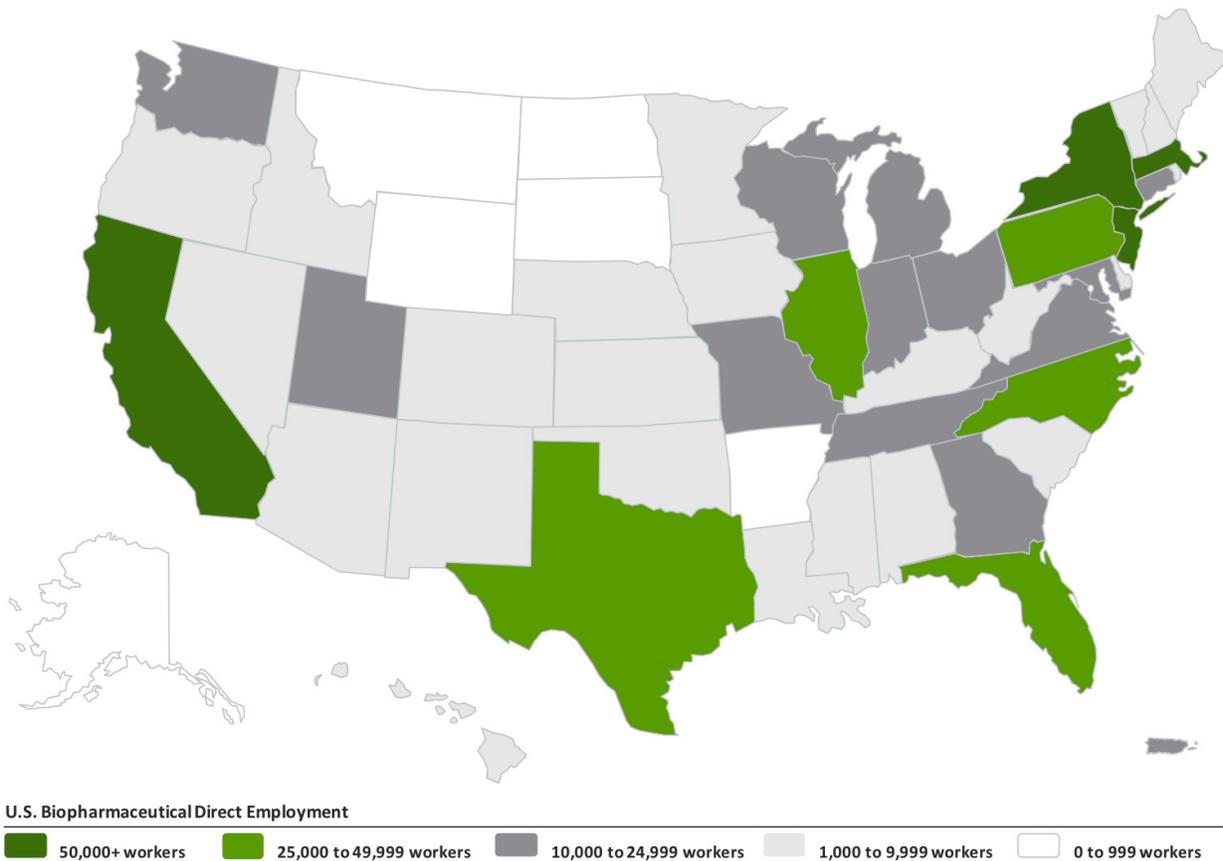
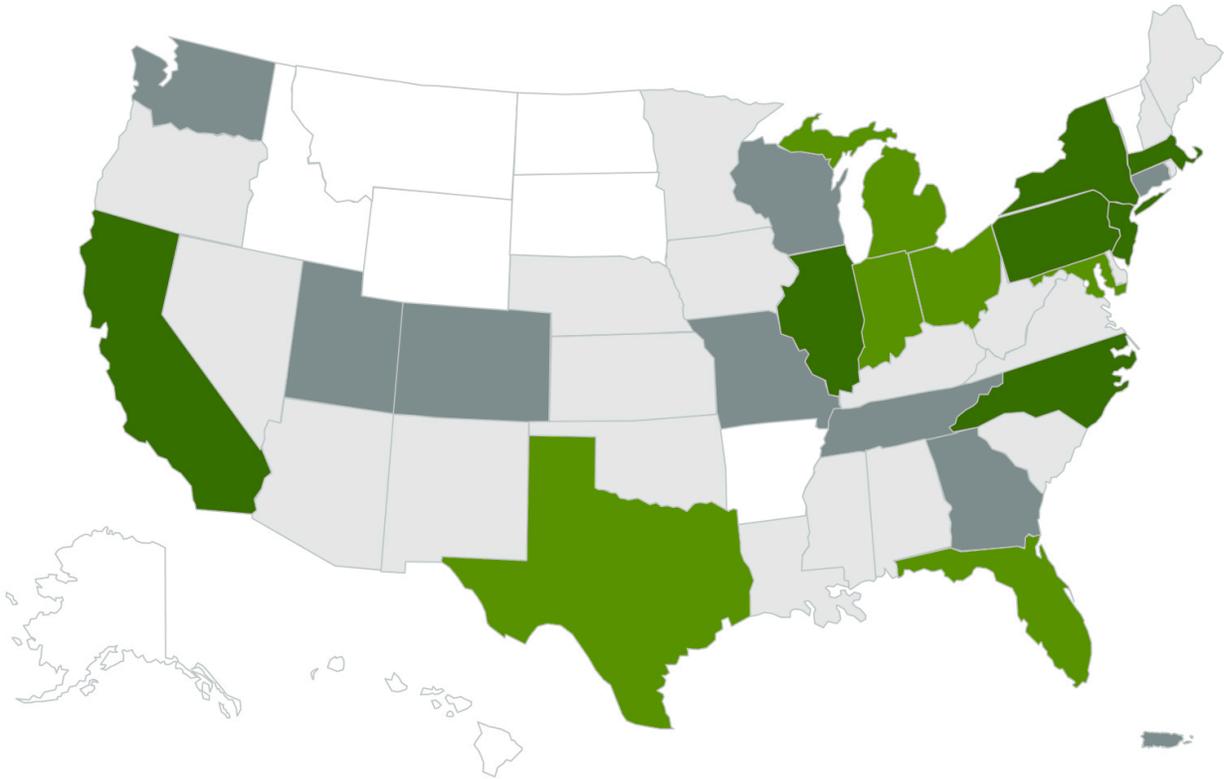


Figure 3. Geographic Distribution of U.S. Biopharmaceutical Industry Direct Employment, 2015

Source: TEconomy Partners data, calculations and analysis.

An examination of the geographic distribution of the biopharmaceutical industry’s total employment impacts shows that the industry has a large-scale, geographically-dispersed, supply chain. For suppliers (indirect employment), there are eleven states where the industry supports at least 50,000 jobs, and another ten states with at least 20,000 supplier jobs. Combining direct, indirect, and induced employment, **the biopharmaceutical industry supports more than 250,000 jobs in six states—California, New Jersey, North Carolina, Illinois, Pennsylvania, and Massachusetts**, supports at least 100,000 jobs in an additional six states, and at least 50,000 jobs in nine additional states. Across the country the biopharmaceutical industry supports more than 20,000 jobs in 33 states.



U.S. Biopharmaceutical Total Employment Impacts

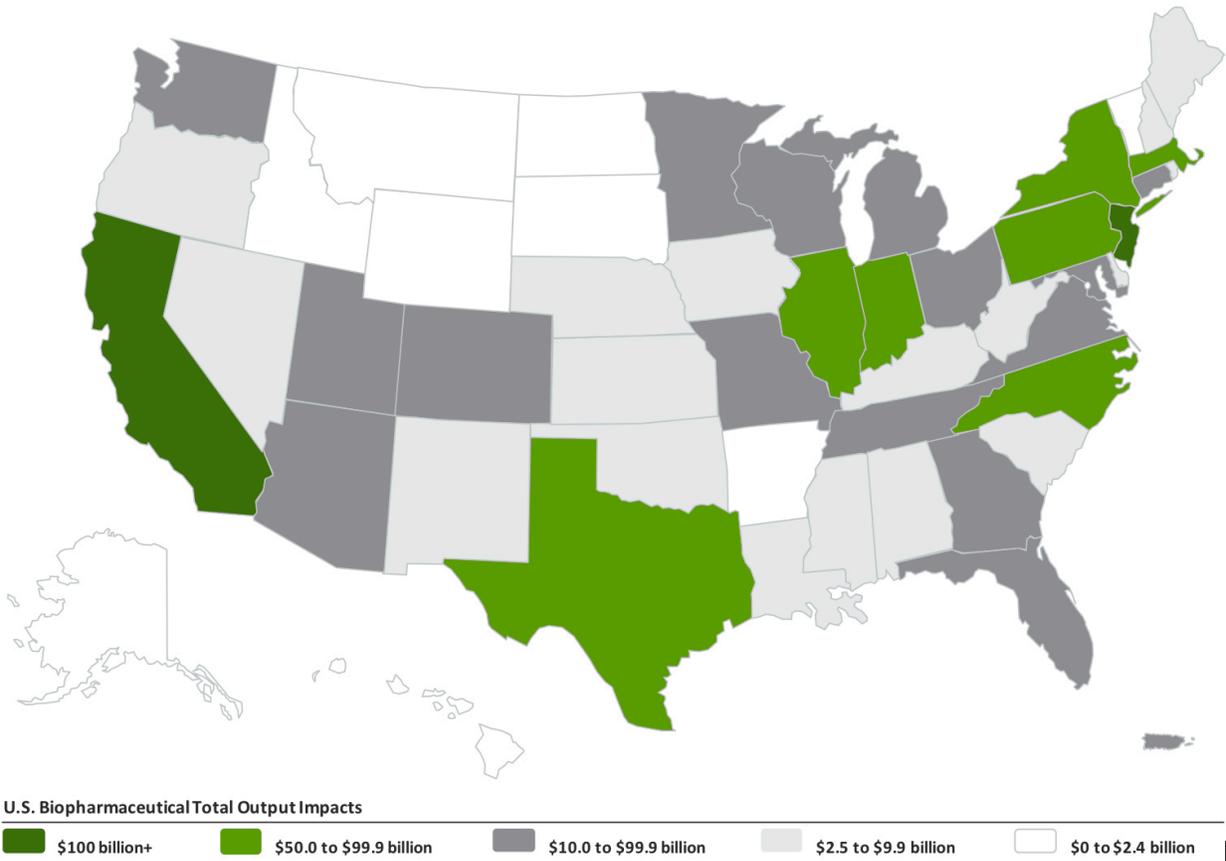


Figure 4. Geographic Distribution of U.S. Biopharmaceutical Industry Total Employment Impacts, 2015

Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015 U.S. model.

The total economic impacts (direct, indirect, and induced output combined) are shown in Figure 5. **Two states, California and New Jersey, exceed \$100 billion in economic impacts stemming from the U.S. biopharmaceutical industry.** A total of nine states have total biopharmaceutical industry impacts of more than \$50 billion, with an additional 16 states reaching impact levels of \$10-49 billion. Fully 44 states, including Puerto Rico, exceed \$1 billion in economic impact.

Figure 5. Geographic Distribution of U.S. Biopharmaceutical Industry Total Economic Impacts, 2015



Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015 U.S. model.

Discussion

The U.S. biopharmaceutical industry is a robust and vibrant component of the nation's economy, with a varied occupational base and extensive supply chain that yields significant impacts. What sustains the success of the biopharmaceutical industry is its broad innovation ecosystem. Led by both small and large innovation-led companies, this innovation ecosystem also draws upon a rich network of collaborators, including but not limited to: venture and other forms of private capital; health care providers; public and private sector researchers, including clinical research organizations, and many other sectors supporting the discovery, development, and delivery of new medicines to patients.

The strength of the U.S. biopharmaceutical innovation ecosystem and innovation-based policies has resulted in the nation being the global leader in biopharmaceutical innovation. This global position in turn has resulted in the U.S. biopharmaceutical industry generating the following economic impacts:

- With more than 800,000 workers and a substantial employment multiplier of 5.94, the U.S. biopharmaceutical industry supported approximately 4.0 million additional U.S. jobs for a total of nearly 4.8 million jobs in 2015.
- With average annual wages and benefits of more than \$129,500—more than twice the U.S. average across all industries—biopharmaceutical industry jobs are both high-wage and high-quality.
- The biopharmaceutical industry exceeded \$580 billion in direct output in 2015, and with the ripple effect of this production throughout the U.S. economy, an additional \$735 billion in output was generated by suppliers and other sectors of the economy.
- Combined, the total output impact of the U.S. biopharmaceutical industry was more than \$1.3 trillion—representing 4.0 percent of the total U.S. (including the District of Columbia and Puerto Rico) output in 2015.

The U.S. biopharmaceutical industry is clearly a major economic driver. However, by the nature of its activities, it is also a truly innovative industry positioned for breakthroughs and enormous societal impact into the future. To realize these future impacts, the U.S. biopharmaceutical industry must be supported by robust innovation policies starting with strong protections of intellectual property, research and development tax incentives, a progressive, national technology transfer mechanism, and a science-based regulatory system to bring new medicines forward.

To continue to sustain and grow this important U.S. industry and ensure its continued contributions to the U.S. economy, a robust policy framework is needed to support the long, costly, and risky investments vital to meeting U.S. patient needs. Fostering an environment that will improve the private sectors' ability to harness research innovations to meet health challenges and continue to create high-wage, high-skill jobs is critical to ensuring that the economic impact of the biopharmaceutical industry continues to be realized at the national and state level. Continued innovation is fundamental to U.S. economic well-being. A long-term commitment to science, technology, and innovation is vital to enabling U.S. biopharmaceutical

companies to improve health outcomes and establish the foundation for economic growth and jobs of the future. The challenges are large, but so too are the opportunities.

Appendix A: Methodology

The following narrative provides an overview of the approach used to develop the 2015 biopharmaceutical industry employment and economic impact estimates at the national and state levels.

Data Sources

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

2015 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 2015. QCEW data is captured at the state-level as part of corporate unemployment insurance data collection efforts 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 offices 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. biopharmaceutical industry employment was 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.

2015 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 to estimate and reflect the inclusion of these self-employed workers.

2012 Economic Census: Some NAICS categories 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 share of biopharmaceutical-relevant economic activity within these NAICS codes.

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 2012. Due to the time requirements to process these substantial data sets, state-level 2012 Economic Census was fully released at the end of 2016. For the 2015 estimates of biopharmaceutical

industry employment in this report, state and U.S. level data from the 2012 Economic Census were used for the product code-level detail necessary to refine the QCEW employment data where necessary. These data for the first time reflected the changes in product-level detail, at the state-level, since the Great Recession in 2009. Hence, for some states significant changes occurred their data.

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.

2015 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 a custom I/O models from IMPLAN Group, LLC. 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 model’s data matrices track the flow of commodities to industries from producers and institutional consumers within the nation. 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.

The Structure of the U.S. Biopharmaceutical Industry

The biopharmaceutical industry’s wide range of activities is spread across numerous NAICS industries within the U.S. economy. For purposes of this analysis, these NAICS categories can be collapsed into four subsectors: biopharmaceutical manufacturing, biopharmaceutical R&D, biopharmaceutical corporate offices, and biopharmaceutical distribution (Table A1).

Table A1. NAICS Structure Relevant to Biopharmaceutical Industry

NAICS Codes Related to Biopharmaceutical Subsectors
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
541711 R&D in biotechnology
541712 R&D in the physical, engineering, and life sciences (except biotech)*
541720 R&D in the social sciences and humanities*
Biopharmaceutical Corporate Offices
551114 Corporate, subsidiary, and regional managing offices*

*Indicate NAICS categories that include both biopharmaceutical and non-biopharmaceutical employment, and which additional refinement is therefore necessary.

Biopharmaceutical Manufacturing

Biopharmaceutical manufacturing was defined to include 100 percent of the employment within NAICS 325411 through 325414. 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, and the vast majority of the manufacturing captured in these codes is related to these activities.

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 improve the biopharmaceutical industry-related estimate from NAICS 4242 (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 distribution) using data from the Economic Census. The size of this non-biopharmaceutical share ranges from less than 1 percent to 80 percent across the states with the U.S. average being 12%. The resulting estimates of biopharmaceutical distribution employment for all of the U.S. represents 88 percent of this NAICS category.

Biopharmaceutical R&D

Biopharmaceutical R&D was defined to include all of one NAICS code and a portion of two others.

NAICS 541711 (R&D in biotechnology) 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.

The share of jobs in NAICS 541712 (R&D in the physical, engineering, and life sciences [except biotechnology]) specific to the biopharmaceutical industry was estimated by applying information derived from Economic Census data for NAICS 541712. Table 2 shows Economic Census data at the NAICS-level data within the broader NAICS 5417 (Scientific R&D services).

Table A2. Overview of NAICS-level detail within Economic Census, Total Establishments, and Receipts, 2012

NAICS Code and Description		Industry Total Estabs., 2012	Industry Total Receipts 2012 (\$1000)
5417	Scientific R&D services	14,125	93,467,639
54171	Physical, engineering, and biological research	13,053	91,509,528
541711	R&D in biotechnology	2,761	16,348,066
541712	R&D in physical, engineering, & life sciences [except biotech]	10,292	75,161,462
54172	R&D in the social sciences and humanities	1,072	1,958,111

Source: U.S. Bureau of the Census, Economic Census 2012

Table 3 shows Economic Census the "product code" structure for NAICS 541712. 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 performed in the

biotechnology product code (39170), the basic and applied research performed in pharmaceutical science product code (39181), and a share of the basic and applied research performed in the medical/health product code (39182). The determination of this combined share of R&D to be considered “biopharmaceutical-related” were also applied to other receipt based product codes (e.g., 39400, licensing of rights to use intellectual property), to capture a portion of these receipts as related to the biopharmaceutical R&D function. This overall value was then used to capture a share of NAICS 54172 to be then applied to the employment basis of this analysis. Though using a financial share to estimate an employment share has limitations, the high-cost nature of biopharmaceutical R&D provide increase the acceptability of this estimation procedure.

Table A3. 2012 Economic Census Key Biopharmaceutical R&D-related Product Codes for NAICS 541712

Key Product Codes and Descriptions (Major and Subcategories)	
30000	Industry total
39020	Testing services (physical/product), excluding medical & veterinary
39170	Basic/applied research in biotechnology
39180	Basic/applied research in the life sciences, excluding biotechnology
39181	<i>Basic/applied research life sciences, excluding biotech - Pharma science</i>
39182	<i>Basic/applied research in the life sciences - Med/health sciences</i>
39183	<i>Basic/applied research in the life sciences - Biological science</i>
39184	<i>Basic/applied research life sciences, excluding biotech - Ag, forestry</i>
39185	<i>Basic/applied research - Animal production, fisheries, & veterinary</i>
39186	<i>Basic/applied research in the life sciences - Other life science</i>
39190	Basic/applied research in the social sciences & humanities
39210	Development services for goods
39220	Development services for processes, systems, or methods
39250	Outright sale of original works of intellectual property
39260	Advisory & consulting services for research & development activities
39280	Engineering services
39400	Licensing of rights to use intellectual property
39600	Resale of merchandise
39700	All other operating receipts

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 2012

A small share of the employment in NAICS 54172 (R&D in the social sciences and humanities) was also included as biopharmaceutical industry employment. For the U.S. overall and for key, large biopharmaceutical states, the 2012 Economic Census include the “biotech R&D” product code within social science industry code NAICS 54172. This added approximately 4,200 biopharmaceutical R&D jobs to the U.S. estimate.

Combining the three components of Scientific R&D services, this procedure estimates that 43 percent of NAICS 5417 Scientific R&D services should be classified as belonging to the biopharmaceutical industry. This percentage captures employment involved in biotechnology activities, pharmaceutical sciences research including CRO activities, and other medical and health related R&D. It should be noted that this share is down from the previous shares developed using the 2007 Economic Census. This change is primarily due to post-recession structural changes in the U.S. economy, but also the likely movement within the biopharmaceutical R&D sector toward biotechnology-oriented research.

Biopharmaceutical Corporate Offices

A meaningful share of biopharmaceutical industry employment, based within headquarters and other administrative or management offices, is not captured by the traditional biopharmaceutical manufacturing, biopharmaceutical R&D, or biopharmaceutical distribution sectors' NAICS codes, and special estimation efforts were required to assess these locations' impacts. With specific corporate examples 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 – Management of companies and enterprises 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 was 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 employment in U.S. establishments that are classified as corporate offices, this approach estimates that 1.6 percent should be considered biopharmaceutical industry employment.

It is important to recognize that these four defined "sectors" are based on establishment-level data 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 were used to adjust the employment estimates to reflect the inclusion of self-employed workers. The CPS provided 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 ranged from 0.2 percent in biopharmaceutical manufacturing to 2.7 percent in biopharmaceutical R&D in 2015. The ratio was then applied to the QCEW-based biopharmaceutical sector employment to arrive at a final biopharmaceutical sector employment estimate. Biopharmaceutical headquarters employment was not adjusted 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 corporate headquarters).

Final Biopharmaceutical Employment Estimates

A summary of the NAICS-based employment for the components of the biopharmaceutical industry, the estimated share of employment within that sector that is attributed to the biopharmaceutical industry, the ultimate employment estimate, and the subsector's share of total biopharmaceutical industry employment are provided in Table A4.

Table A4. Final U.S. Biopharmaceutical Industry Subsector Estimates, 2015

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	294,422	100.0%	294,422	36.7%
Biopharmaceutical Distribution	4242 Drug and druggist sundries wholesale	201,304	89.3%	185,592	23.1%
Biopharmaceutical R&D	5417 Scientific research and development (R&D)	678,516	42.3%	287,096	35.8%
Biopharmaceutical Corporate Offices	5511 Management of companies and enterprises	2,209,841	1.6%	35,757	4.5%
Total U.S. Biopharmaceutical Industry				802,867	100.0%

Source: TEconomy Partners analysis, calculations and estimations using 2015 BLS QCEW and CPS Employment Data. Data includes the 50 States, the District of Columbia, and Puerto Rico.

Differences from Previous Estimates of Direct Biopharmaceutical Employment

The only methodological difference between the current 2015 estimate of employment for this sector and the previous 2014 estimate is the availability and use of the most recent 2012 U.S. Economic Census data for the U.S., and each of the 50 states, the District of Columbia, and Puerto Rico. As discussed, this updated Economic Census data reflected, for the first time in TEconomy's economic analysis of the biopharmaceutical industry, the structural changes occurring within the industry, especially within the biopharmaceutical R&D sector of the industry, stemming from the 2009 Great Recession. Beyond this particular structural change in the employment estimation methodology, all other changes in the data reflect the movement, growth and decline of particular sectors of the U.S. biopharmaceutical industry.

Differences from Previous Estimates of Biopharmaceutical Total Impacts

It was determined that the methodological approach for estimating the total impacts of the U.S. biopharmaceutical industry in the previous (2014 data) version were overly conservative in its adjustments for biopharmaceutical corporate office indirect (and induced) effects. In the previous study, in order to avoid double counting this unique subsector as both a "biopharmaceutical subsector" of its own and as a supplier to biopharmaceutical manufacturing the model was developed so that biopharmaceutical manufacturing would generate no inputs from the IMPLAN headquarters sector. This approach was eliminating the biopharmaceutical

manufacturing sector's ability to buy from any industry sector's headquarters or corporate office context, not just biopharmaceutical corporate office. Additionally, in a state with no direct biopharmaceutical corporate office employment to control for, this overly conservative approach restricted the model from supplying bioharmaceutical manufacturing from headquarters functions from other non-pharmaceutical industries. Due to the importance of this sector, in general and within the IMPLAN models (as this sector is a big supplier industry from an impact modeling perspective to all industries), a new post-processing routine was developed to remove any potential double counting for those states when direct biopharmaceutical corporate office employment is modeled.

Total Economic Impact of the Biopharmaceutical Industry

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 a custom I/O model from IMPLAN. The IMPLAN model's data matrices track the flow of commodities to industries from producers and institutional consumers within the nation. 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.

The biopharmaceutical industry employment estimates described above serve as the inputs to the I/O model. The model's outputs, which are the impacts typically measured in an economic impact study, are the expenditure impacts of the biopharmaceutical industry. They quantify direct and indirect job creation, associated personal incomes, business output, and associated revenues to federal, state and local taxing jurisdictions.

Appendix B: State-Level Estimates

Table B1. U.S. and State Employment: Direct, Indirect, and Induced Effects and Total Impacts, 2015

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
U.S. Total (incl. District of Columbia and Puerto Rico)	802,867	1,817,358	2,146,144	4,766,368	5.94
Alabama	4,185	8,940	7,350	20,476	4.89
Alaska	165	119	141	425	2.58
Arizona	7,961	20,049	20,249	48,259	6.06
Arkansas	753	1,766	1,333	3,852	5.12
California	130,958	339,100	425,755	895,813	6.84
Colorado	8,748	21,746	26,375	56,869	6.50
Connecticut	11,313	19,127	25,763	56,204	4.97
Delaware	9,387	9,281	14,552	33,220	3.54
District of Columbia	644	502	419	1,565	2.43
Florida	26,315	61,779	67,215	155,309	5.90
Georgia	10,661	23,825	27,353	61,839	5.80
Hawaii	1,131	1,345	1,392	3,868	3.42
Idaho	1,552	1,871	2,034	5,457	3.52
Illinois	44,819	116,973	164,207	325,999	7.27
Indiana	23,476	67,157	75,255	165,888	7.07
Iowa	5,525	7,806	10,106	23,436	4.24
Kansas	5,445	14,141	12,587	32,173	5.91
Kentucky	5,718	7,992	8,308	22,018	3.85
Louisiana	3,342	5,171	5,149	13,661	4.09
Maine	4,312	10,114	10,078	24,505	5.68
Maryland	24,644	35,412	51,666	111,722	4.53
Massachusetts	55,704	102,598	147,443	305,745	5.49
Michigan	20,024	50,991	53,990	125,005	6.24
Minnesota	7,588	15,193	20,565	43,346	5.71
Mississippi	1,820	5,217	3,254	10,291	5.65
Missouri	13,554	30,584	34,550	78,688	5.81
Montana	871	1,142	1,137	3,150	3.62
Nebraska	3,246	7,472	7,251	17,969	5.54
Nevada	1,803	4,797	3,735	10,335	5.73
New Hampshire	2,009	4,373	5,068	11,451	5.70
New Jersey	65,199	131,447	179,860	376,507	5.77
New Mexico	3,656	5,164	5,411	14,231	3.89

State	Employment				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
New York	53,552	109,036	108,718	271,306	5.07
North Carolina	44,569	130,520	139,236	314,325	7.05
North Dakota	344	410	376	1,130	3.29
Ohio	22,858	43,661	48,846	115,364	5.05
Oklahoma	2,915	5,108	4,727	12,750	4.37
Oregon	3,869	7,195	7,509	18,574	4.80
Pennsylvania	43,569	104,050	137,654	285,273	6.55
Puerto Rico	17,534	33,152	26,176	76,862	4.38
Rhode Island	1,982	7,158	8,189	17,330	8.74
South Carolina	5,153	13,710	10,661	29,524	5.73
South Dakota	404	379	474	1,257	3.11
Tennessee	11,819	20,509	23,218	55,546	4.70
Texas	37,074	90,696	100,583	228,353	6.16
Utah	11,681	43,053	33,039	87,774	7.51
Vermont	1,366	3,233	2,732	7,331	5.37
Virginia	10,137	17,210	20,148	47,495	4.69
Washington	12,110	18,700	20,326	51,136	4.22
West Virginia	4,100	12,032	9,159	25,291	6.17
Wisconsin	11,011	23,637	24,443	59,091	5.37
Wyoming	292	712	379	1,382	4.73

Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015 models.

Table B2. U.S. and State Output: Direct, Indirect, and Induced Effects and Total Impacts, 2015

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
U.S. Total (incl. District of Columbia and Puerto Rico)	\$584,353	\$392,148	\$342,992.6	\$1,319,493.3	2.26
Alabama	\$2,928.4	\$1,629.0	\$1,068.6	\$5,626.1	1.92
Alaska	\$48.1	\$23.6	\$23.0	\$94.7	1.97
Arizona	\$3,807.5	\$3,707.0	\$3,096.5	\$10,611.0	2.79
Arkansas	\$427.9	\$343.3	\$188.9	\$960.1	2.24
California	\$109,834.5	\$77,868.5	\$73,164.4	\$260,867.3	2.38
Colorado	\$4,823.0	\$4,698.4	\$4,206.1	\$13,727.4	2.85
Connecticut	\$8,266.6	\$4,853.0	\$4,406.6	\$17,526.2	2.12
Delaware	\$2,942.0	\$1,912.9	\$2,317.4	\$7,172.3	2.44
District of Columbia	\$255.7	\$132.1	\$77.8	\$465.6	1.82
Florida	\$12,105.3	\$11,422.6	\$10,159.0	\$33,686.9	2.78
Georgia	\$5,454.8	\$4,756.1	\$4,165.5	\$14,376.4	2.64
Hawaii	\$286.5	\$228.3	\$218.7	\$733.6	2.56
Idaho	\$452.2	\$292.1	\$270.9	\$1,015.3	2.25
Illinois	\$37,938.3	\$27,282.8	\$26,662.0	\$91,883.1	2.42
Indiana	\$40,083.4	\$13,497.5	\$10,892.4	\$64,473.3	1.61
Iowa	\$3,132.2	\$1,503.6	\$1,444.9	\$6,080.7	1.94
Kansas	\$3,170.8	\$2,791.4	\$1,846.7	\$7,808.8	2.46
Kentucky	\$2,372.0	\$1,376.3	\$1,185.3	\$4,933.5	2.08
Louisiana	\$1,407.7	\$927.8	\$730.5	\$3,066.0	2.18
Maine	\$2,251.3	\$1,805.8	\$1,409.5	\$5,466.5	2.43
Maryland	\$12,085.4	\$7,156.1	\$8,273.0	\$27,514.4	2.28
Massachusetts	\$31,584.3	\$23,318.1	\$24,268.8	\$79,171.2	2.51
Michigan	\$13,469.9	\$10,333.7	\$8,008.7	\$31,812.4	2.36
Minnesota	\$3,845.9	\$3,354.3	\$3,333.7	\$10,533.8	2.74
Mississippi	\$1,641.6	\$959.1	\$446.7	\$3,047.4	1.86
Missouri	\$7,956.6	\$6,185.6	\$5,118.8	\$19,260.9	2.42
Montana	\$273.2	\$186.9	\$150.7	\$610.7	2.24
Nebraska	\$2,786.7	\$1,548.4	\$1,056.0	\$5,391.1	1.93
Nevada	\$1,044.1	\$957.6	\$586.1	\$2,587.9	2.48
New Hampshire	\$1,034.8	\$888.7	\$750.4	\$2,674.0	2.58
New Jersey	\$42,898.8	\$31,149.1	\$30,670.0	\$104,717.8	2.44
New Mexico	\$1,381.3	\$868.8	\$766.3	\$3,016.4	2.18
New York	\$38,019.6	\$27,934.6	\$18,877.6	\$84,831.8	2.23
North Carolina	\$45,385.1	\$26,583.4	\$20,633.8	\$92,602.4	2.04
North Dakota	\$159.0	\$79.9	\$57.0	\$295.8	1.86

State	Output (\$ Millions)				
	Direct Effects	Indirect Effects	Induced Effects	Total Impacts	Multiplier
Ohio	\$11,211.1	\$8,529.9	\$7,372.9	\$27,113.9	2.42
Oklahoma	\$1,323.0	\$925.8	\$702.2	\$2,951.0	2.23
Oregon	\$1,663.6	\$1,345.3	\$1,073.0	\$4,081.9	2.45
Pennsylvania	\$33,425.9	\$23,775.7	\$21,627.1	\$78,828.6	2.36
Puerto Rico	\$24,885.5	\$4,039.0	\$2,414.4	\$31,338.9	1.26
Rhode Island	\$1,987.5	\$1,653.7	\$1,281.2	\$4,922.4	2.48
South Carolina	\$3,893.1	\$2,463.5	\$1,509.8	\$7,866.4	2.02
South Dakota	\$104.3	\$64.3	\$69.3	\$237.9	2.28
Tennessee	\$5,257.5	\$3,788.7	\$3,503.4	\$12,549.7	2.39
Texas	\$25,849.2	\$19,530.6	\$16,083.0	\$61,462.8	2.38
Utah	\$8,036.0	\$8,146.5	\$4,883.5	\$21,065.9	2.62
Vermont	\$913.1	\$592.9	\$382.1	\$1,888.0	2.07
Virginia	\$5,156.5	\$3,678.6	\$3,167.7	\$12,002.9	2.33
Washington	\$4,573.2	\$3,955.1	\$3,445.3	\$11,973.6	2.62
West Virginia	\$4,504.2	\$2,220.7	\$1,238.2	\$7,963.2	1.77
Wisconsin	\$5,715.4	\$4,739.6	\$3,651.9	\$14,106.9	2.47
Wyoming	\$299.6	\$141.5	\$55.5	\$496.6	1.66

Source: TEconomy Partners data, calculations and analysis; IMPLAN 2015 models.

Table B3. U.S. and State Occupational Share Estimates, 2015

State	Life, Physical, and Social Science	Architecture and Engineering	Computer and Mathematical	Management	Business and Financial Operations	Office and Administrative Support	Production	Sales and Related Support	Transportation and Material Moving	All Other Occupational Categories
U.S. Total (incl. District of Columbia and Puerto Rico)	16%	8%	7%	12%	9%	14%	14%	8%	4%	9%
Alabama	11%	5%	4%	10%	8%	16%	16%	14%	6%	10%
Alaska	3%	1%	3%	8%	7%	23%	6%	26%	11%	11%
Arizona	11%	5%	5%	10%	8%	17%	11%	15%	7%	10%
Arkansas	18%	9%	7%	12%	9%	12%	15%	6%	3%	9%
California	17%	8%	7%	12%	9%	13%	14%	7%	4%	9%
Colorado	14%	7%	6%	11%	8%	15%	14%	12%	5%	10%
Connecticut	13%	6%	6%	13%	11%	15%	16%	7%	4%	9%
Delaware	12%	7%	10%	15%	14%	19%	4%	6%	3%	10%
District of Columbia	18%	10%	8%	11%	9%	14%	8%	8%	4%	10%
Florida	10%	5%	5%	10%	7%	19%	9%	18%	7%	10%
Georgia	13%	6%	5%	10%	8%	16%	12%	13%	6%	10%
Hawaii	14%	8%	7%	10%	8%	17%	5%	14%	6%	10%
Idaho	9%	4%	4%	10%	7%	19%	12%	18%	8%	10%
Illinois	12%	6%	6%	12%	10%	15%	16%	9%	5%	9%
Indiana	16%	7%	5%	12%	9%	11%	25%	4%	3%	8%
Iowa	16%	8%	6%	12%	8%	12%	20%	6%	4%	9%
Kansas	19%	10%	7%	12%	9%	11%	16%	4%	3%	9%
Kentucky	11%	5%	5%	10%	8%	18%	11%	16%	7%	10%
Louisiana	9%	5%	5%	10%	7%	19%	8%	19%	8%	10%
Maine	17%	8%	6%	11%	8%	13%	16%	7%	4%	9%
Maryland	21%	11%	9%	12%	9%	11%	11%	4%	2%	9%
Massachusetts	22%	12%	10%	12%	10%	11%	8%	4%	2%	9%
Michigan	13%	6%	6%	12%	9%	15%	16%	9%	5%	9%
Minnesota	14%	7%	5%	11%	8%	14%	16%	10%	5%	9%
Mississippi	13%	6%	4%	11%	8%	14%	20%	10%	5%	9%
Missouri	16%	8%	6%	11%	8%	13%	14%	8%	4%	9%
Montana	17%	8%	6%	11%	8%	13%	16%	7%	4%	9%
Nebraska	15%	7%	6%	11%	8%	13%	19%	8%	4%	9%
Nevada	16%	8%	6%	11%	8%	13%	16%	8%	4%	9%
New Hampshire	16%	8%	6%	12%	8%	12%	21%	6%	4%	9%
New Jersey	15%	8%	7%	12%	10%	15%	13%	8%	4%	9%
New Mexico	23%	13%	10%	12%	9%	11%	7%	4%	2%	10%

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

Source: U.S. Bureau of Labor Statistics 2015 Occupational Employment Survey data; TEconomy Partners data, calculations and analysis.