

## APPENDIX I: METHODOLOGY

This report presents an analysis of the impact of the biopharmaceutical sector on the U.S. economy. The geographies examined as part of this report include the U.S., each of the 50 states, Washington, D.C., Puerto Rico, and 20 MSAs (Table 9). The analysis reflects the economic activity associated with biopharmaceutical companies in 1996 and 2006, using inflation-adjusted 2006 dollar amounts for monetary assessments. The analytics performed in this report attempt to quantify the absolute impact of the biopharmaceutical sector on the economy, rather than its marginal impact. An absolute approach considers all economic activity (direct, indirect, and induced) that is attributable to the sector's presence; by contrast, a marginal approach acknowledges that a certain portion of this economic activity would still exist in the absence the sector, and thus only measures the additional economic activity that is unique to the sector's presence in a given area. The absolute impact is a measure of the economic loss that would occur if the sector were to disappear and were not to be replaced by another sector, while the marginal impact is a measure of the economic loss that would result if the sector were to disappear but were to have its labor and capital redeployed to other sectors. 2006 was the most recent year for which complete data sets were available for most of the economic impact analyses, at the time analyses were performed. Totals may not be equal to sum of individual components due to rounding.

To quantify the sector's impact on the U.S. economy, this study measured common economic indicators, including employment, contribution to GDP, and output. Employment is defined as the number of jobs supported by the sector. Contribution to GDP is the value of sales generated by the sector less the value of the raw materials used, representing the sector's net effect on the nation's economy. In contrast to contribution to GDP, output is the value of all sales generated by companies in the sector. In addition, this report identified ongoing research and development (R&D) investments in the sector, an important driver of the sector's overall economic impact.

**Table 9: 20 Metropolitan Statistical Areas Studied**

Atlanta-Sandy Springs-Marietta, GA	Minneapolis-St. Paul-Bloomington, MN-WI
Baltimore-Towson, MD	New York-Northern New Jersey-Long Island, NY-NJ-PA
Boston-Cambridge-Quincy, MA-NH	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Chicago-Naperville-Joliet, IL-IN-WI	Portland-Vancouver-Beaverton, OR-WA
Denver-Aurora and Boulder, CO	Raleigh-Cary, NC
Detroit-Warren-Livonia, MI	San Diego-Carlsbad-San Marcos, CA
Houston-Baytown-Sugar Land, TX	San Francisco-Oakland-Fremont, CA
Kansas City, MO-KS	San Jose-Sunnyvale-Santa Clara, CA
Los Angeles-Long Beach-Santa Ana, CA	Seattle-Tacoma-Bellevue, WA
Miami-Fort Lauderdale-Miami Beach, FL	Washington-Arlington-Alexandria, DC-VA-MD-WV

For the purposes of this study, the biopharmaceutical sector is composed of an extensive and diverse collection of companies that research and manufacture medications, from small start-up firms to large and well-established organizations. Companies in this sector focus on the discovery, development, testing, and manufacturing of new biopharmaceutical products, and belong to one of the following sub-sectors: medicinal botanical manufacturing, pharmaceutical preparation manufacturing, in-vitro diagnostic substance manufacturing, biological product manufacturing, life sciences research, or biotechnology research. This report defines the biopharmaceutical sector and its sub-sectors using the North American Industry Classification System (NAICS). The sector includes the research and manufacturing companies associated with the NAICS codes in Table 10 below. For this study, this sector’s definition includes only private companies and excludes government agencies (e.g., National Institutes of Health). While this definition includes manufacturers of both brand and generic drugs, the vast majority of the sector’s economic activity is believed to be related to the discovery, development, and manufacturing of brand medicines. Analyses may exclude some biopharmaceutical activity to the extent that companies report economic data (e.g., employment and wages) to data providers, such as U.S. Census Bureau and Bureau of Labor Statistics, under alternative industry classification codes.

**Table 10: Biopharmaceutical Sector Definition**

NAICS Code	NAICS Definition	
3254: Pharmaceutical and Medicine Manufacturing	325411	Medicinal and Botanical Manufacturing
	325412	Pharmaceutical Preparation Manufacturing
	325413	In-Vitro Diagnostic Substance Manufacturing
	325414	Biological Product (except Diagnostic) Manufacturing
5417: Scientific Research and Development Services	541711	R&D in Biotechnology
	541712	R&D in Physical, Engineering, & Life Sciences (except Biotechnology)

**Multiplier Effect Analysis for Employment, Contribution to GDP, and Output**

Considering only the direct employment, contribution to GDP, and output of the biopharmaceutical sector understates its importance to national, state, and local economies. To fully capture the sector’s value in economic terms, this report provides an analysis of how the sector interacts with other components of national and state economies, specifically in terms of how this interaction generates impact in other sectors. To account for this interaction, this report also includes the indirect and induced effects of

the biopharmaceutical sector in its estimates of total economic impact. Indirect effects are those impacts associated with products and services required to support the direct impact of the biopharmaceutical sector. Induced effects are those impacts that are associated with products and services purchased with wages earned by direct and indirect sector participants. Therefore, indirect and induced should be accounted for when quantifying the absolute impact of the biopharmaceutical sector.

Consider an example of a biopharmaceutical company operating in the state of Utah with 300 full-time employees including scientists who are hired to conduct research, business and financial professionals who work on financing, and administrative personnel who support daily operations. To assert that the biopharmaceutical company only supported 300 total jobs to the state economy may not be entirely accurate, as the company supports other jobs providing services to support the firm, its operations, and its employees. For example, these jobs include employment at accounting and law firms that are engaged by the biopharmaceutical company for various tax and legal services, and employment at janitorial services companies that are engaged by the biopharmaceutical company for daily upkeep and maintenance services. Furthermore, the combined presence of direct employees of the biopharmaceutical company and the indirect employees of the tax, law, and janitorial firms (required to support the biopharmaceutical company) has effectively generated spending power (in the form of employee compensation) that will flow into the local economy. As these individuals become consumers of everyday goods and services such as groceries, dry cleaning, and real estate, their spending stimulates the local economy by creating demand for these products, and, thereby, supporting jobs in their respective sector.

To quantify the indirect and induced economic impact for the biopharmaceutical sector, this report applied the “multiplier effect” concept, which is widely used for economic analyses such as this one. The U.S. Bureau of Economic Analysis (BEA), which itself provides tools to conduct multiplier effect analyses on the impacts of various economic projects, states that “analysis of economic impacts must account for the inter-industry relationships within regions because these relationships largely determine how regional economies are likely to respond to project and program changes.”<sup>1</sup> The BEA also states that multipliers are an effective means to “account for inter-industry relationships within regions” and are “useful tools for conducting regional economic impact analysis.”<sup>2</sup> Multiplier effect analysis has been used to assess the significance of an industry to the national economy, or to the economies of states and other localities. Recent examples include the West Virginia University College of Business and Economics report on the impact of the bioscience industry on the state economy<sup>3</sup> and the Sage Policy Group’s similar report on bioscience in the state of Maryland.<sup>4</sup>

The multiplier effect methodology translates a sector’s direct employment, contribution to GDP, and output into indirect and induced metrics. At its core, multiplier analyses reflect the fact that a sector’s relationship with the local economy is such that the presence of one direct sector job, one dollar of sector contribution to GDP, or one dollar of sector output has a multiplicative effect that supports jobs, dollars of contribution to GDP, and dollars of output in dependent sectors.

For this report, employment, output, and contribution to GDP data were obtained from the Minnesota IMPLAN Group (MIG) along with software (IMPLAN®) to implement this economic analysis for the U.S., each of the 50 states, Washington, D.C., Puerto Rico, and the 20 MSAs. Since MIG supplied the data in predefined proprietary sectors, corrections were applied to the acquired data sets to isolate activity associated with the biopharmaceutical sector, as defined for this report. Therefore, if a biopharmaceutical company produced an array of consumer products in addition to producing prescription medicines, this report attempted to exclude the activities related to these consumer products for this company in the analyses. To perform these corrections, two samples of 100 companies each were identified (one sample for 1996 and another one for 2006) to represent the MIG-predefined proprietary sectors containing data on the biopharmaceutical sector. Both samples were drawn randomly from a population of firms identified in the U.S. Securities and Exchange Commission (SEC) Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system using the standard industrial classification system. The SEC 10-K filing for each sample company was examined to identify sales associated with biopharmaceutical-related activities (as defined for this report) and total sales for the respective year. Then, an overall fraction of sales for biopharmaceutical-related activities was derived for each sample. These fractions were applied to the MIG data to estimate biopharmaceutical output for each year. With these “corrected” output figures for the biopharmaceutical sector, IMPLAN was used to calculate direct, indirect, and induced employment, contribution to GDP, and output for 1996 and 2006.

Another correction was then performed to address the risk of overestimating the total impact of the biopharmaceutical sector on employment, contribution to GDP, and output that may occur when sector companies buy goods and services from each other. With guidance from MIG, correction factors for indirect and induced employment, contribution to GDP, and output were derived by adjusting the production function relationship of the sector as defined in this report in the IMPLAN software at the national level. All state- and MSA-level estimates were scaled proportionally using these correction factors, resulting in more conservative estimates for indirect and induced employment, output, and contribution to GDP.

Monetary-based results (e.g., contribution to GDP and output) derived for 1996 were inflated to 2006 dollars using the Producer Price Index (PPI). The PPI program releases indexes that are specific to certain NAICS industries. The index for sector 3254 was used to adjust all biopharmaceutical-related dollar amounts, while the index for “all commodities” was used to inflate non-biopharmaceutical figures used as a basis for comparison. Therefore, all growth rates for monetary values were calculated in real terms, using 2006 dollars. For Puerto Rico, only 1992 MIG data was available. Therefore, the 1992 monetary results for Puerto Rico were inflated to 2006 dollars to estimate 2006 results (without real growth). Similarly, employment estimates for Puerto Rico were inflated from 1992 to 2006 using publically available employment growth rates (see section below on employment growth rates for additional details).

For the purpose of this analysis, “rest of economy” is defined as all sectors combined less the biopharmaceutical sector. Therefore, in this report, the average of the rest of the economy for any given measure refers to the weighted average value for the rest of the economy. The number of direct jobs serves as a proxy for the number of direct employees.

As a point of reference regarding the data used for this report, for 2006, 504 sectors were identified, including biopharmaceuticals, resulting in total U.S. employment of 174.7 million, GDP of \$13.2 trillion, and output of \$24.8 trillion. Data for Washington, D.C. is included in these figures but data for Puerto Rico is not included. Therefore, all represented U.S. totals based on IMPLAN data (e.g., biopharmaceutical employment, contribution to GDP, and output) include Washington, D.C. but not Puerto Rico.

Several predefined IMPLAN sectors were not considered sectors of interest for this report since they represented financial adjustments to complete the data set, as opposed to being representative of a particular industry. As a result, when applicable, values associated with these sectors were allocated proportionally to the defined 504 sectors based on the relative weight of each for the relevant measurement. These financial adjustments, such as “owner occupied dwellings” (estimates what owner/occupants would pay in rent if they rented rather than owned their homes), were not allocated to the direct biopharmaceutical estimates of contribution to GDP and output to provide conservative estimates of the impact by the sector. However, these financial adjustments were allocated back to the other sectors and, therefore, may have affected the indirect and induced estimates for contribution to GDP and output for the biopharmaceutical sector.

Each geography studied in this report (i.e., the U.S. as a whole, each of the 50 states, Washington, D.C., Puerto Rico, and the 20 MSAs) was analyzed independently, identifying each geographical location as an independent system. For each economic impact analysis, no attempt was made to measure impacts outside the system. Therefore, cross-border interactions (i.e., country to country, state to state, and MSA to MSA) were not measured. However, when examining the U.S. as a whole, cross-border interactions between states were taken into account since the interactions took place within the system (defined as the U.S. as a whole), yielding numerical results for the U.S. as a whole that were higher than the sum of the individual states and Washington, D.C. (Puerto Rico is not included in the U.S. totals) for employment, contribution to GDP, and output. The difference for each of these three measures is the estimated cross-border biopharmaceutical activity, or the indirect or induced activity resulting in one geographical location from the presence of the biopharmaceutical sector located in different geographical locations (e.g., a biopharmaceutical company located in California engaging the services of an accounting firm located in New York).

The cross-border biopharmaceutical activity for both output and employment were estimated for each state, approximating how much indirect and induced output and employment in a given state were due to biopharmaceutical activity in the other states. For each of these two metrics, the total indirect and induced cross-border biopharmaceutical activity was identified for each sector, and these totals were allocated to the fifty states and Washington, D.C. based on the proportion of in-state activity in these geographical locations for each sector.

The cross-border biopharmaceutical activity for both output and employment were not estimated for each of the 20 MSAs studied. Since this report did not analyze all the MSAs, the method used for the allocation of cross-border biopharmaceutical activity, as used with allocations to the states, could not be performed since the combined geography of the 20 MSAs studied did not correspond to the entire U.S. as a whole.

The averages calculated for per employee estimates (e.g., direct contribution per direct employee and taxes paid per direct employee) are weighted averages, using employment as the basis for the weighting. The averages calculated for per sector estimates (e.g., direct employees per sector and direct output per sector) are arithmetic averages.

### **Other Employment Related Analyses**

Methodologies used for other employment related analyses are described below:

#### ***Employment Growth Rates for Biopharmaceutical Sector and Rest of Economy, 1996 – 2006***

To compute compound annual employment growth in the biopharmaceutical sector and in the rest of the economy from 1996 to 2006, employment estimates for both years were obtained from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW). The QCEW program publishes estimates of employment and wages for all states and MSAs to the 6-digit NAICS level.

For biopharmaceutical employment in each geographical location studied, employment estimates for NAICS codes 54171 and 3254 were obtained for the year 1996 and 2006, and compound annual growth rates were computed accordingly. For employment growth in the rest of the economy, QCEW employment figures were obtained for all industries and compound annual growth rates were computed once the biopharmaceutical employment totals were removed from each year.

For the U.S. as a whole, employment growth rates (both biopharmaceutical employment and employment in the rest of the economy) were calculated using 1996 and 2006 employment estimates from both MIG and QCEW. The MIG estimates were similar to the results collected from the BLS data and were used instead of the BLS data to be consistent with the results of the multiplier effect analysis (i.e., direct, indirect, and induced employment, contribution to GDP, and output).

In instances when information for one of the two biopharmaceutical NAICS codes was not available, MIG wage and employment data were used to estimate the missing information (by assuming that the relationship between the size of the two sub-industries observed in the MIG data is similar to that in the BLS data). In the case of Puerto Rico, for which 1992 MIG data was the most recent available source of employment data, the employment growth rate from the BLS data was applied to the 1992 MIG employment data to estimate 2006 employment.

Biopharmaceutical employment growth was calculated for 18 MSAs, but was not calculated for Philadelphia-Camden-Wilmington and Seattle-Tacoma-Bellevue, as BLS did not disclose the data necessary for calculating these data points for these MSAs.

#### ***Biopharmaceutical Sector Occupational Profiles***

The occupational profile which shows percentage breakdown of employment by job type of biopharmaceutical employment in the U.S. was based on analysis of BLS Occupational

Employment Statistics (OES) data. The OES program publishes national employment estimates by Standard Occupation Code (SOC) across all industries and also for specific industries to the 5-digit NAICS code level. SOC codes follow a hierarchical structure whereby the first 2 digits refer to the general occupation class (e.g., “management occupations”), while the last 4 digits specify the particular job type within the greater category.

SOC employment estimates were obtained for NAICS industries 3254 and 54171. The number of employees listed in each 2-digit SOC code was summed, and a share was calculated for each SOC code as a percentage of total employment across all SOC codes for both industries combined.

While the OES program releases SOC data by industry (NAICS) for the U.S. as a whole, it does not provide similar data at the state level. Various state-specific biopharmaceutical occupational profiles were gathered by contacting the respective labor office listed by the OES program as a state point-of-contact. Depending on the state, a varying level of industry detail (i.e., NAICS digit) was available, and data presented to the 4-digit NAICS level at minimum was analyzed in similar fashion to the U.S. biopharmaceutical occupational profile.

Due to the modest size of certain industries in a given state, states occasionally withhold employment figures for a particular NAICS code to prevent identification of particular companies in the area. In cases where SOC data was not disclosed for one of the two NAICS codes in a given state, occupational profiles were estimated based on the relevant biopharmaceutical NAICS data available. For example, if data for 3254 was not disclosed, 5417 data was analyzed and used as a proxy for the biopharmaceutical occupational profile.

Occupational profile data and direct employment data were obtained from different sources; relationship is assumed to be directionally accurate.

### ***Biopharmaceutical Employment Supported Per 10,000 Jobs***

To analyze the domestic geographical dispersion of biopharmaceutical employment, the effects of population sizes were removed by examining employment on a per 10,000 job basis. “10,000 jobs” was selected as the basis, or denominator, for this analysis to yield results that were easily interpretable in terms of decimals (i.e., a per-job basis would have yielded results that require many decimal places to observe significant digits).

Biopharmaceutical employment supported per 10,000 jobs was obtained by comparing MIG-derived estimates of state-level direct biopharmaceutical employment to MIG-derived employment figures for all sectors in the economy in each location.

### ***Biopharmaceutical Wages***

The wages earned by biopharmaceutical employees were computed based on 2006 BLS QCEW data. For each study location, QCEW total wages and total employment

data were obtained from BLS for NAICS codes 3254 and 54171 (to represent the biopharmaceutical sector) and for all sectors. Average wages per employee was defined as total wages divided by total employment. The biopharmaceutical average wage shown was derived as the weighted average of NAICS codes 3254 and 54171, weighed by MIG employment data (with the exception of Puerto Rico, which was weighted by BLS employment data since the MIG sectors defining biopharmaceuticals for this location were different than the other geographies studied). The wage data collected from NAICS codes 3254 and 54171 were assumed to be representative of the salaries earned for the firms associated with these sectors, and, therefore, no corrections were assumed necessary to derive biopharmaceutical wages associated with these sectors. The average wage for the rest of the economy was derived by removing biopharmaceuticals from both total wages and total employees prior to calculation.

In instances when information for one of the two biopharmaceutical NAICS codes was not available, MIG wage and employment data were used to estimate the missing information (assumed respective BLS data is proportional to MIG data).

Reported U.S. total and average wage estimates include the 50 states and Washington, D.C. but not Puerto Rico.

### ***Biopharmaceutical State, Federal, and Social Security Personal Income Tax Contributions***

The state, federal, and Social Security income taxes paid by biopharmaceutical employees were computed based on 2006 BLS QCEW average wage data, the National Bureau of Economic Research (NBER) TAXSIM 8.0 simulator, and MIG employment data.

For each study location, QCEW average wage data was computed from BLS employment and wages data for NAICS codes 3254 and 54171 to represent the biopharmaceutical sector, and for all sectors (see “Biopharmaceutical Wages” for more information on methodology). State and federal tax liability, including Social Security, for 2006 was computed for each biopharmaceutical NAICS code and for the rest of the economy (defined as all sectors less biopharmaceutical NAICS codes) based on the average wage for each biopharmaceutical NAICS code and for the rest of the economy and the following tax assumptions for household characteristics: married, joint-filing status, one dependent under the age of 17, and \$4,000 in annual contribution to retirement account.

Once average employee state and federal tax (including Social Security) liabilities were calculated for each biopharmaceutical NAICS code and for the rest of the economy in all states or MSA, the average tax liabilities were multiplied by the corresponding number of employees in each corresponding MIG sector for that state or MSA. Note that the average wage of the rest of the economy includes contributions of NAICS codes 3254 and 54171 not associated with biopharmaceuticals (54171 code was used as a proxy for the parent NAICS code 5417). In calculating the average state tax per employee, states that do not collect state taxes were omitted in the calculation.

For MSAs that span multiple states, state taxes were estimated by calculating the average of the average state taxes paid by biopharmaceutical workers in each state

comprising the MSA, weighted by the number of direct biopharmaceutical jobs in the MSA within those states.

Biopharmaceutical tax contributions were not calculated for Philadelphia-Camden-Wilmington and Seattle-Tacoma-Bellevue, as BLS did not disclose the data necessary for calculating these data points for these MSAs.

For Puerto Rico, local taxes for 2006 were derived using the Puerto Rico Departamento de Hacienda 2006 short individual income tax return form, and Social Security taxes were based on the standard Social Security tax rate for the year 2006. Taxpayer profile assumptions were similar to those used for tax data derived for other geographies.

The averages calculated for per employee estimates (e.g., direct contribution per direct employee, taxes paid per direct employee) are weighted averages, using employment for the basis of the weighting. The averages calculated for per sector estimates (e.g., direct output per sector) are arithmetic averages.

Reported U.S. total and average tax estimates include the 50 states and Washington, D.C. but not Puerto Rico.

Due to methodology selected and general assumptions used to estimate taxes paid, total U.S. taxes paid derived from estimates identified in this report may not be equivalent to actual taxes collected.

## **Research and Development**

Methodologies used for other research and development related analyses are described below:

### ***Annual Drug Approvals***

To determine the number of new drug approvals by the U.S. Food and Drug Administration (FDA), data was collected from the FDA Center for Drug Evaluation and Research (CDER) and the FDA Center for Biologics Evaluation and Research (CBER). CDER's Drugs@FDA data files were queried to identify the medicines that gained approval between 1996 and 2006 and that were classified as either New Molecular Entities (NME) or Biopharmaceuticals. Other approvals, such as new formulations, new combinations, and new indications, were not included. Approval data available on CBER's website were evaluated to identify biologics for which the Biological License Application (BLA) or biologic New Drug Application (NDA) gained approval between 1996 and 2006. Approvals obtained from CBER that were classified as any of the following were then removed from the analysis: source plasmas for further manufacture, assays, screening tests, solutions, human blood and blood components for transfusions, and shared manufacturing arrangements. The remaining CBER approvals were then added to the annual CDER approval totals to complete the data set.

### ***Compounds in Development***

To determine the number of compounds in development, data from Wolters Kluwer's Adis R&D Insight database were examined. The data included a numeric identifier for each compound, and this identifier was assumed to be unique to each compound. Therefore, to determine whether a compound was "new in development" or "already in development," a list of compounds in development was generated for every two years between 1997 and 2007. Each list was compared to those of previous years (up to 1997). A compound "new in development" is defined as a compound that appeared on a list but did not appear on lists for prior years, while a compound that is "already in development" is defined as a compound that has also appeared on a list for prior years. Note that 1997 is the initial year of study for this analysis as older data was not available. Hence, lists were not compared to data prior to 1997 to determine whether a compound had any development activity prior to 1997, and therefore some compounds identified as "new in development" may in fact be categorized as "already in development." 1997 also is not included in Figure 13 for this reason.

### ***Active Clinical Trials***

To determine clinical trial activity, data was downloaded from clinicaltrials.gov in September 2008 for analysis, resulting in a database supplied by The Lewin Group. A clinical trial is a scientific study, examining the clinical benefits and risks of a compound to be used for medicinal purposes. A trial can be for a compound in development seeking FDA approval or for a compound already approved by the FDA.

The clinical trial analysis examined active trials targeting nine condition categories: heart disease, behavioral and mental disorders, cancers and other neoplasms, rare diseases, respiratory tract diseases, diabetes, HIV/AIDS, Alzheimer's disease, and Parkinson's disease. To assign clinical trials to these nine condition categories, The Lewin Group first relied upon the categories provided by clinicaltrials.gov<sup>5</sup> and supplemented these category definitions with guidance from a pharmacist on staff at PhRMA. Additionally, because clinicaltrials.gov does not provide a complete list of condition names for each category, The Lewin Group supplemented the clinicaltrials.gov categorization whenever possible. For example, the "cancers and other neoplasms" category did not include all types of cancers, such as breast cancer and lung cancer. To address this issue, any time "cancer" was included in a condition name, The Lewin Group assigned the clinical trial targeting that condition to the "cancer and other neoplasms" category.

Due to the large number of condition names and the slight variations in how the names are reported in the clinicaltrials.gov data, every trial was not assigned to a condition grouping. The counts of trials by condition grouping for these nine condition categories may therefore be understated.

When a clinical trial targets more than one condition, The Lewin Group counted the trial once for each of the conditions it targets. For example, a trial of treatments for both breast cancer and diabetes would be counted once in the "cancers and other neoplasms" category and once in the "diabetes" category. The U.S. total includes

unique counts of clinical trials by condition category, counting a clinical trial only once if it is conducted in multiple states. Data for Washington, D.C. and Puerto Rico is included in the U.S. total.

### ***Venture Capital Investments***

To determine venture capital activity, data was downloaded from PricewaterhouseCoopers' Money Tree database for analysis. Data was analyzed for the category "biotechnology," and, therefore, some data may be for sectors beyond biopharmaceuticals, such as agriculture, but still rely on biotechnology as the core technology platform. Monetary based results for years prior to 2006 were inflated to 2006 dollars using the "all commodities" PPI.

Reported U.S. totals include data for the 50 states, Washington, D.C., and Puerto Rico.

### ***Biopharmaceutical R&D Investments***

To determine 2006 R&D spending by the biopharmaceutical sector, U.S. national data was sourced from PhRMA and Burrill & Company in PhRMA 2008 Pharmaceutical Industry Profile. Upon consultation with Burrill (conversation with Peter Winter in December 2008), a correction factor of 80% was applied to the PhRMA and Burrill figures to remove international R&D expenditures from the total. To determine state-by-state allocations of this R&D expenditure total, data was obtained from the National Science Foundation (NSF) 2006 survey of industrial R&D. Estimates of each state's industrial R&D expenditure by 4-digit NAICS code were analyzed for NAICS codes 3254 and 5417, and the state's relative percent contribution to total 3254 and 5417 expenditures was applied to the U.S. total derived by the PhRMA and Burrill figure. Due to NSF non-disclosure of 3254 and 5417 expenditure estimates for certain states, the sum of all states' 3254 and 5417 R&D investment did not add up to the U.S. total. This difference was allocated back to non-disclosed states based on BLS estimates of employment for each of the NAICS in the given state. The national total figures from the PhRMA and Burrill figure were used instead of NSF data due to the underestimation of industry R&D expenditures in NSF's methodology, as identified by F. M. Scherer.<sup>6</sup>

### ***National Institutes of Health***

To determine the value of National Institutes of Health grant funding in 1996 and 2006, data from the NIH database of awards by state and foreign site was analyzed. 1996 dollar values were adjusted to 2006 real dollars using the "all commodities" PPI. To determine the number of NIH grants awarded, data from the NIH database of awards by state and congressional district were used. Because the state and congressional award database does not provide data prior to 1998, dollars per grant figures were calculated for the years 1998 and 2006. All NIH data (both grant value and number of grants) included award data for Washington, D.C., Guam, Virgin Islands, and Puerto Rico.

### ***Capital Projects***

Expenditures on capital projects in biopharmaceutical-related fields were obtained from the NSF Survey of Science and Engineering Research Facilities. The survey is a biennial project conducted by the NSF to gain insight into the creation and renovation of science and engineering infrastructure at academic and biomedical institutions. Expenditures on new and renovated facilities were grouped into projects started in fiscal years 2004-2005 and those planned for 2006-2007, and figures are presented in nominal terms. The sum of state totals does not match the reported value for the U.S., because the U.S. total was weighted and imputed by the NSF to determine a national estimate, while the state values were not weighted or imputed. All capital projects data include Washington, D.C., Guam, Virgin Islands, and Puerto Rico.

### ***Other Analyses***

Methodologies used for other analyses are described below:

#### ***Distribution of Shareholder Ownership Type***

To identify the distribution of shareholder ownership type, a biopharmaceutical electronic traded fund was used for the basis of sampling to represent the sector. All 30 companies contained in the Invesco PowerShares Dynamic Pharmaceuticals (PJP) portfolio were examined, including Abbott Laboratories, Allergan Inc., Amgen Inc., Biogen Idec Inc., Bristol-Myers Squibb Co., Celgene Corp. Cephalon Inc., Chattem Inc., Endo Pharmaceutical Holdings Inc., Forest Laboratories Inc., Genzyme Corp., Gilead Sciences Inc., Johnson & Johnson, King Pharmaceuticals Inc., Eli Lilly & Co., Medicines Co., Medicis Pharmaceutical Corp., Merck & Co. Inc., Par Pharmaceutical Cos. Inc., Perrigo Co., Pfizer Inc., Prestige Brands Holdings Inc., Questcor Pharmaceuticals Inc., Schering-Plough Corp., Sepracor Inc., Valeant Pharmaceuticals International, VIVUS Inc., Warner-Chilcott Ltd., Watson Pharmaceuticals Inc., and Wyeth. Using Factset's LionShares database, data as of December 2008 was collected on the number of shares outstanding and by type of institution, as defined by Factset. Long-term investors were defined by the LionShares sub-sectors: "mutual fund manager," "insurance division management," and "pension fund."

#### ***Sector Allocation by Pension Funds***

To identify the sector allocation by pension funds, a sample of 10 pension funds were examined, including California Public Employees Retirement System, State Teacher Retirement System of Ohio, APG Investments, Dupont Capital Management Corp, IBM Retirement Plan, Kentucky Teacher's Retirement System, Verizon Pension Fund, BP Investment Management Ltd, General Motors Investment Management Corp., and Industriens Pension. Using Factset's LionShares database, data as of September 2008 was collected on the value of investments made by the sector. Based on market value, the sector allocations were identified, using predefined Factset definitions. Biopharmaceuticals was defined by LionShares sub-sectors: "pharmaceutical: major," "pharmaceutical: generic," "pharmaceutical: other," and "biotechnology."

## Endnotes – Appendix I: Methodology

<sup>1</sup> U. S. Department of Commerce (U.S. Bureau of Economic Analysis). (2008). Regional Multipliers from the Regional Input-Output Modeling System (RIMS II): A Brief Description. Available at: <http://www.bea.gov/regional/rims/brfdesc.cfm> (Accessed: October, 2008). Washington, D.C.: BEA.

<sup>2</sup> Ibid.

<sup>3</sup> A.C. Gregory and T. S. Witt. (2008). An Economic Profile of the Biosciences Industry in West Virginia. Available at: <http://www.be.wvu.edu/bber/pdfs/BBER-2008-01.pdf> Morgantown, WV: West Virginia University Research Corporation.

<sup>4</sup> Sage Policy Group, Inc. (2007). Maryland: The Nation's Bioscience Leader. Available at: <http://www.comp.state.md.us/publications/nr/current/bioscienceSummit.pdf> (Accessed October, 2008). Maryland: Office of the Comptroller.

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