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The Ohio Bioscience Industry

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Prepared for:

BioOHIO

Prepared by:

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February 2010

**THE OHIO
BIOSCIENCE
INDUSTRY**

**Center for
Economic
Development**

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EXECUTIVE SUMMARY

This report summarizes findings from research on the bioscience sector in Ohio and each of the state's six regions. It describes trends in the bioscience sector and each of its six subsectors (listed alphabetically): Agricultural Biotechnology, Medical Device & Equipment Manufacturers, Medical Laboratories & Diagnostic Imaging Centers, Pharmaceuticals & Therapeutics, Research & Development, and Testing Laboratories. Trends are analyzed between the years 2000 and 2008 with more detail provided for the post-2004 period. Trends in the bioscience sector are analyzed using four measures: employment, payroll, average wages, and number of establishments.

In addition to industry trends, the study also estimates the economic impact of the commercial bioscience sector in 2008. Economic impact of the bioscience sector and each of its six subsectors is measured for Ohio and each of the six regions. Economic impact is measured in terms of employment, output, value added, labor income, and taxes.

TRENDS IN BIOSCIENCE IN OHIO

Total employment in Ohio's bioscience sector in 2008 was 55,465. Employment increased continuously since 2000. Since the year 2000, the bioscience sector in Ohio added over 8,400 jobs, a 17.9% increase. Bioscience employment grew by 2.8% between 2007 and 2008, adding 1,520 jobs. Moreover, the growth in the bioscience sector occurred while the overall economy declined.

The bioscience sector in Ohio had a payroll totaling \$3.9 billion in 2008, an increase of \$895 million or nearly 30% since 2000 (measured in 2008 dollars). Bioscience payroll grew by \$109.8 million (2.9%) from 2007 to 2008. There were 1,628 bioscience establishments in Ohio in 2008, a number that grew by 400 since the year 2000.

Bioscience sector jobs paid an average wage of \$70,232 in 2008 for all bioscience industries and all occupations, not just for scientists and top managers. The average wage in the bioscience sector rose from \$63,755 in 2000, after adjustment for inflation.

As a result of growing bioscience employment and declining total employment, the share of bioscience employment in Ohio increased from 0.9% in 2000 to 1.1% in 2008. While the bioscience sector is still a relatively small employer in Ohio, its share of state employment (1.1%) is higher than the sector's share of national employment (0.9%). In terms of payroll, the bioscience share increased from 1.4% in 2000 to 1.8% in 2008; the share of bioscience payroll in total payroll nationally was only 1.6%. Moreover, the share of Ohio's bioscience in the national bioscience sector also rose over this period.

The bioscience sector consists of six subsectors. The Medical Device & Equipment Manufacturers subsector accounted for 31% (17,180 employees) of total bioscience employment in 2008, followed by Pharmaceuticals & Therapeutics (17%; 9,447 employees) and Agricultural Biotechnology (17%; 9,415 employees). The three subsectors that gained the most in employment from 2000 to 2008 were Pharmaceuticals & Therapeutics, Medical Laboratories & Diagnostic Imaging Centers, and Research & Development. These three subsectors combined accounted for 95% of new bioscience jobs gained between 2000 and 2008.

The Medical Device & Equipment Manufacturers sector also had the largest payroll (\$1.1 billion) in 2008. The Agricultural Biotechnology and Pharmaceuticals & Therapeutics sectors followed with \$797 million and \$761 million payrolls, respectively. Payrolls increased for all sectors from 2000 to 2008. From 2007 to 2008, the largest increase in payroll was in the Medical Device & Equipment Manufacturers sector.

The Research & Development subsector paid the highest average wage (\$87,051) in 2008. Agricultural Biotechnology and Pharmaceuticals & Therapeutics also had high average wages of over \$80,000. The Medical Device & Equipment Manufacturers subsector, the subsector with the largest number of employees, paid a lower average wage of \$65,312; this wage, however, is still considerably higher than the average wage in Ohio when all industries are taken into account (\$41,513).

Nearly 55% of all bioscience establishments are in two subsectors—Medical Laboratories & Diagnostic Imaging Centers (565) and Medical Device & Equipment Manufacturers (325). The number of establishments increased in all subsectors between 2000 and 2008, except in Testing Laboratories.

BIOSCIENCE IN OHIO'S SIX REGIONS

Bioscience employment was highest in the Northeast and Central regions of Ohio which, when combined, accounted for 61% of bioscience employment in Ohio in 2008. The Southeast region (mostly Appalachian region) had the lowest bioscience employment with 3% of the total. All regions experienced employment growth from 2000 to 2008 and five of the six continued to grow during the last year with only the Northeast Ohio region remaining flat. Bioscience employment in the Central region added the most jobs and grew at the fastest rate (44%) during the entire study period. Between 2007 and 2008, the Southeast region grew at the fastest rate among all regions.

The Northeast region also led the state in annual payroll (\$1.3 billion) followed by the Central region (\$1.1 billion) and the Southwest region (\$0.94 billion). Since 2000, the Central region's payroll has grown at the very high rate of 63%, more than twice the rate of the bioscience sector in Ohio.

The average wage in bioscience in 2008 was highest in the Southwest region (nearly \$82,000) followed by the Central (\$73,700) and Northeast regions (\$67,400). From 2000 to 2008, the average wage grew in all regions, with the Northwest and Southeast regions growing at the fastest rates.

The Northeast region led the state in number of bioscience establishments with 39.5% of all bioscience establishments. The Central and Southwest regions followed with about 16% of bioscience establishments each. Since 2000, all regions have grown in the total number of bioscience establishments.

This report describes the important bioscience subsectors in each region. Medical Device & Equipment Manufacturers, the largest sector in Ohio in terms of employment and payroll, is the largest sector in both the Northeast and Southwest Ohio regions. The largest subsector in employment and payroll in Central Ohio is Pharmaceuticals & Therapeutics although it is the second-largest subsector in terms of employment and the third-largest in terms of payroll statewide. The Research & Development subsector, which ranked fourth in the state in both employment and payroll, was ranked second in the Central region and third in Southwest Ohio; it was the smallest subsector in Northeast Ohio.

ECONOMIC IMPACT OF THE BIOSCIENCE SECTOR

The total economic impact including direct, indirect and induced impacts of the bioscience sector in Ohio in 2008 was:

- Employment impact 162,859 jobs
- Output impact \$46.7 billion
- Value-added impact \$15.2 billion
- Labor income impact \$9.5 billion
- Tax revenues \$3.4 billion

The Agricultural Biotechnology subsector, which consists of 10 manufacturing industries, had the most impact in terms of all five measures of impact, followed by Medical Device & Equipment Manufacturers and Pharmaceuticals & Therapeutics.

Analysis by region shows that bioscience in Northeast Ohio has the highest economic impact, followed by the Central and Southwest regions. Again these rankings hold when impact is estimated using the five different measures. In Northeast Ohio, the Agricultural Biotechnology subsector has the highest impact followed by Medical Device & Diagnostic Imaging. In the Southwest region, the Agricultural Biotechnology subsector also has the highest impact, but the second-highest impact is attributed to Pharmaceuticals & Therapeutics. In contrast to the two largest regions as defined by size, the Pharmaceuticals & Therapeutics subsector has the highest impact in the Central region and is followed by Agricultural Biotechnology.

INTRODUCTION

This report summarizes findings from research on the bioscience sector in Ohio and the state's six regions. The study was conducted by the Center for Economic Development at Cleveland State University for BioOhio, an advocacy and economic development group for bioscience in Ohio. BioOhio's mission is "to accelerate bioscience discovery, innovation, and commercialization of global value, driving economic growth and improved quality of life in Ohio."¹ This research is in support of the *Ohio Bioscience Growth Report*, released annually by BioOhio.

The report describes trends in the bioscience sector and each of its six subsectors: Agricultural Biotechnology, Medical Device & Equipment Manufacturers, Medical Laboratories & Diagnostic Imaging Centers, Pharmaceuticals & Therapeutics, Research & Development, and Testing Laboratories. Trends are analyzed for the years 2000 to 2008 with more detailed information on the post-2004 period in order to document growth during the recovery from the recession of the early 2000s. This research captures only the beginning of the current recession and it excludes the deepest months of the recession. Trends in the bioscience sector are analyzed using four measures: employment, payroll, average wages, and number of establishments.

In addition to the industry trends, the study also estimates the economic impact of the bioscience sector in 2008. Economic impact is measured in terms of employment, output, value added, labor income and taxes. The economic impact of bioscience and each of its six subsectors is measured for Ohio and each of the six regions.

This report consists of six parts. The first part includes the executive summary and this introduction. The second part includes a methodology section that defines the six Ohio regions by county and the six bioscience subsectors by industry. It also explains how a database of bioscience companies in Ohio was created and the methodology underlying the trend and the impact analyses. The third part analyzes trends in the bioscience sector in Ohio from 2000 to 2008 and shows the share of bioscience in the total economy; it also analyzes trends in each of the bioscience subsectors. The fourth part analyzes trends in the bioscience sector in each of Ohio's six regions. The fifth part is focused on the economic impact analysis. In addition to analyzing the impact of the whole bioscience sector on Ohio, it analyzes the impact of each bioscience subsector on each region. The report ends with concluding comments.

¹ <http://bioohio.com/about/> as of February 24, 2010

METHODOLOGY

THE SIX OHIO REGIONS

This study analyzes the bioscience industry in Ohio and its six regions. The regions were defined for the Entrepreneurial Signature Program of the Ohio Department of Development. The Southwest region includes the greater Cincinnati area and consists of seven counties: Brown, Butler, Clermont, Clinton, Hamilton, Highland, and Warren. It includes the five Ohio counties in the Cincinnati-Middletown Metropolitan Statistical Area (MSA) and two non-metro counties.

The Northeast region includes 21 counties in the Greater Cleveland area: Ashland, Ashtabula, Carroll, Columbiana, Crawford, Cuyahoga, Erie, Geauga, Holmes, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Tuscarawas and Wayne. It includes six metropolitan areas: Cleveland-Elyria-Mentor MSA, Akron MSA, Youngstown-Warren-Boardman MSA (Ohio counties only), Canton-Massillon MSA, Mansfield MSA, and Sandusky MSA. Eight additional counties that are not part of the metropolitan areas are also included.

The Central region centers on Columbus and is comprised of 15 counties: Delaware, Fairfield, Fayette, Franklin, Hocking, Knox, Licking, Logan, Madison, Marion, Morrow, Perry, Pickaway, Ross, and Union. This region includes the entire Columbus MSA and seven non-metro counties.

The Northwest region is home to the cities of Toledo, Bowling Green, Findlay, and Lima. It contains 18 counties: Allen, Auglaize, Defiance, Fulton, Hancock, Hardin, Henry, Lucas, Mercer, Ottawa, Paulding, Putnam, Sandusky, Seneca, Van Wert, Williams, Wood, and Wyandot. The two MSAs in this region are Toledo and Lima and 13 counties are not part of the metropolitan areas.

The West Central region includes the cities of Dayton, Springfield, Troy, and Xenia. It encompasses eight counties: Champaign, Clark, Darke, Greene, Miami, Montgomery, Preble, and Shelby. This region includes the Dayton MSA, the Springfield MSA, and three non-metro counties.

The Southeast region includes the cities of Marietta, Athens, Portsmouth, and Zanesville. It contains 19 counties: Adams, Athens, Belmont, Coshocton, Gallia, Guernsey, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Pike, Scioto, Vinton, and Washington. This region contains one Ohio county of the Weirton-Steubenville MSA, as well as one Ohio county in each of the three West Virginia MSAs: Wheeling, Huntington-Ashland, and Parkersburg-Marietta-Vienna. The majority of counties in this region are non-metro counties.

Figure 1: Map of BioOhio Regions



CREATING THE BIOSCIENCE DATA SET

The study analyzes trends and economic impact of the bioscience sector in Ohio and its six regions. The study describes the bioscience sector in Ohio using the industry definition adopted by BioOhio in their two previous BioOhio Growth Reports.² Since combinations of industries are involved in the bioscience and healthcare continuum, BioOhio adopted the bioscience definition established in “Technology, Talent and Capital: State Bioscience Initiatives, 2008,” Which was prepared for the Biotechnology Industry Organization (BIO) by Battelle Technology Partnership Practice and SSTI. This definition includes six subsectors which are outlined in detail in Table 1: Pharmaceuticals & Therapeutics, Agricultural Biotechnology, Medical Device & Equipment Manufacturers, Testing Laboratories, Research & Development and Medical Laboratories & Diagnostic Imaging Centers.³

² *Ohio Bioscience Growth Report*, December 2007 and *BioOhio and Ohio Bioscience Growth Report 2007-08*, BioOhio

³ Previous BioOhio Growth Reports also included a “miscellaneous” category with NAICS codes that were used to include ten or fewer specific companies; this category is excluded from this report.

Table 1: NAICS Codes Associated with each Subsector of the Bioscience Industry

| Pharmaceuticals & Therapeutics | |
|--|--|
| 325411 | Medicinal and Botanical Manufacturing |
| 325412 | Pharmaceutical Preparation Manufacturing |
| 325413 | In-Vitro Diagnostic Substance Manufacturing |
| 325414 | Biological Product (except Diagnostic) Manufacturing |
| Agricultural Biotechnology | |
| 311221 | Wet Corn Milling |
| 311222 | Soybean Processing |
| 311223 | Other Oilseed Processing |
| 325193 | Ethyl Alcohol Manufacturing |
| 325199 | All Other Basic Organic Chemical Manufacturing |
| 325221 | Cellulosic Organic Fiber Manufacturing |
| 325311 | Nitrogenous Fertilizer Manufacturing |
| 325312 | Phosphatic Fertilizer Manufacturing |
| 325314 | Fertilizer (Mixing Only) Manufacturing |
| 325320 | Pesticide and Other Agricultural Chemical Manufacturing |
| Medical Device & Equipment Manufacturers | |
| 333314 | Optical instrument & lens manufacturing |
| 334510 | Electromedical and Electrotherapeutic Apparatus Manufacturing |
| 334516 | Analytical Laboratory Instrument Manufacturing |
| 334517 | Irradiation Apparatus Manufacturing |
| 339111 * | Medical Equipment and Supplies Manufacturing |
| 339112 | Surgical and Medical Instrument Manufacturing |
| 339113 | Surgical Appliance and Supplies Manufacturing |
| 339114 | Dental Equipment and Supplies Manufacturing |
| 339115 | Ophthalmic Goods Manufacturing |
| Research & Development ** | |
| 541711 | Research and Development in Biotechnology |
| 541712 *** | Research & Development in the Physical, Engineering, & Life Sciences |
| Testing Laboratories | |
| 339116 | Dental Laboratories |
| 541380 **** | Testing Laboratories |
| Medical Laboratories & Diagnostic Imaging Centers | |
| 621511 | Medical Laboratories |
| 621512 | Diagnostic Imaging Centers |

* 339111 is a 2002 NAICS Code and the code does not exist in the 2007 NAICS structure.

** In the original study, a portion of the 5-digit NAICS Code 54171 was used to classify the industries in "Research and Development in the Physical, Engineering, and Life Sciences" which are bioscience companies. For the purposes of this study, the entire 6-digit code 541711 "Research and Development in Biotechnology" was included as well as a portion of 541712 that captures the Life Sciences in "Research and Development in the Physical, Engineering, and Life Sciences."

*** The NAICS code 541712 "Research & Development in the Physical, Engineering, & Life Sciences" uses the following ratios to capture the life sciences: Establishments share = 39.7%; Employment & Wages share = 13.9%. The Center examined firms in this NAICS code with over 50 employees to determine if they are working in the biosciences.

**** The NAICS code 541380 "Testing Laboratories" uses the following ratios to capture testing laboratories associated with bioscience: Establishments share = 8.38%; Employment & Wages share = 3.99%. The Center examined firms in this NAICS code with over 50 employees to determine if they are working in the biosciences.

To conduct the trend analysis and estimate the economic impact of the bioscience sector in Ohio, a data set of bioscience companies in Ohio was created using two sources: the Quarterly Census of Employment and Wages (QCEW) database and a comprehensive list received from BioOhio.

The QCEW (also known as the ES202 data) is managed, maintained, and edited by the Center for Economic Development at Cleveland State University's Levin College of Urban Affairs. The QCEW data has confidentiality restrictions that protect companies' information. The QCEW includes information on most companies with paid employees (by site location) in Ohio with information on company name, address, city, county, industry classification codes (NAICS), employment, and wages. It includes data from 2000 through 2008. Company data from the QCEW database is aggregated by industry and region.

The list received from BioOhio in June 2009 included 1,752 establishments that BioOhio identified as participating in the bioscience industry in Ohio.

The data set for bioscience in Ohio used in this study was assembled through the following steps:

- Included all companies in the QCEW that have a BIO-centric NAICS code. Companies and establishments were included even if they were not on the list received from BioOhio.
- Assigned an industry code (NAICS) to every company in the BioOhio list using as many as four sources: QCEW database, Hoover's, LexisNexis and the Dun and Bradstreet list as provided by BioOhio.
- Organized the BioOhio list into four categories:
 - Companies that had a NAICS code in QCEW that is part of the bioscience definition were automatically included in the bioscience data set.
 - Companies that were not in the QCEW database were excluded from the bioscience data set.
 - Companies that had a bioscience NAICS code in one or more of the three other sources (Hoover's, LexisNexis and/or Dun and Bradstreet) were added to the bioscience data set.
 - Companies to which none of the four sources assigned a bioscience definition NAICS code were excluded from the bioscience data set.
- Assigned a secondary "Bio" NAICS code to companies in the QCEW database in cases where their main NAICS was non-bio. These companies were listed in the BioOhio list and were assigned a bio-centric NAICS by at least one source.

- Examined companies with over 50 employees associated with the bioscience industry with NAICS codes 541712 (Research & Development in the Physical, Engineering, & Life Sciences) and 541380 (Testing Laboratories). This was done to ensure that the activity of each firm was in the bioscience industry because many companies in these two industries are not part of the bioscience sector; the companies working in the bioscience sector were added to the data set. In the previous studies, ratios were applied to employment payroll and number of establishments in these two industries in order to capture the bioscience activity. The same ratios were applied here for companies in these two industries with less than 50 employees.
- Examined large companies (with at least 500 employees) associated with the bioscience industry across time and across all of their establishments to ensure that consistent information was included for the years 2000 through 2008 (See Appendix A).
- Assembled the bioscience data set from companies that had a bioscience NAICS code in the QCEW and companies from the BioOhio list that at least one other source identified with a bioscience NAICS code and which were found in the QCEW under another NAICS. Employment and wage data are assigned to individual companies from the QCEW data. Since data on individual companies are confidential, only aggregated data by industry and region are included in the report.

To summarize, the Center for Economic Development created a data set for bioscience which is based on confidential data from the QCEW database for the years 2000 through 2008. It includes all companies that have a bioscience NAICS in the QCEW database and those companies that are assigned a different NAICS in the QCEW, but were identified as bioscience companies by one of the other three sources used to assign NAICS to the database received from BioOhio. Employment and wage data on these companies include all the workers at each of the businesses identified, regardless of their occupation. Because of confidentiality restrictions, data about individual companies cannot be reported, but industry trends are described. Also due to confidentiality restrictions, detailed industry information for some smaller regions is suppressed.

TREND ANALYSIS

The objective of this study is to examine the economic performance of the bioscience industry in Ohio over time. Trends in Ohio's six regions from 2000 through 2008 are compared to trends in Ohio and the United States, detailing two time periods, 2000 to 2004 and 2004 to 2008. When appropriate, analysis of the years from 2007 to 2008 is included.

The primary data source utilized in this report is the Quarterly Census of Employment and Wages. The Center for Economic Development at Cleveland State University receives quarterly updates of this data from the Ohio Department of Jobs and Family Services. The data includes company level information but, due to confidentiality restrictions, only industry level data can be reported. Information for some industries (primarily small industries in small geographic areas) had to be suppressed due to confidentiality issues. This data was used to perform the trend analysis of the six BioOhio regions and the six bioscience subsectors in Ohio.

Three measures of economic activity are being used for the trend analysis: employment, payroll, and the number of establishments. Analysis of employment trends provides information on local jobs without differentiation between part-time and full-time employment and among low-skill, low-pay jobs and high-skill, high-pay jobs. Analysis of payroll (wage) trends describes the scale of the bioscience sector in the different economies. Although payroll does not measure gross regional product, it can be viewed as a proxy for value-added output. The number of establishments counts the individual locations of businesses and does capture different functionality that firms have at different sites.

Additionally, two other variables are included. Average wage is calculated as payroll per employee and estimates the annual average wage in each industry and for each region. The average number of employees per establishment is calculated as the total employment divided by the number of establishments and shows the average size of bioscience firms.

ECONOMIC IMPACT

The second part of the analysis of the bioscience industry in Ohio is its economic impact. This analysis uses IMPLAN Professional and IMPLAN Data Files. IMPLAN Professional® 2.0 is an economic impact assessment software system. The IMPLAN Data Files allow for the creation of sophisticated models of local economies in order to estimate a wide range of economic impacts.

Economic impact estimates will be provided for total output impact (direct, indirect, and induced output impact); total employment impact (direct, indirect, and induced employment impact); total labor income (household earnings) impact (direct, indirect, and induced income impact); and tax impact (federal, state and local taxes).

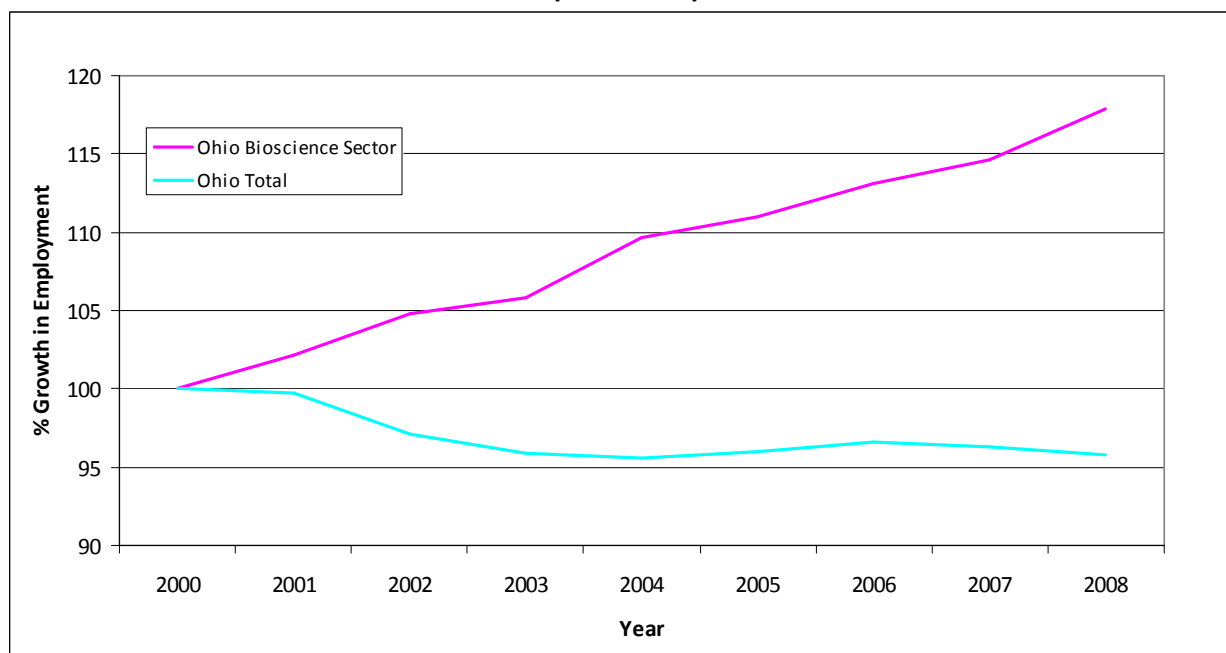
There are three components of the total output impact. The *direct impact* refers to the initial value of goods and services, including labor, purchased by the bioscience industry within a defined economic region. These purchases are sometimes referred to as the first-round effect. *Indirect impact* measures the value of labor, capital, and other inputs of production needed to produce the goods and services required by the bioscience industry (second-round and additional-round effects). *Induced impact* measures the change in spending by local households due to increased earnings by employees in local industries who produce goods and services for the bioscience industry and its suppliers.

BIOSCIENCE SECTOR IN OHIO

TRENDS IN OHIO'S BIOSCIENCE SECTOR

Total employment in Ohio's bioscience sector in 2008 was 55,465. Employment increased continuously since 2000. From 2000 to 2008, the bioscience sector in Ohio added over 8,400 jobs, growing by 17.9%. Just over the last year for which data is available (2007-2008), employment grew by 2.8% (1,520 jobs). Moreover, the growth in the bioscience sector occurred while the rest of the economy declined (Figure 2).

Figure 2: Bioscience Employment and Total Employment in Ohio, 2000 - 2008 (2000=100)



The bioscience sector in Ohio had a payroll of \$3.9 billion in 2008. Measuring in 2008 dollars, bioscience payroll in Ohio rose by nearly 30% (\$895 million) since 2000. Bioscience payroll grew by \$109.8 million (2.9%) from 2007 to 2008.

The bioscience sector is relatively small compared to other sectors, but it is growing. By 2008, there were 1,628 bioscience establishments in Ohio, growing by 400 since the year 2000. Bioscience sector jobs paid an average wage of \$70,232 in 2008. This is the average wage for all industries and all occupations included in this sector, not just for scientists and executives. The average wage in the bioscience sector rose from \$63,755 in 2000, after adjustment for inflation. The average wage for bioscience industries in 2008 was 77% higher than the average wage for all industries in Ohio (\$39,601).

SHARES OF BIOSCIENCE IN OHIO

The bioscience sector in Ohio can be measured against all industries in Ohio as well as in comparison to the bioscience sector nationally.

The Role Bioscience Plays in Ohio's Economy

The bioscience sector is small in Ohio and in the U.S., but bioscience shares of Ohio's economy are slightly higher than bioscience shares nationally (Table 2). Bioscience employment in Ohio has grown by 17.9% since 2000 in contrast to a decline of 4.2% in total employment in all sectors in Ohio. As a result, the share of bioscience employment in total employment in Ohio increased slightly from 0.9% to 1.1% in 2008; (the bioscience employment share nationally was only 0.9%). The share of bioscience payroll in total payroll in Ohio increased from 1.4% in 2000 to 1.8% in 2008 and it was slightly higher than the U.S. share of 1.6%. From 2000 through 2008 the share of bioscience establishments in Ohio grew very slightly from 0.5% to 0.6% in comparison to the national share of 0.5%.

Table 2: Share of Ohio Bioscience Sector in the Total Ohio Economy, 2008

| | OH | US |
|----------------|------|------|
| Employment | 1.1% | 0.9% |
| Payroll | 1.8% | 1.6% |
| Establishments | 0.6% | 0.5% |

Although these shares are small, by 2008 the bioscience sector was playing a more dominant role in Ohio's economy than the role it plays in the country as evidenced by higher bioscience shares in Ohio than in the United States. These shares show that the bioscience sector is more concentrated in Ohio relative to the United States. Moreover, its relative employment concentration, measured by location quotients, has increased from 0.95 (lower concentration of bioscience employment in Ohio than nationally) in 2000 to 1.14 in 2008 (higher concentration than nationally).

The bioscience sector is slightly more dominant in Ohio than in the nation not only based on employment, but also based on payroll and establishments. For instance, payroll share of bioscience in Ohio's total payroll is 1.8% compared to 1.6% in the nation.

Ohio Bioscience in Comparison to U.S. Bioscience

The bioscience industry in Ohio experienced growth in its percentages of the entire bioscience industry in the United States. In 2008, 4.4% of the total employment in the bioscience industry was located in the state of Ohio, growing from 4.1% in 2000 (Table 3). The share increased yearly from 2000 until 2004 and since then has remained relatively flat. As suggested by the concentration ratios above, Ohio's share of bioscience jobs in the United States is larger than Ohio's share of overall employment in the nation (3.9%). Ohio's shares are high specifically in two subsectors: the Ohio Agricultural Biotechnology subsector accounted for 8.4% of U.S. employment in this subsector and Testing Laboratories in Ohio represented 6.0% of U.S. employment in Testing Laboratories.

Table 3: Ohio Bioscience as Shares of Bioscience in the U.S.: 2000, 2004 & 2008

| | 2000 | 2004 | 2008 |
|----------------|-------|-------|-------|
| Employment | 4.06% | 4.37% | 4.40% |
| Payroll | 3.55% | 3.87% | 3.86% |
| Establishments | 3.29% | 3.46% | 3.57% |

The share of payroll in the Ohio bioscience sector was 3.9% of the national bioscience sector in 2008. Ohio's payroll share increased from 2000 to 2005, decreased slightly through 2007 and saw a slight upswing in 2008. The height of Ohio's share of the national payroll (4.1%) occurred in 2003. The share of establishments in the Ohio bioscience sector grew between 2000 and 2007 to a height of 3.7%. The most current year, 2008, saw a slight dip to 3.6%.

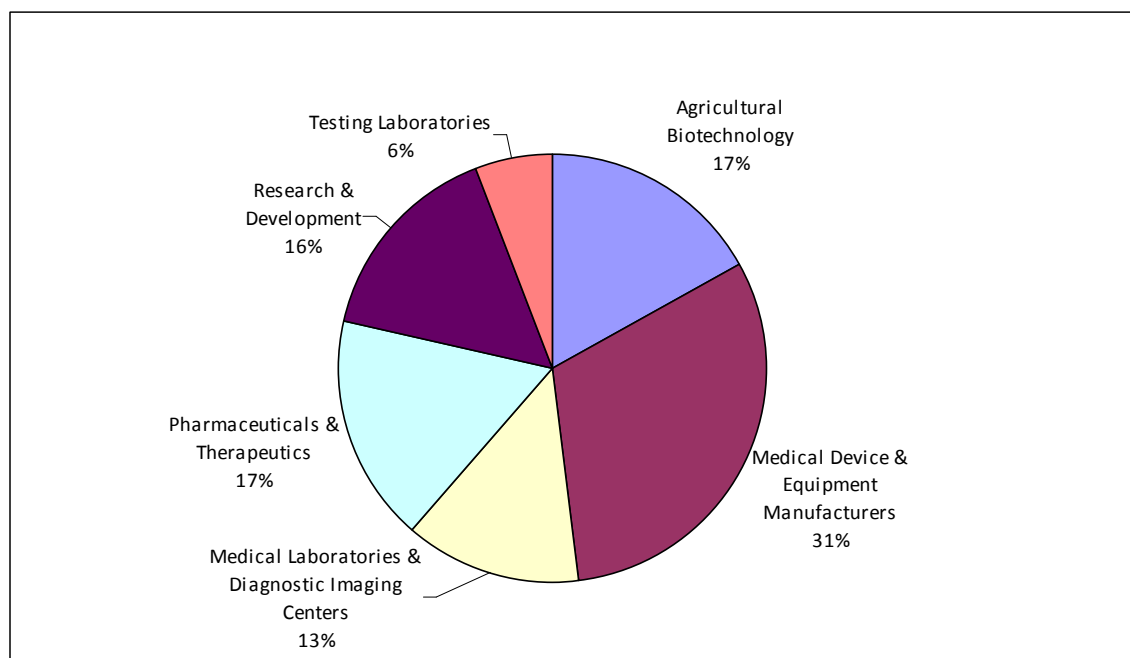
BIOSCIENCE IN OHIO BY SUBSECTOR

The bioscience subsector with the largest employment in 2008 was Medical Device & Equipment Manufacturers with 31% (17,180 employees) of total bioscience employment, followed by Pharmaceuticals & Therapeutics with 17% (9,447 employees) and Agricultural Biotechnology with 17% (9,415 employees) (Table 4 and Figure 3).

Table 4: Bioscience Employment in Ohio by Subsector, 2000 - 2008

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Agricultural Biotechnology | 9,268 | 9,268 | 9,286 | 9,343 | 9,239 | 8,658 | 8,839 | 8,994 | 9,415 |
| Medical Device & Equipment Manufacturers | 17,433 | 17,851 | 18,016 | 17,225 | 17,375 | 17,537 | 17,088 | 16,943 | 17,180 |
| Medical Labs & Diagnostic Imaging Centers | 4,913 | 5,136 | 5,573 | 5,763 | 7,016 | 7,066 | 7,260 | 7,587 | 7,485 |
| Pharmaceuticals & Therapeutics | 6,443 | 6,658 | 6,776 | 7,490 | 7,919 | 8,458 | 8,914 | 8,999 | 9,447 |
| Research & Development | 6,289 | 6,413 | 6,885 | 7,091 | 7,139 | 7,540 | 8,055 | 8,263 | 8,675 |
| Testing Laboratories | 2,711 | 2,729 | 2,770 | 2,871 | 2,914 | 2,950 | 3,048 | 3,160 | 3,264 |
| Total Bioscience in Ohio | 47,057 | 48,055 | 49,305 | 49,784 | 51,602 | 52,209 | 53,204 | 53,946 | 55,465 |

Figure 3: Bioscience Sector Employment in Ohio by Subsector, 2008



The largest subsector, Medical Device & Equipment Manufacturers, lost about 250 jobs between 2000 and 2008; however it gained 237 jobs from 2007 to 2008 (Table 5). The five other subsectors gained employment from 2000 to 2008, with each gaining between 145 and 3,000 new jobs. The three subsectors that gained the most employment from 2000 to 2008 were Pharmaceuticals & Therapeutics, Medical Laboratories & Diagnostic Imaging Centers, and Research & Development with each gaining more than 2,380 jobs over this time period. Combined, these three subsectors accounted for 95% of new bioscience jobs gained between 2000 and 2008.

Table 5: Employment Change by Subsector

| Subsector | Change in Employment | | | | | % Change in Employment | | | | |
|---|----------------------|--------------|--------------|--------------|--------------|------------------------|-------------|-------------|-------------|-------------|
| | 2000-2008 | 2000-2004 | 2004-2008 | 2006-2008 | 2007-2008 | 2000-2008 | 2000-2004 | 2004-2008 | 2006-2008 | 2007-2008 |
| Agricultural Biotechnology | 147 | (29) | 176 | 576 | 421 | 1.59 | (0.31) | 1.91 | 6.52 | 4.68 |
| Medical Device & Equipment Manufacturers | (253) | (58) | (195) | 92 | 237 | (1.45) | (0.34) | (1.12) | 0.54 | 1.40 |
| Medical Labs & Diagnostic Imaging Centers | 2,572 | 2,103 | 469 | 225 | (102) | 52.36 | 42.81 | 6.68 | 3.09 | (1.34) |
| Pharmaceuticals & Therapeutics | 3,004 | 1,476 | 1,528 | 533 | 448 | 46.62 | 22.91 | 19.29 | 5.98 | 4.98 |
| Research & Development | 2,385 | 850 | 1,535 | 619 | 411 | 37.93 | 13.52 | 21.50 | 7.69 | 4.98 |
| Testing Laboratories | 553 | 203 | 350 | 217 | 104 | 20.38 | 7.48 | 12.00 | 7.11 | 3.29 |
| Total Bioscience in Ohio | 8,408 | 4,545 | 3,863 | 2,261 | 1,519 | 17.87 | 9.66 | 7.49 | 4.25 | 2.82 |

During the 2007 to 2008 time period, five subsectors added jobs for a total of nearly 1,520 additional jobs; only Medical Laboratories & Diagnostic Imaging Centers lost employment during this time.

The Medical Device & Equipment Manufacturers sector had the largest payroll (\$1.1 billion) in 2008 followed by the Agricultural Biotechnology and Pharmaceuticals & Therapeutics sectors with \$797 million and \$761 million in payroll, respectively. Payroll increased for all sectors from 2000 to 2008, but increased in four out of six sectors over the last year after adjusting for inflation. Between 2007 and 2008, the largest increase in payroll was in the Medical Device & Equipment Manufacturers subsector (7.1%).

The Research & Development subsector paid the highest average wage of \$87,051 in 2008. This subsector also saw the highest increase in wages since 2000. Two other subsectors, Agricultural Biotechnology and Pharmaceuticals & Therapeutics, also had high average wages of over \$80,000. The Medical Device & Equipment Manufacturers subsector, the subsector with the largest number of employees, paid a lower average wage of \$65,312; this wage is however still considerably higher than the average wage in Ohio (\$41,513) when all industries are taken into account. Between 2000 and 2008 wages in the R&D subsector grew at the fastest rate (17.9%) followed by the Testing Laboratories subsector (15.3%). Over the last year, however, average wages in the Medical Device & Equipment Manufacturers subsector improved the most, growing at a rate of 5.6%, followed by R&D, which saw a minor increase; the remaining four sectors experienced a decline in their average wage during this time period.

Nearly 55% of all bioscience establishments are in two subsectors—Medical Laboratories & Diagnostic Imaging Centers (565) and Medical Device & Equipment Manufacturers (325). The number of establishments increased in all subsectors between 2000 and 2008, except in Testing Laboratories, where the number of establishments declined. The number of establishments more than doubled for the Medical Laboratories & Diagnostic Imaging Centers, accounting for more than 70% of the net increase within this time period. Over the last year, the number of Medical Laboratories & Diagnostic Imaging Center new establishments increased by 35; three other subsectors increased the number of sites, but two subsectors experienced declines in the number of establishments.

The employment, payroll, average wages, and the number of bioscience establishments in Ohio for 2008 are summarized in Table 6.

Table 6: Bioscience Employment, Payroll, and Wages by Subsector, 2008

| Table 3: Bioscience by Subsector in Ohio, 2008 | Employment | Payroll (\$) | Average Wages (\$) | Number of Establishments |
|---|------------|---------------|---------------------|--------------------------|
| Agricultural Biotechnology | 9,415 | 797,211,152 | 84,678 ⁴ | 128 |
| Medical Device & Equipment Manufacturers | 17,180 | 1,122,065,620 | 65,312 | 325 |
| Medical Labs & Diagnostic Imaging Centers | 7,485 | 314,929,384 | 42,075 | 565 |
| Pharmaceuticals & Therapeutics | 9,447 | 760,596,976 | 80,512 | 71 |
| Research & Development | 8,675 | 755,123,836 | 87,051 | 287 |
| Testing Laboratories | 3,264 | 145,526,568 | 44,583 | 252 |
| Total Bioscience in Ohio | 55,465 | 3,895,453,536 | 70,232 | 1,628 |

⁴The high average wage in the Agricultural Biotechnology subsector is primarily attributed to one of its industries, All Other Basic Organic Chemical Manufacturing (NAICS 325199). This industry accounts for over one-half of all employment in the Agricultural Biotechnology subsector (5,100 jobs) with an average wage of \$101,700. Within Ohio, the Northeast Ohio region has the most employees in this industry.

BIOSCIENCE IN OHIO'S SIX REGIONS

Across Ohio's six regions, bioscience employment was highest in the Northeast and Central regions; the two regions accounted for 61% of bioscience employment in Ohio in 2008 (Figure 4). The Southeast region (mostly Appalachian region) had the lowest bioscience employment with 3% of the total. All regions experienced employment growth from 2000 to 2008 and five of the six continued to grow during the last year with only the largest region, the Northeast, remaining flat (Table 7). Bioscience employment in the Central region added the most jobs and grew at the fastest rate, 44%, during the entire study period (2000-2008) (Figure 5). Between 2007 and 2008, the Southeast region grew at the fastest rate among all the regions in Ohio.

Figure 4: Bioscience Employment in Ohio by Region, 2008

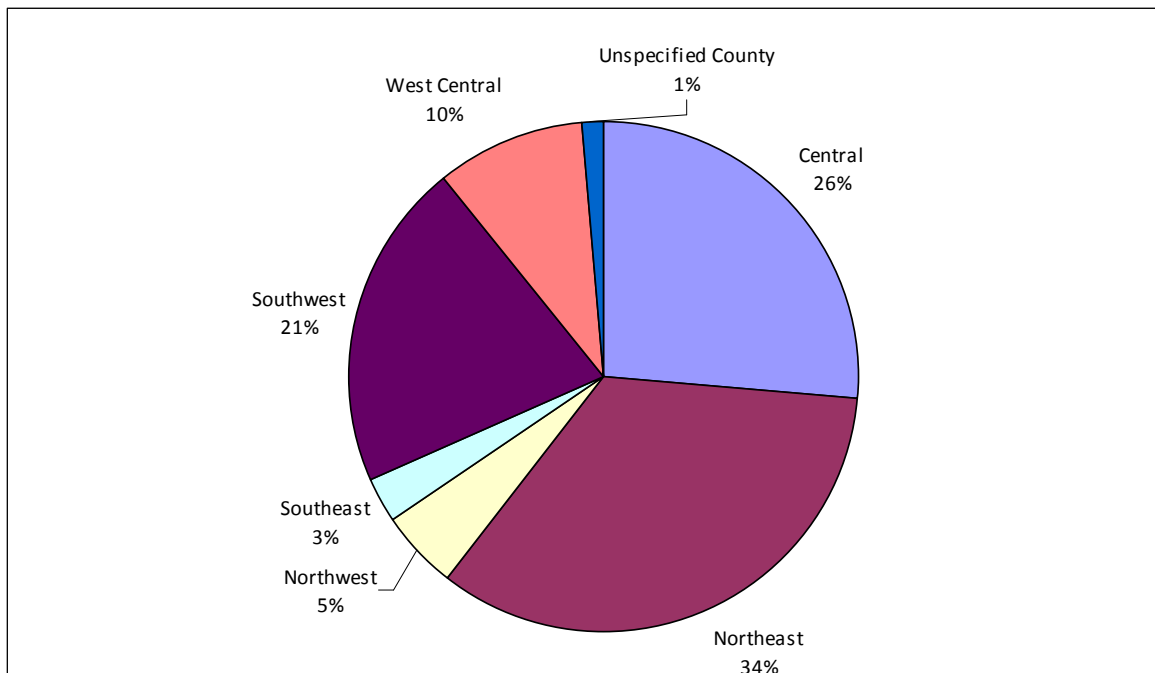
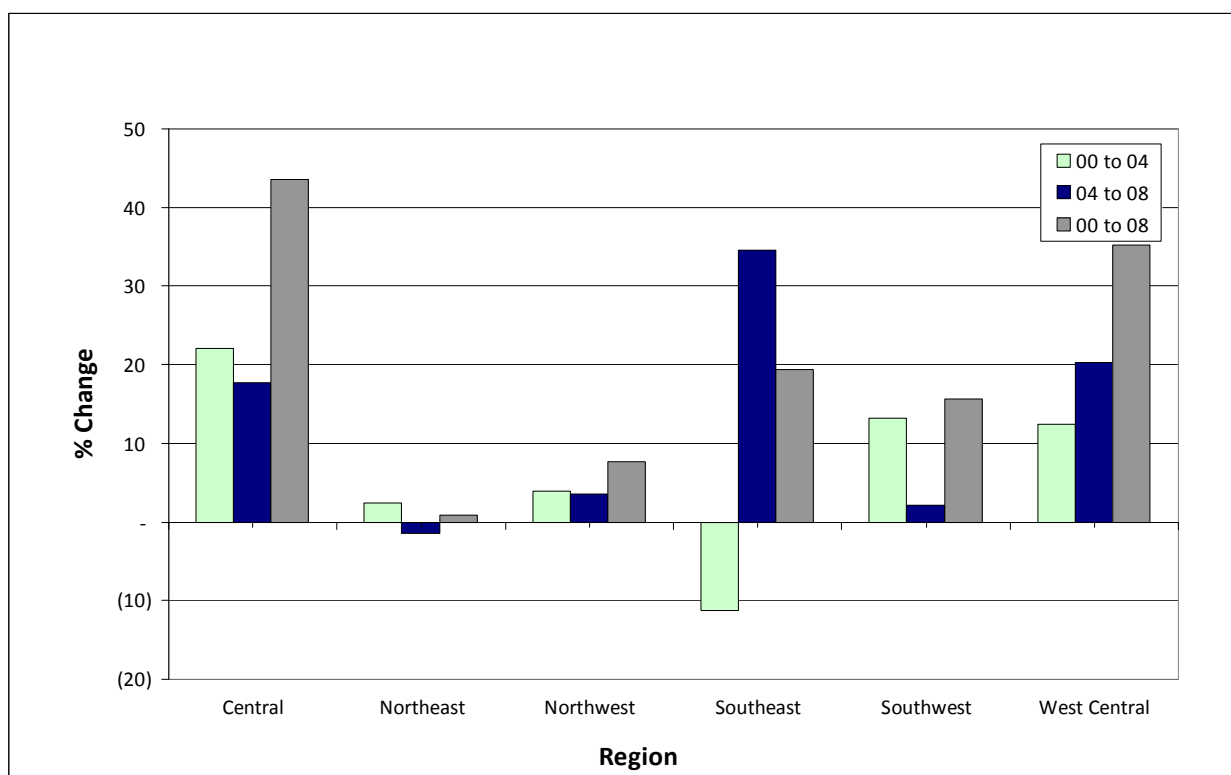


Table 7: Bioscience Employment in Ohio by Region, 2000-2008

| Region | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Central | 10,230 | 10,484 | 10,924 | 11,893 | 12,486 | 12,934 | 13,384 | 13,990 | 14,688 |
| Northeast | 18,764 | 19,122 | 19,695 | 18,875 | 19,223 | 19,368 | 19,370 | 18,936 | 18,933 |
| Northwest | 2,561 | 2,615 | 2,577 | 2,646 | 2,660 | 2,647 | 2,670 | 2,679 | 2,756 |
| Southeast | 1,290 | 1,226 | 1,214 | 1,167 | 1,145 | 1,143 | 1,243 | 1,418 | 1,540 |
| Southwest | 9,920 | 10,208 | 10,316 | 10,477 | 11,231 | 10,863 | 10,847 | 11,158 | 11,467 |
| West Central | 3,903 | 4,098 | 4,229 | 4,291 | 4,388 | 4,676 | 5,037 | 5,025 | 5,277 |
| Unspecified County ⁵ | 391 | 301 | 349 | 435 | 469 | 579 | 653 | 740 | 804 |
| Total Bioscience in Ohio | 47,057 | 48,055 | 49,305 | 49,784 | 51,602 | 52,209 | 53,204 | 53,946 | 55,465 |

Figure 5: Percentage Change in Bioscience Employment by Region



⁵ The “Unspecified County” designation refers to establishments that are statewide or could not be placed into one of the regions. In future updates of this study, additional efforts will be made to assign these companies to specific counties.

In 2008, the Northeast region led the state in annual payroll (\$1.3 billion) followed by the Central region (\$1.1 billion) (Table 8). The Southwest region also had high payroll of almost \$0.94 billion. Since 2000, the Central region's payroll has grown at a very high rate of 63%, more than twice the rate of the bioscience sector in Ohio. The Northeast region, which had the highest payroll in 2008, grew at the slowest rate (8%) from 2000 to 2008 and experienced a small decline in bioscience payroll between 2007 and 2008.

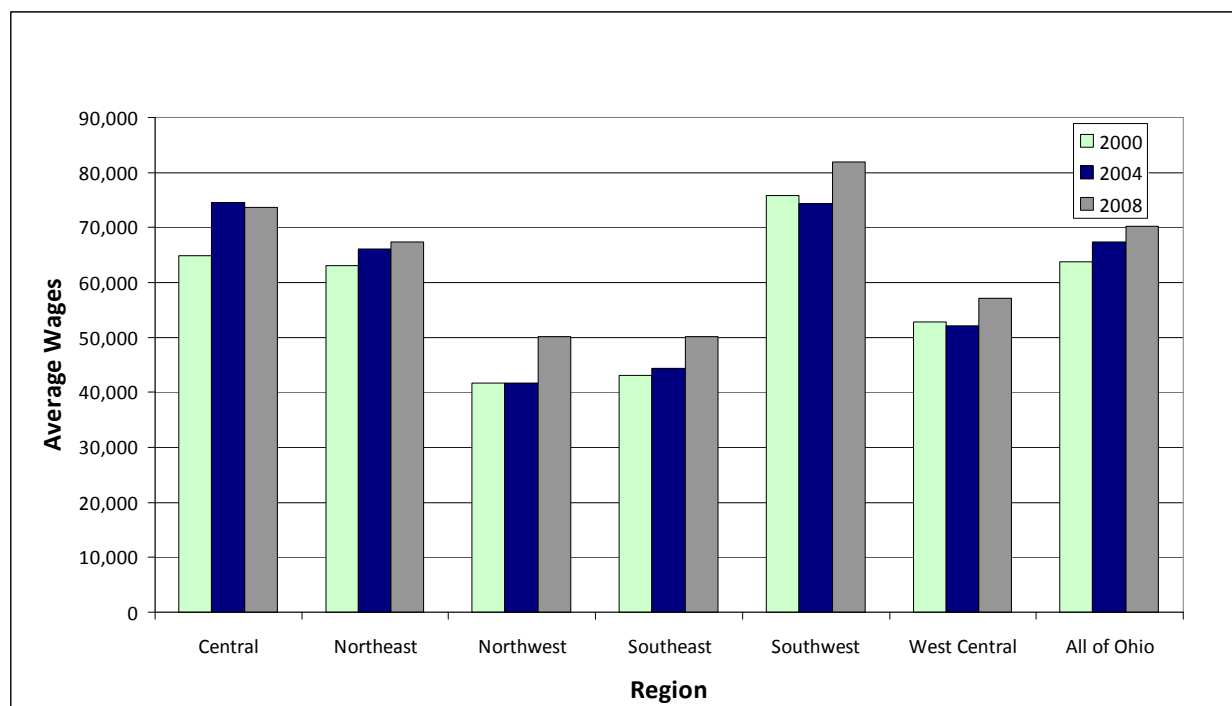
Table 8: Bioscience by Region in Ohio, 2008

| Region | Employment | Payroll (\$) | Average Wages (\$) | Number of Establishments |
|---------------------------------|------------|---------------|--------------------|--------------------------|
| Central | 14,688 | 1,082,903,580 | 73,726 | 268 |
| Northeast | 18,933 | 1,276,711,156 | 67,435 | 643 |
| Northwest | 2,756 | 138,342,092 | 50,197 | 135 |
| Southeast | 1,540 | 77,294,384 | 50,182 | 51 |
| Southwest | 11,467 | 939,070,808 | 81,893 | 262 |
| West Central | 5,277 | 301,269,744 | 57,089 | 180 |
| Unspecified County ⁶ | 804 | 79,861,768 | 99,334 | 89 |
| Total Bioscience in Ohio | 55,465 | 3,895,453,536 | 70,232 | 1,628 |

The average wage in bioscience in 2008 was highest in the Southwest region (nearly \$82,000) followed by the Central (\$73,700) and Northeast regions (\$67,400) (Figure 6). From 2000 to 2008, the average wage grew in all regions with the Northwest and Southeast regions growing at the fastest rates (20.7% and 16.5%). In the 2007 to 2008 time period, average wage in both the Northeast and Central regions declined; the Central region's average wage has been declining since 2006.

The Northeast region led the state in number of bioscience establishments with 39.5% of the total. The Central and Southwest regions followed with each having about 16% of bioscience establishments. Since 2000 all regions have grown in the total number of bioscience establishments. Since 2007, however, three regions lost some businesses—Southeast, Northeast and Central.

⁶ The "Unspecified County" designation refers to establishments that are statewide or could not be placed into one of the regions. In future updates of this study, additional efforts will be made to assign these companies to specific counties.

Figure 6: Average Wage in the Bioscience Sector, 2000, 2004 & 2008

BIOSCIENCE SECTOR IN THE NORTHEAST REGION

General Trends

The Northeast region of Ohio consists of 21 counties: Ashland, Ashtabula, Carroll, Columbiana, Crawford, Cuyahoga, Erie, Geauga, Holmes, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Tuscarawas and Wayne. The counties are a part of six Metropolitan Statistical Areas (MSAs) including the Akron MSA, Canton-Massillon MSA, Cleveland-Elyria-Mentor MSA, Mansfield MSA, Sandusky MSA and Youngstown-Warren-Boardman MSA. Eight other counties are non-metro counties.

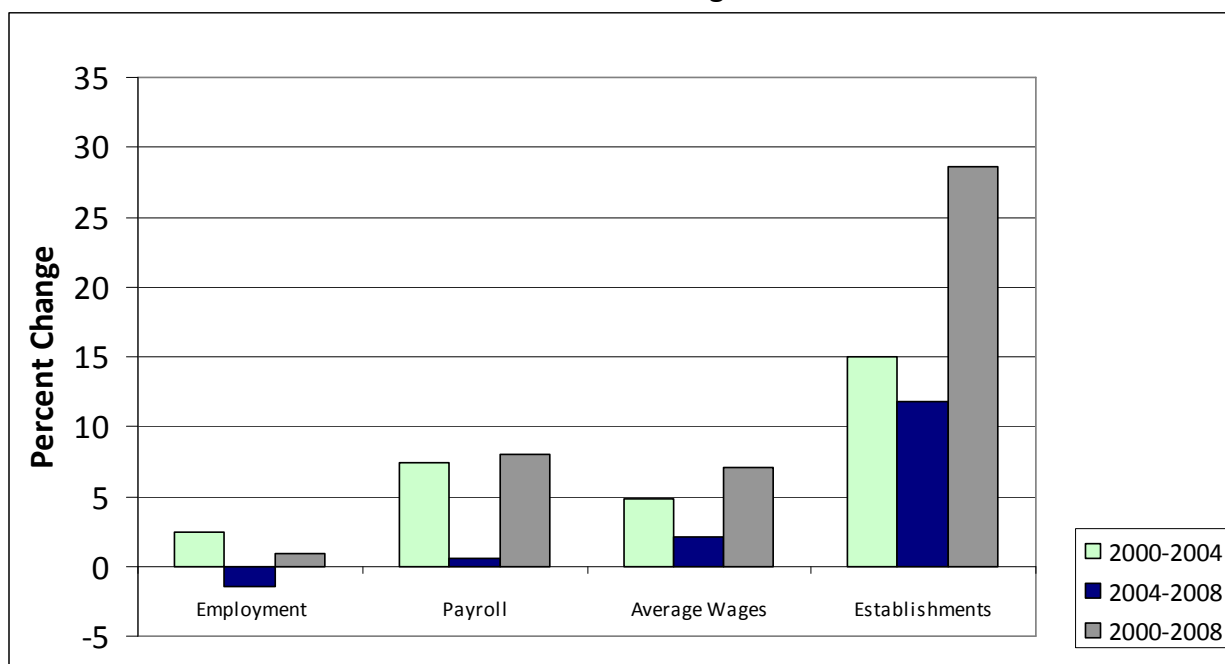
A large portion of the bioscience activity in Ohio takes place in the Northeast region. In 2008, the region was home to 34.1% of the bioscience employment, 32.8% of the payroll, and 39.5% of the total establishments.

From 2000 to 2008, the Northeast region has had the highest bioscience employment of all the regions in Ohio, with 18,933 people in 2008. Bioscience employment in the Northeast region peaked in 2002 at 19,695. This region also has had the largest number of establishments (643 in 2008) and the highest payroll (\$1.28 billion in 2008) for the entire study period. In the last year there were fewer establishments. The average wage for an employee in the bioscience industry in the Northeast region was \$67,435 in 2008, lower than the Southwest and Central regions as well as the state average. The \$1.28 billion payroll in the last year was 3.8% lower

from the previous year. Payroll peaked at \$1.33 billion in 2007. It was the only region that experienced payroll decline between 2007 and 2008.

The Northeast region had the second-lowest growth rate of all the regions in terms of employment between 2000 and 2004 (Figure 7). From 2004 to 2008 the region saw a decrease in employment. For the entire study period, the region's employment increased 0.9%. Moderate growth occurred in payroll and average wages for the Northeast when it is compared to the other regions in Ohio. In addition, the region experienced the third-highest growth in the number of bioscience establishments between 2000 and 2008.

Figure 7: Percentage Change in Employment, Payroll, Average Wages & Establishments for the Northeast Region



Bioscience by Subsector

Medical Device & Equipment Manufacturers was the largest subsector in 2008 in terms of employment (8,458) and payroll (\$487.8 million), followed by Agricultural Biotechnology (3,779 employees and a payroll of \$404.2 million) (Table 9). Agricultural Biotechnology had the highest average number of employees per establishment (86). It also had the highest average wage in 2008 of over \$100,000 which was almost \$30,000 higher than Research & Development, the next highest subsector. Medical Laboratories & Diagnostic Imaging Centers had the most establishments in 2008 (204) followed by Medical Device & Equipment Manufacturers (163).

Table 9: Employment, Payroll, Average Wage & Establishments in the Northeast Region, 2008

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|------------|---------------|----------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 3,779 | 404,202,012 | 106,969 ⁷ | 44 | 86 |
| Medical Device & Equipment Manufacturers | 8,458 | 487,767,660 | 57,669 | 163 | 52 |
| Medical Labs & Diagnostic Imaging Centers | 1,917 | 81,486,456 | 42,507 | 204 | 9 |
| Pharmaceuticals & Therapeutics | 1,864 | 131,451,756 | 70,521 | 24 | 78 |
| Research & Development | 1,026 | 79,073,864 | 77,042 | 94 | 11 |
| Testing Laboratories | 1,889 | 92,729,408 | 49,101 | 114 | 17 |
| Total Northeast | 18,933 | 1,276,711,156 | 67,435 | 643 | 29 |

The Pharmaceuticals & Therapeutics subsector grew at the fastest rate from 2000 to 2008. It experienced 70.0% growth in employment and 72.4% growth in payroll. The number of establishments increased by 33.3% and was the third-highest growing subsector in the Northeast region in terms of establishments. Medical Laboratories & Diagnostic Imaging Centers saw the highest growth in the number of establishments with a 106.1% increase between 2000 and 2008. However, this sector has the lowest average wage (\$42,507).

Three subsectors lost employment over the study period: Agricultural Biotechnology (-12.1%), Medical Device & Equipment Manufacturers (-10.1%) and Research & Development (-2.6%). Employment in both the Agricultural Biotechnology and Medical Device & Equipment Manufacturers subsectors saw the peak of their employment in 2001, while employment in R&D peaked in 2002.

The only subsector to lose payroll was Medical Device & Equipment Manufacturers. Agricultural Biotechnology gained some payroll, although it lost jobs. The Testing Laboratories subsector added jobs and payroll, but lost establishments.

BIOSCIENCE SECTOR IN THE CENTRAL REGION

General Trends

The Central region of Ohio centers on the Columbus MSA and its surrounding counties. It is comprised of 15 counties: Delaware, Fairfield, Fayette, Franklin, Hocking, Knox, Licking, Logan, Madison, Marion, Morrow, Perry, Pickaway, Ross and Union. Of these counties, eight are part of the Columbus MSA and the other seven are non-metro counties.

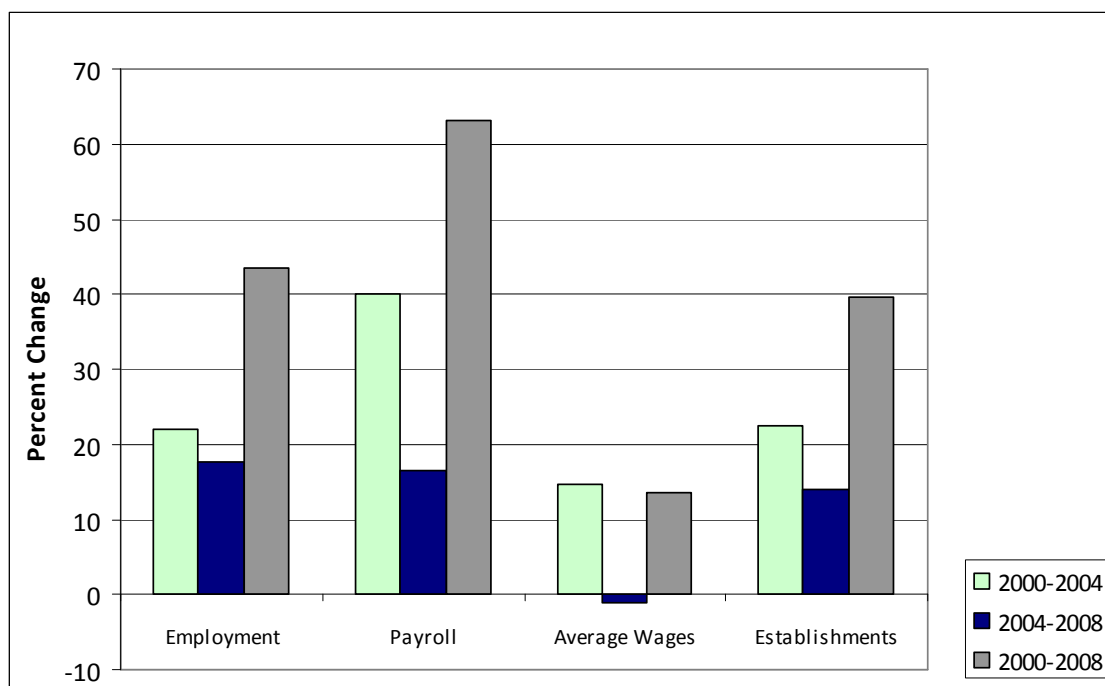
⁷ This high average wage is primarily due to one industry within the Agricultural Biotechnology sector, All Other Basic Organic Chemical Manufacturing (NAICS 325199). It accounts for 75% of the subsector employment and its average wage is over \$120,000.

The Central region has 26.5% of the bioscience employment within the state and 27.8% of the bioscience payroll; however the Central region is home to only 16.5% of the total bioscience establishments in Ohio.

The Central region was ranked the second-highest bioscience center in Ohio in terms of all measures: employment (14,688), payroll (\$1,082,903,580), average wages (\$73,726), and the number of establishments (269).

In terms of employment, the Central region had the highest growth rate in the state during the recessionary period from 2000 to 2004 (22.1%) but was only the third-highest during the expansionary period from 2004 to 2008 (17.6%) (Figure 8). Over the period studied (2000-2008), the Central region had the highest growth rate in employment with a 43.6% increase. The region also ranked first in the growth rates of payroll (63.1%) and the number of establishments (39.6%), but it ranked third in the percentage change in average wages (13.6%).

Figure 8: Percentage Change in Employment, Payroll, Average Wages & Establishments for the Central Region



Bioscience by Subsector

The Pharmaceuticals & Therapeutics and Research & Development subsectors had by far the largest employment in 2008 with 4,199 and 4,191 employees, respectively; together they represent over 57% of employment in the entire bioscience sector in the region (Table 10). These two subsectors also had the highest payroll with a combined payroll of over \$720 million, and accounted for 66.5% of all payroll associated with bioscience in the Central region. Again,

these two subsectors had the highest average wage in the region, both paying over \$84,000. The Medical Laboratories & Diagnostic Imaging Centers subsector had the most establishments in 2008 (98), followed by the R&D and Testing Laboratories (47 establishments each). The Pharmaceuticals & Therapeutics subsector had the lowest number of establishments with only 16 but the highest average number of employees per establishment with 262.

Table 10: Employment, Payroll, Average Wage & Establishments in the Central Region, 2008

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|------------|---------------|-------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 1,866 | 143,479,128 | 76,878 | 26 | 72 |
| Medical Device & Equipment Manufacturers | 2,216 | 123,791,048 | 55,854 | 35 | 63 |
| Medical Labs & Diagnostic Imaging Centers | 1,762 | 75,168,404 | 42,669 | 98 | 18 |
| Pharmaceuticals & Therapeutics | 4,199 | 364,641,300 | 86,840 | 16 | 262 |
| Research & Development | 4,191 | 355,587,808 | 84,837 | 47 | 89 |
| Testing Laboratories | 453 | 20,235,892 | 44,624 | 47 | 10 |
| Total Central | 14,688 | 1,082,903,580 | 73,726 | 269 | 55 |

Employment and payroll grew in all subsectors in Ohio's Central region between 2000 and 2008. Over this period, the largest growth in employment in the region was in Medical Device & Equipment Manufacturers (81.3%) followed by Pharmaceuticals & Therapeutics (69.4%). In terms of payroll, Testing Laboratories saw an increase of 108.8% and Pharmaceuticals & Therapeutics increased by 105.4%. As for establishments, Medical Laboratories & Diagnostic Imaging Centers saw an increase of 127.9% over the entire period. However, two subsectors lost establishments: Medical Device & Equipment Manufacturers (-7.9%) and Testing Laboratories (-2.1%).

BIOSCIENCE SECTOR IN THE SOUTHWEST REGION

General Trends

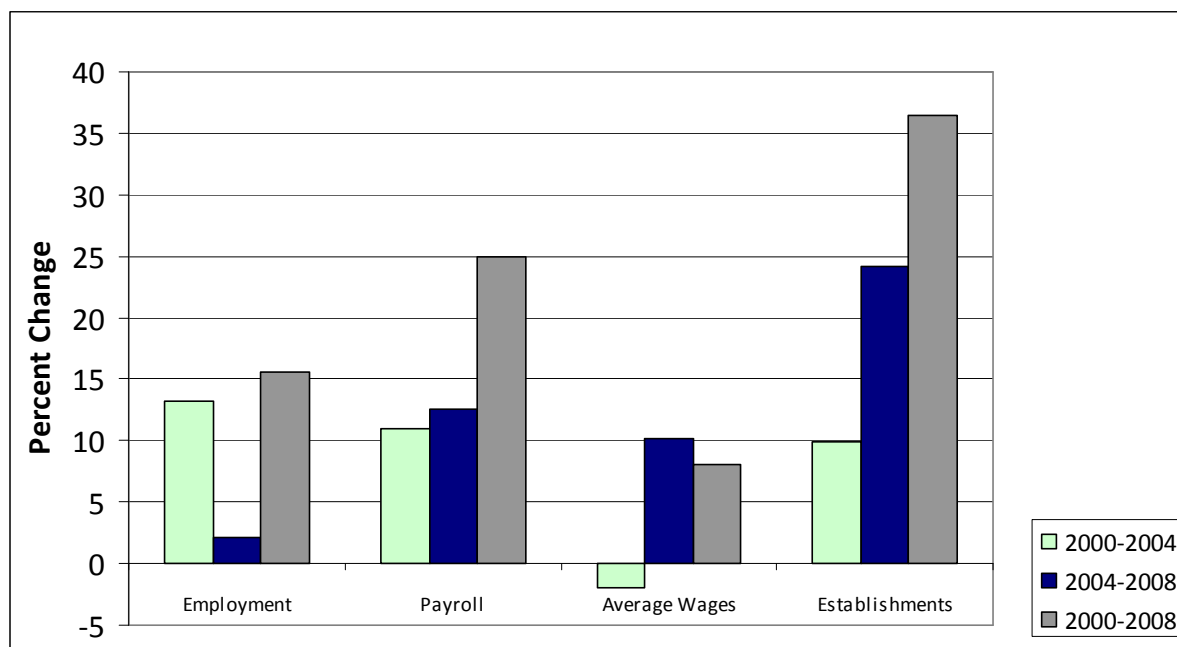
The Southwest region of Ohio consists of seven counties surrounding Cincinnati including Brown, Butler, Clermont, Clinton, Hamilton, Highland, and Warren. The Southwest region has a large share of the bioscience activity within the state. In 2008, the region had 20.7% of the employment in the bioscience sector, 24.1% of the payroll, and 16.1% of the establishments.

This region has the third-largest bioscience employment in the state with 11,467 jobs in 2008. It also has the third-largest payroll with \$939 million in 2008 and third-largest number of establishments with 261. During the years 2005-2008, the Southwest has the highest bioscience average wages of anywhere in the state, which is likely due to the fact that they have more people working in higher wage subsectors like Pharmaceuticals & Therapeutics and

Research & Development than the state as a whole. The average wage in 2008 was \$81,893, which is over \$11,000 higher than the state average.

The Southwest region had the second-highest growth rate in employment from 2000 to 2004 but saw little growth from 2004 to 2008 resulting in a 15.6% increase over the entire study period (Figure 9). The region saw the second-highest growth in the number of establishments during the 2000-2008 years, adding 70 establishments for a growth rate of 36.5%.

Figure 9: Percentage Change in Employment, Payroll, Average Wages & Establishments for the Southwest Region



Bioscience by Subsector

Looking individually at the subsectors that comprise the region, Medical Device & Equipment Manufacturers has the largest employment (2,944) and payroll (\$306.8 million) (Table 11). This is consistent with the largest subsector in Northeast Ohio. The second-largest subsector in the Southwest region is Pharmaceuticals & Therapeutics with 2,832 employees and a payroll of \$226.2 million. Not surprisingly, the Research & Development subsector had the highest average wage of \$105,369, closely followed by Medical Device & Equipment Manufacturers with an average wage of \$104,188. This high average wage is close to twice as high as the average wage for the same subsector in other regions in Ohio. Average wages in both the Medical Laboratories & Diagnostic Imaging Centers and Testing Laboratories were quite low, around \$37,000 each. Although there are only 23 Pharmaceuticals & Therapeutics establishments in the region, they have the highest average number of employees at 123. The smallest subsector in terms of establishments was Agricultural Biotechnology with only 19 contrasted with 87 Medical Laboratories & Diagnostic Imaging Centers.

Table 11: Employment, Payroll, Average Wage & Establishments in the Southwest Region, 2008

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|---------------|--------------------|-------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 1,559 | 113,726,796 | 72,964 | 19 | 82 |
| Medical Device & Equipment Manufacturers | 2,944 | 306,763,696 | 104,188 | 45 | 65 |
| Medical Labs & Diagnostic Imaging Centers | 1,640 | 61,103,376 | 37,258 | 87 | 19 |
| Pharmaceuticals & Therapeutics | 2,832 | 226,177,144 | 79,874 | 23 | 123 |
| Research & Development | 2,030 | 213,869,384 | 105,369 | 54 | 38 |
| Testing Laboratories | 463 | 17,430,412 | 37,674 | 33 | 14 |
| Total Southwest | 11,467 | 939,070,808 | 81,893 | 261 | 44 |

Medical Laboratories & Diagnostic Imaging Centers grew significantly between 2000 and 2008. Employment rose by 220.9%, payroll increased by 198.4% and the number of establishments grew by 97.7%. The Research & Development and Pharmaceuticals & Therapeutics subsectors also saw increases in employment, payroll, and number of establishments. The only two subsectors that lost employment in the Southwest region during the study period were Agricultural Biotechnology and Medical Device & Equipment Manufacturers.

BIOSCIENCE SECTOR IN THE WEST CENTRAL REGION

General Trends

The West Central region includes the cities of Dayton, Springfield, Troy and Xenia. It encompasses eight counties: Champaign, Clark, Darke, Greene, Miami, Montgomery, Preble, and Shelby. Four of these counties are a part of the Dayton MSA, and one county is included in the Springfield MSA (Clark).

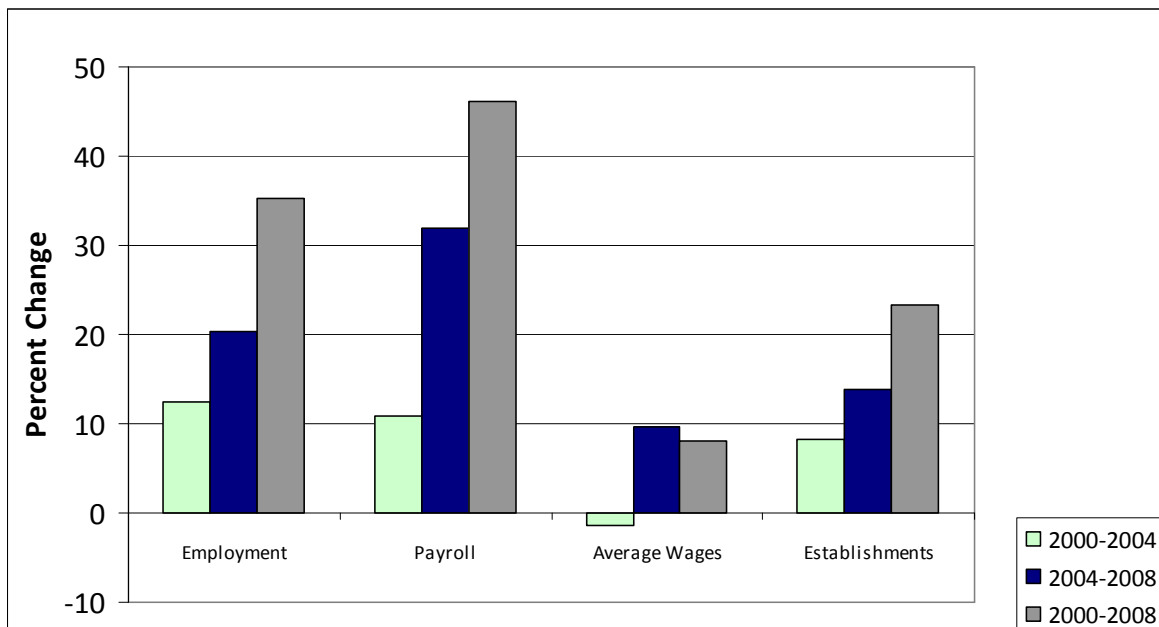
This region has less bioscience activity compared to the Northeast, Central, and Southwest regions. The West Central region contains 9.5% of the total bioscience employment in Ohio, 7.7% of the total payroll, and 11.1% of the total establishments.

The West Central region was the fourth largest region in 2008 in terms of bioscience employment (5,277), payroll (\$301.3 million), average wages (\$57,089), and number of establishments (180), following the Northeast, Central and Southwest regions. The average wage of bioscience employees in this region is \$13,143 less than the average for the entire state, making it more competitive than other regions.

The bioscience sector did grow relatively fast in this region. The West Central region had the third-highest growth rate in terms of employment in the state between 2000 and 2004 (12.4%) (Figure 10). Between 2004 and 2008, employment grew at the second-highest rate in the state (20.3%). For the entire study period, this region saw 35.2% growth in terms of employment,

again ranking second in the state. For the entire period, the West Central region was ranked second in terms of payroll growth (46.2%) and fourth in terms of growth in average wage (8.1%) and the number of establishments (23.3%). The only decrease was in average wage from 2000 to 2004 (1.4%).

Figure 10: Percentage Change in Employment, Payroll, Average Wages & Establishments for the West Central Region



Bioscience by Subsector

The two subsectors with the largest employment in 2008 in the West Central region are Medical Device & Equipment Manufacturers (2,179) and Medical Laboratories & Diagnostic Imaging Centers (1,040) (Table 12). Medical Device & Equipment Manufacturers also had the highest payroll with \$123.4 million. The highest average wage was paid in Pharmaceutical & Therapeutics, but the information is suppressed due to confidentiality. The second-highest average wage was in Research & Development (\$77,268) followed by both Agricultural Biotechnology and Medical Device & Equipment Manufacturers, each of which paid over \$55,000 per year. The average wages in the West Central region were lower than the average wages in the state in each of the subsectors. In 2008, there were 63 establishments in the Medical Laboratories & Diagnostic Imaging Centers subsector, which was the subsector with the second-lowest average wage and average number of employees per establishment (the lowest ranked subsector was Testing Laboratories, but its information also needed to be suppressed due to confidentiality). There were only 12 Agricultural Biotechnology establishments in 2008, but they had the highest average number of employees per establishment with 81.

Table 12: Employment, Payroll, Average Wage & Establishments in the West Central Region, 2008⁸

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|------------|--------------|-------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 977 | 53,943,128 | 55,232 | 12 | 81 |
| Medical Device & Equipment Manufacturers | 2,179 | 123,379,364 | 56,622 | 32 | 68 |
| Medical Labs & Diagnostic Imaging Centers | 1,040 | 43,209,308 | 41,547 | 63 | 17 |
| Pharmaceuticals & Therapeutics | NA | NA | NA | NA | NA |
| Research & Development | 763 | 58,967,240 | 77,268 | 40 | 19 |
| Testing Laboratories | NA | NA | NA | NA | NA |
| Total West Central | 5,277 | 301,269,740 | 57,089 | 180 | 29 |

All of the subsectors saw growth between 2000 and 2008 in terms of employment, payroll, and the number of establishments. In terms of employment, Agricultural Biotechnology saw the highest increase at 59.7%, followed by Medical Device & Equipment Manufacturers with a 46.8% increase. Medical Device & Equipment Manufacturers had a 60.5% increase in payroll over the entire study period and Medical Laboratories & Diagnostic Imaging Centers saw a 45.5% increase. There was a 71.4% increase in the number of Agricultural Biotechnology establishments and a 50.0% increase in the number of Medical Laboratories & Diagnostic Imaging Center establishments.

BIOSCIENCE SECTOR IN THE NORTHWEST REGION

General Trends

The Northwest region of Ohio contains 18 counties: Allen, Auglaize, Defiance, Fulton, Hancock, Hardin, Henry, Lucas, Mercer, Ottawa, Paulding, Putnam, Sandusky, Seneca, Van Wert, Williams, Wood and Wyandot. Only two MSAs are included in the region: the Toledo MSA with four counties and the Lima MSA with one county. The remaining 13 are non-metro counties. This region is home to the cities of Toledo, Bowling Green, Findlay, and Lima.

The Northwest region has only a small share of the bioscience activity within Ohio. It represents 5.0% of total bioscience employment, 3.6% of the payroll, and 8.3% of the establishments.

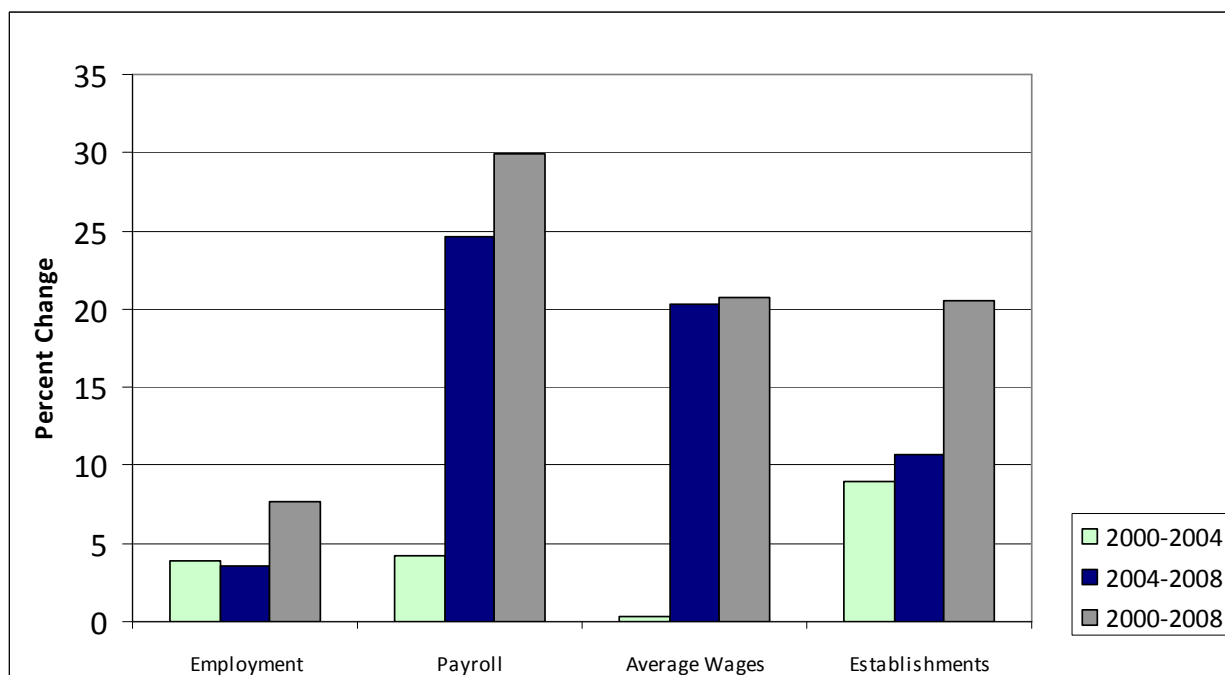
In terms of bioscience employment, this region is the second-smallest in the state. It has 2,756 employees, a payroll of \$138.3 million, an average wage of \$50,197, and 135 establishments. The average wage of employees in the bioscience industry in the Northwest region is nearly

⁸ NA indicates that data in these subsectors is suppressed due to confidentiality restrictions as data cannot be reported if there are less than three companies in any one area or if one company has 80% or more of the total employment.

\$22,000 lower than the state average for the bioscience industry, making it a very wage competitive area.

The Northwest region grew slower than the state average in terms of employment and the number of establishments from 2000 to 2008. Payroll increased by 29.9% which is almost equal with the overall average for Ohio (Figure 11). Average wages in this region increased by 20.7% over the study period, which was the highest growth rate in all of the Ohio regions.

Figure 11: Percentage Change in Employment, Payroll, Average Wages & Establishments for the Northwest Region



Bioscience by Subsector

In 2008, the largest subsector in terms of employment was Agricultural Biotechnology with 823 employees (Table 13). Medical Laboratories & Diagnostic Imaging Centers was the second-largest subsector with 779 jobs, followed by Medical Device & Equipment Manufacturers with 468 employees.

Agricultural Biotechnology had the highest payroll (\$54.5 million), followed by Medical Laboratories & Diagnostic Imaging Centers (\$30.9 million) and Research & Development (\$23.1 million). The highest average wage was in Agricultural Biotechnology, the largest subsector, which paid \$66,225. In 2008, the average wages in each of the subsectors were significantly lower than the state levels by as much as \$33,500 (Pharmaceuticals & Therapeutics). Medical Laboratories & Diagnostic Imaging Centers had the most establishments (58) and Agricultural Biotechnology had the highest average number of employees per establishment (51). There

were only three Pharmaceuticals & Therapeutics establishments in the Northwest region in 2008.

Table 13: Employment, Payroll, Average Wage & Establishments in the Northwest Region, 2008

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|------------|--------------|-------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 823 | 54,503,356 | 66,225 | 16 | 51 |
| Medical Device & Equipment Manufacturers | 468 | 19,010,472 | 40,649 | 26 | 18 |
| Medical Labs & Diagnostic Imaging Centers | 779 | 30,872,688 | 39,614 | 58 | 13 |
| Pharmaceuticals & Therapeutics | 66 | 3,118,368 | 47,013 | 3 | 22 |
| Research & Development | 390 | 23,089,356 | 59,170 | 13 | 30 |
| Testing Laboratories | 229 | 7,747,852 | 33,771 | 19 | 12 |
| Total Northwest | 2,756 | 138,342,092 | 50,197 | 135 | 20 |

Within the bioscience sector, the subsector that experienced the most growth in the Northwest region was Research & Development. Between 2000 and 2008, R&D grew by 96.5% in terms of employment and by 175.4% in payroll. Overall, employment grew in four of the six subsectors, but decreased in Medical Device & Equipment Manufacturers (-23.9%) and Testing Laboratories (-19.2%). These two subsectors were also the only two to lose in payroll (-22.8% and -20.3%, respectively) and in the number of establishments (-3.7% and -13.6%, respectively).

BIOSCIENCE SECTOR IN THE SOUTHEAST REGION

General Trends

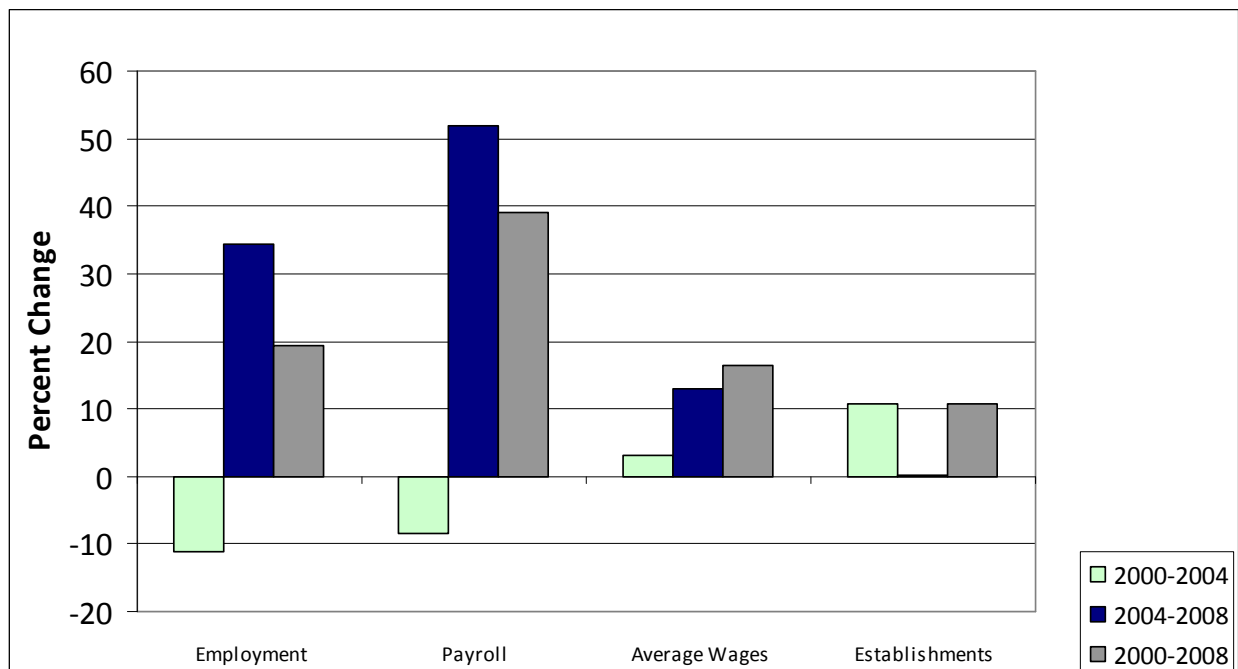
The Southeast region includes the cities of Marietta, Athens, Portsmouth, and Zanesville and contains 19 counties: Adams, Athens, Belmont, Coshocton, Gallia, Guernsey, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Pike, Scioto, Vinton and Washington. All of these counties are rural, non-metro counties.

The Southeast region had the smallest percentage of the total bioscience activity within Ohio in 2008. It represents only 2.8% of the total employment, 2.0% of the total payroll, and 3.1% of the total establishments. Of all six regions in Ohio in 2008, the Southeast is the smallest in terms of employment (1,540), payroll (\$77.3 million), average wage (\$50,182), and the number of establishments (51). The bioscience average wage in the Southeast region was over \$20,000 lower than the state average in the bioscience sector.

From 2000 to 2004, the Southeast region had the lowest growth rate in terms of employment, losing 11.2% of the bioscience workforce (Figure 12). However, the region's bioscience employment grew by 34.5% between 2004 and 2008 for an overall growth of 19.4% for the entire study period. The Southeast region had the third-highest growth in employment from

2000 to 2008. Payroll in the region declined by 8.4% between 2000 and 2004, but for the entire study period its payroll grew at the third-fastest rate (39.2%). The Southeast region had the second-highest growth in terms of average wage (16.5%) but had the lowest growth in the number of establishments (10.9%) between 2000 and 2008.

Figure 12: Percentage Change in Employment, Payroll, Average Wages & Establishments for the Southeast Region



Bioscience by Subsector

The largest subsector in terms of employment in 2008 was Medical Device & Equipment Manufacturers with 666 employees (Table 14). The next highest was Agricultural Biotechnology with 374 employees. The Medical Device & Equipment Manufacturers subsector also had the largest payroll in 2008 (\$33.4 million). Again, Agricultural Biotechnology was second with a payroll of \$24.2 million. Agricultural Biotechnology paid the highest average wage in 2008 of \$64,575, followed by Medical Device & Equipment Manufacturers' average wage of \$50,237. Medical Laboratories & Diagnostic Imaging Centers and Testing Laboratories had the lowest average wages. However, Medical Laboratories & Diagnostic Imaging Centers had the most establishments (22), followed by Medical Device & Equipment Manufacturers with 11 establishments. The two suppressed subsectors had only a few establishments: Pharmaceuticals & Therapeutics and Research & Development. Both the Agricultural Biotechnology and Medical Device & Equipment Manufacturers subsectors had over 60 employees per establishment in 2008. In contrast, Medical Laboratories & Diagnostic Imaging Centers and Testing Laboratories each had fewer than seven employees per establishment.

Table 14: Employment, Payroll, Average Wage & Establishments in the Southeast Region, 2008⁹

| | Employment | Payroll (\$) | Average Wage (\$) | Establishments | Average Employees per Establishment |
|---|------------|--------------|-------------------|----------------|-------------------------------------|
| Agricultural Biotechnology | 374 | 24,172,252 | 64,575 | 6 | 62 |
| Medical Device & Equipment Manufacturers | 666 | 33,440,972 | 50,237 | 11 | 61 |
| Medical Labs & Diagnostic Imaging Centers | 138 | 4,417,420 | 31,934 | 22 | 6 |
| Pharmaceuticals & Therapeutics | NA | NA | NA | NA | NA |
| Research & Development | NA | NA | NA | NA | NA |
| Testing Laboratories | 44 | 1,462,536 | 33,606 | 6 | 7 |
| Total Southeast | 1,540 | 77,294,384 | 50,182 | 51 | 30 |

The Agricultural Biotechnology and Medical Laboratories & Diagnostic Imaging Centers performed well over the 2000 to 2008 study period. Both subsectors improved in employment (279.4% and 139.9%, respectively), payroll (544.3% and 181.2%, respectively) and the number of establishments (20% and 100%, respectively). In contrast, the Medical Device & Equipment Manufacturers and the Testing Laboratories subsectors lost employment, payroll, and establishments between 2000 and 2008. Though this region started from a smaller base, the growth rates in Agricultural Biotechnology and Medical Laboratories & Diagnostic Imaging Centers in this region were quite high when compared to the other regions throughout the state.

⁹ NA indicates that data in these subsectors is suppressed due to confidentiality restrictions.

ECONOMIC IMPACT OF THE BIOSCIENCE SECTOR IN OHIO

INTRODUCTION

The bioscience sector in Ohio is linked to other industries through buy-sell relationships. In order to produce goods and services, companies in this sector buy intermediary goods and services from other companies in their own industries as well as from other industries that are not in the bioscience sector. The buy-sell relationships that occur within the state of Ohio contribute to the economic impact of the sector.

Five measures of impact are used: employment, output, value added, labor income, and taxes. *Employment* measures the number of jobs that are present because of the existence of the bioscience sector. *Output* measures the total value of goods and services produced in the state as a result of the activities of the bioscience sector. *Value added* measures the value of goods and services less the intermediary goods; value added is a portion of output. *Labor income* is payroll paid to employees plus proprietors' income. *Taxes* include federal, state and local tax revenues.

Each of the impacts, except for taxes, is a summation of direct impact, indirect impact, and induced impact. *Direct impact* is the initial value of goods and services the sector purchases in the state. *Indirect impact* measures the jobs and production needed to produce goods and services required by the sector. *Induced impact* is the increase in spending of local households because of income received through their work in the bioscience sector and its suppliers.

ECONOMIC IMPACT OF BIOSCIENCE

The bioscience sector in Ohio accounted for 162,859 jobs in 2008. Of these, 52,304 jobs, or 32%, were the direct impact of the sector representing primarily the jobs that exist in bioscience industries (with some adjustments).¹⁰ An additional 66,240 (41%) employees worked for industries that sell goods and services to the bioscience industry and its suppliers. In addition, 44,314 employees work for industries that sell goods and services to households in Ohio that are associated with the bioscience industry and its suppliers. Table 15 shows the economic impact of the bioscience sector, presenting estimates for these direct, indirect and induced effects.

¹⁰ The number of jobs reported as direct impact is lower than the number of bioscience employees reported in the trend analysis (55,465). Two adjustments explain this difference. First, each industry was adjusted in IMPLAN to capture only the production of its own product. Second, IMPLAN model had to be adjusted to account for the difference between the model year (2007) and the data year (2008).

Table 15: Economic Impact of Bioscience in Ohio (by Direct, Indirect, and Induced Impacts), 2008

| | Employment | Output | Value Added | Labor Income |
|------------------|------------|------------|-------------|--------------|
| Direct | 52,304 | \$27,859.3 | \$6,844.0 | \$4,364.5 |
| Indirect | 66,240 | \$13,996.2 | \$5,652.6 | \$3,588.5 |
| Induced | 44,314 | \$4,873.6 | \$2,698.1 | \$1,530.4 |
| Total Bioscience | 162,859 | \$46,729.1 | \$15,194.7 | \$9,483.4 |

Note: Output, Value Added, and Labor Income in millions of dollars.

The estimated output impact of the bioscience industry is \$46.7 billion. This is the value of goods and services that were produced in Ohio through all the buy-sell relationships that were affiliated with the bioscience sector. Of these, 60% were associated with direct impact, 30% with indirect impact, and 10% with induced impact. Excluding all the intermediate goods and services, the value added of the goods and services that were produced in Ohio in 2008 in association with bioscience was \$15.2 billion. Of that, 45% was due to the direct impact, 37% to indirect impact, and 18% to induced impact.

Nearly \$9.5 billion of household income was affiliated with the bioscience sector in Ohio. Its distribution within the impact components is similar to that of value added. Finally, \$3.4 billion of tax revenues are associated with the bioscience sector. Of that, \$2.1 billion (61.4%) are federal tax revenues and \$1.3 billion (38.8%) are state and local tax revenues.

To summarize, the economic impact of the bioscience sector in Ohio in 2008 was:

- Employment impact 162,859 jobs
- Output impact \$46.729 billion
- Value-added impact \$15.195 billion
- Labor income impact \$9.483 billion
- Tax revenues \$3.364 billion

ECONOMIC IMPACT OF BIOSCIENCE SUBSECTORS

The bioscience sector consists of six subsectors. Table 16 summarizes the total economic impact in each of the subsectors of bioscience in Ohio using the five measures of impact. *Agricultural Biotechnology* is the subsector with the most impact; its employment impact is nearly 62,807 jobs, its value-added impact is \$6.5 billion, and its labor income impact is \$3.6 billion (Table 16).¹¹ Agricultural biotechnology accounts for 39% of bioscience sector's employment impact, 56% of output, 43% of value added and 46% of tax revenues. According to

¹¹ Although Agricultural Biotechnology has the largest impact, the largest subsector in direct employment as outlined in the previous section is Medical Device & Equipment Manufacturers. The Agricultural Biotechnology subsector has the largest impact because the industries included in this subsector have relatively large multipliers, especially in the indirect portion.

most impact measures, the subsector with the second-largest impact is Medical Device & Equipment Manufacturing followed very closely by Pharmaceuticals & Therapeutics. Medical Device & Equipment manufacturing accounts for 23% of bioscience impact measured in terms of employment and labor income and it accounts for 18% of bioscience output impact. Figure 13 shows the percentages of bioscience impact for each of the six subsectors.

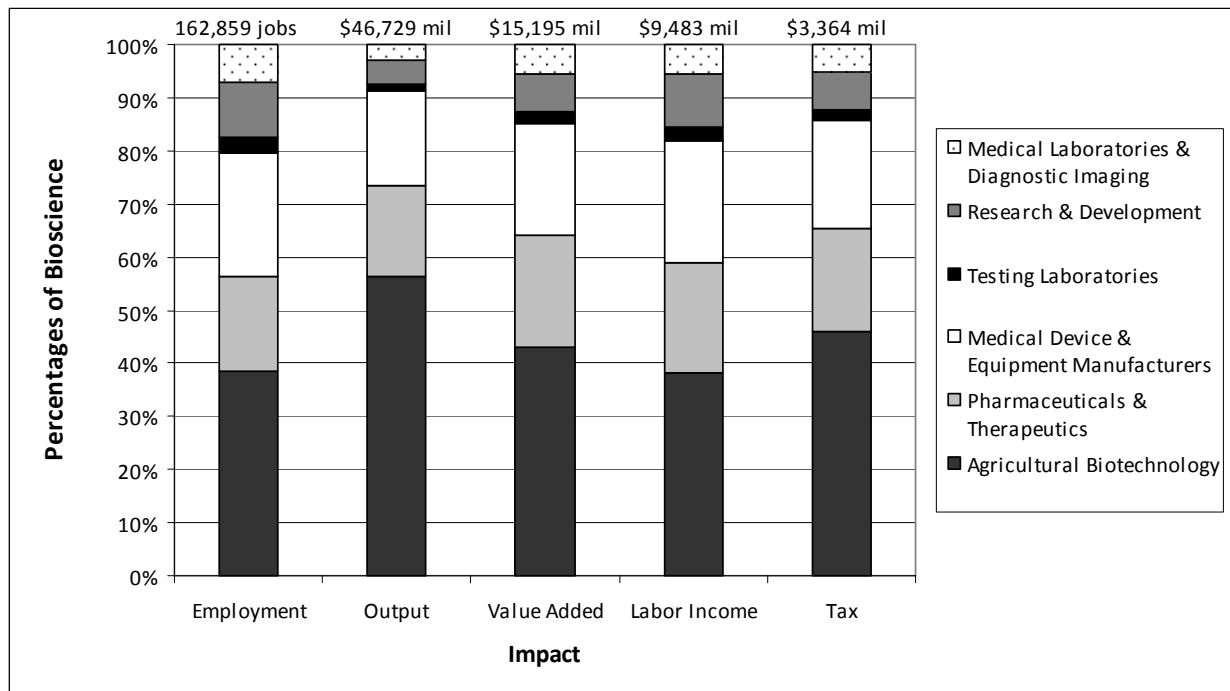
Table 16: Economic Impact of Bioscience by Subsector in Ohio, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|------------|------------|-------------|--------------|-----------|
| Agricultural Biotechnology | 62,807 | \$26,354.5 | \$6,517.6 | \$3,617.4 | \$1,547.8 |
| Medical Device & Equipment Manufacturers | 38,019 | \$8,336.4 | \$3,219.9 | \$2,178.1 | \$681.9 |
| Medical Laboratories & Diagnostic Imaging | 11,763 | \$1,434.6 | \$844.5 | \$510.3 | \$172.4 |
| Pharmaceuticals & Therapeutics | 28,686 | \$8,018.6 | \$3,205.1 | \$1,965.2 | \$652.3 |
| Research & Development | 16,562 | \$2,060.5 | \$1,094.9 | \$950.4 | \$242.3 |
| Testing Laboratories | 5,022 | \$524.5 | \$312.7 | \$262.1 | \$67.5 |
| Total | 162,859 | \$46,729.1 | \$15,194.7 | \$9,483.4 | \$3,364.2 |

Output, Value Added, Labor Income and Tax in millions of dollars.

The subsector with the smallest impact is Testing Laboratories, which accounts for 1% to 3% of the economic impacts of the bioscience sector. Medical Laboratories & Diagnostic Imaging Centers also have small impact, accounting for 3% to 7% of impact.

Figure 13: Percentage of Economic Impact by Bioscience Subsector in Ohio, 2008



ECONOMIC IMPACT OF BIOSCIENCE IN OHIO'S SIX REGIONS

All of Ohio's six regions participate in the bioscience sector, but as indicated earlier in the report, three regions account for the majority of the industry: Northeast, Central, and Southwest. These three regions include the three largest metropolitan areas in Ohio: Cleveland, Columbus, and Cincinnati. Employment impact of bioscience in the Northeast region is nearly 57,000 jobs and accounts for 35% of the state's employment impact of bioscience (Table 17). The Central region accounts for over 37,000 jobs, or 23%, and the Southwest region accounts for over 30,000 jobs, or 19% of the employment impact of bioscience in Ohio.

Table 17: Economic Impact of Bioscience by Region, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|------------------|------------|------------|-------------|--------------|-----------|
| Central | 37,361 | \$9,699.9 | \$3,680.0 | \$2,393.2 | \$782.1 |
| Northeast | 56,965 | \$17,788.6 | \$5,437.5 | \$3,316.6 | \$1,219.5 |
| Southeast | 3,729 | \$1,273.4 | \$320.0 | \$188.4 | \$73.2 |
| Northwest | 7,785 | \$2,453.0 | \$616.5 | \$375.0 | \$139.0 |
| Southwest | 30,285 | \$8,958.2 | \$3,067.3 | \$1,929.6 | \$667.1 |
| West Central | 13,563 | \$3,371.6 | \$1,104.4 | \$725.2 | \$245.6 |
| Total Bioscience | 162,859 | \$46,729.1 | \$15,194.7 | \$9,483.4 | \$3,364.2 |

Notes:

Output, Value Added, Labor Income and Tax in millions of dollars.

Regions do not add up to total for Ohio because some establishments are statewide or could not be placed into one of the regions. In future updates of this study, additional efforts will be made to assign these companies to specific counties

The rest of this section will describe the economic impact of bioscience and its subsectors in the three large regions. Information about the three smaller regions will be described briefly.

Economic Impact of Bioscience in Northeast Ohio

In Northeast Ohio, there were 56,965 jobs, \$17.8 billion of goods and services produced in Northeast Ohio, \$5.4 billion of value-added production, and \$3.3 billion of labor income due to the bioscience sector (Table 18). Of the employment impact, 31% was attributed to direct impact, 41% to indirect impact, and 27% to induced impact. Of the labor income impact of bioscience in Northeast Ohio, 46% was attributable to direct impact, 38% to the indirect impact, and 16% to the induced impact. Tax revenues amounted to \$1.2 billion, of which 60% went to the federal government and 40%, or \$485 million, went to Ohio and local governments in the region.

Table 18: Economic Impact of Bioscience in the Northeast Region (by Direct, Indirect, and Induced Impacts), 2008

| | Employment | Output | Value Added | Labor Income |
|--------------|---------------|-------------------|------------------|------------------|
| Direct | 17,865 | \$11,339.7 | \$2,553.1 | \$1,527.6 |
| Indirect | 23,490 | \$4,798.2 | \$1,961.5 | \$1,263.8 |
| Induced | 15,609 | \$1,650.7 | \$922.9 | \$525.3 |
| Total | 56,965 | \$17,788.6 | \$5,437.5 | \$3,316.6 |

Output, Value Added, Labor Income and Tax in millions of dollars.

The bioscience subsector with the highest impact in Northeast Ohio is Agricultural Biotechnology. Its impact is significantly larger than the second most important subsector, Medical Device & Equipment Manufacturers (Table 19). This subsector accounts for 33% of the bioscience employment impact, 24% of output impact, 29% of value added, 32% of labor income, and 27% of tax revenues.

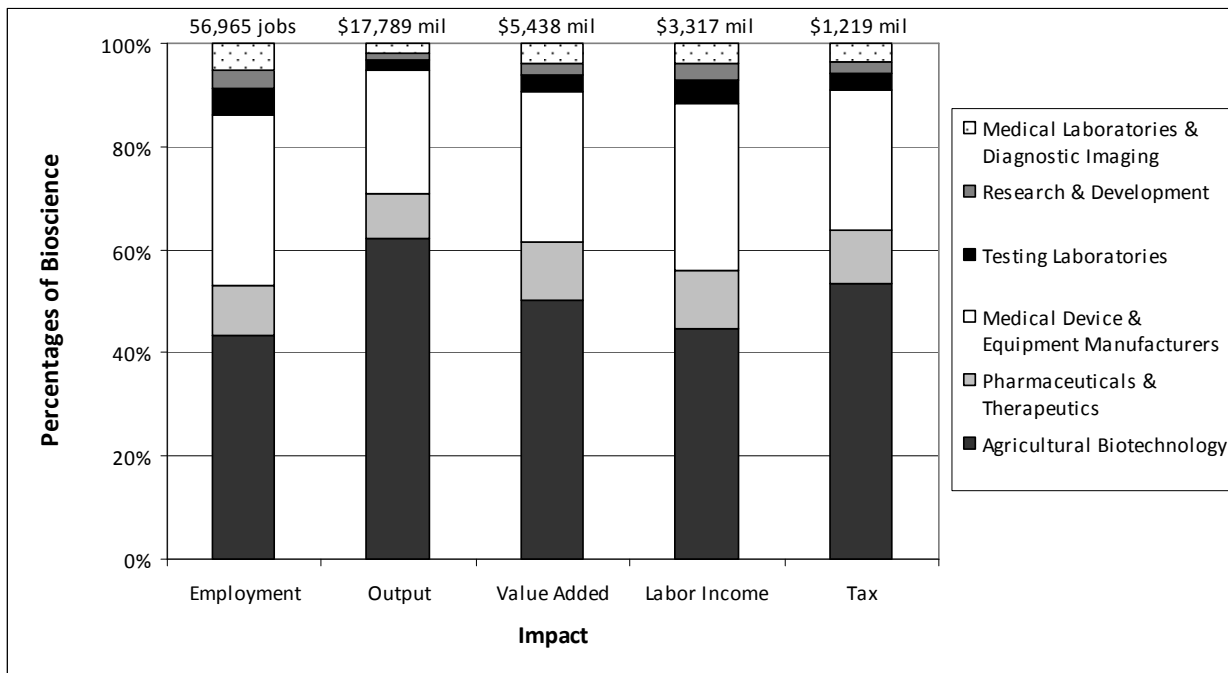
Table 19: Economic Impact of Bioscience by Subsector in the Northeast Region, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|---------------|-------------------|------------------|------------------|------------------|
| Agricultural Biotechnology | 24,695 | \$11,048.1 | \$2,726.5 | \$1,478.3 | \$650.8 |
| Pharmaceuticals & Therapeutics | 5,498 | \$1,544.3 | \$615.9 | \$378.4 | \$124.7 |
| Medical Device & Equipment Manufacturers | 18,903 | \$4,302.9 | \$1,582.1 | \$1,072.6 | \$335.2 |
| Testing Laboratories | 2,938 | \$303.8 | \$180.0 | \$151.6 | \$38.7 |
| Research & Development | 1,950 | \$237.7 | \$126.0 | \$110.4 | \$27.8 |
| Medical Laboratories & Diagnostic Imaging | 2,981 | \$351.7 | \$207.0 | \$125.3 | \$42.2 |
| Total Bioscience | 56,965 | \$17,788.6 | \$5,437.5 | \$3,316.6 | \$1,219.5 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Pharmaceuticals & Therapeutics, the subsector with the third-largest impact has considerably less impact than the first two subsectors (Figure 14). It accounts for about 10% of the impact of bioscience in Northeast Ohio according to all measures of economic impact. The other three subsectors combined account for 13% of employment impact, 5% of output impact, 9% of value-added impact, 12% of labor income impact, and 8% of tax impact.

Figure 14: Percentage of Economic Impact by Bioscience Subsector in the Northeast Region, 2008



Economic Impact of Bioscience in Central Ohio

The economic impact of bioscience in Central Ohio in 2008 was 37,361 jobs, \$9.7 billion in output, \$3.7 billion in value added, and \$2.4 billion in labor income (Table 20). Of the employment impact, 37% was attributed to direct impact, 36% to indirect impact, and 27% to induced impact. Of the value-added impact of bioscience in Central Ohio, 51% was attributable to direct impact, 32% to the indirect impact, and 18% to the induced impact.

Table 20: Economic Impact of Bioscience in the Central Region (by Direct, Indirect, and Induced Impacts), 2008

| | Employment | Output | Value Added | Labor Income |
|--------------|---------------|------------------|------------------|------------------|
| Direct | 13,839 | \$6,100.3 | \$1,860.5 | \$1,254.7 |
| Indirect | 13,325 | \$2,476.9 | \$1,168.8 | \$773.5 |
| Induced | 10,197 | \$1,122.7 | \$650.8 | \$365.0 |
| Total | 37,361 | \$9,699.9 | \$3,680.0 | \$2,393.2 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Impact of tax revenues in Central Ohio amounted to \$782 million, of which 63% went to the federal government and 37%, or \$291 million, remained in Ohio and the local governments in the region.

The bioscience subsector with the highest impact in Central Ohio is Pharmaceuticals & Therapeutics. This subsector has the most employees in comparison to other regions. Among the six subsectors in Central Ohio, Pharmaceuticals & Therapeutics has the second highest number of employees and the second highest employment multiplier. This combination results in the high overall impact of this subsector. This is significantly different from the Northeast Ohio region and the state as a whole, where Agricultural Biotechnology had the most impact.

Employment impact in the Pharmaceuticals & Therapeutics subsector was 12,267 jobs, accounting for 33% of bioscience employment impact in Central Ohio. Second-ranked was Agricultural Biotechnology (9,508 jobs) followed by Research & Development (7,737 jobs) (Table 21).

Table 21: Economic Impact of Bioscience by Subsector in the Central Region, 2008

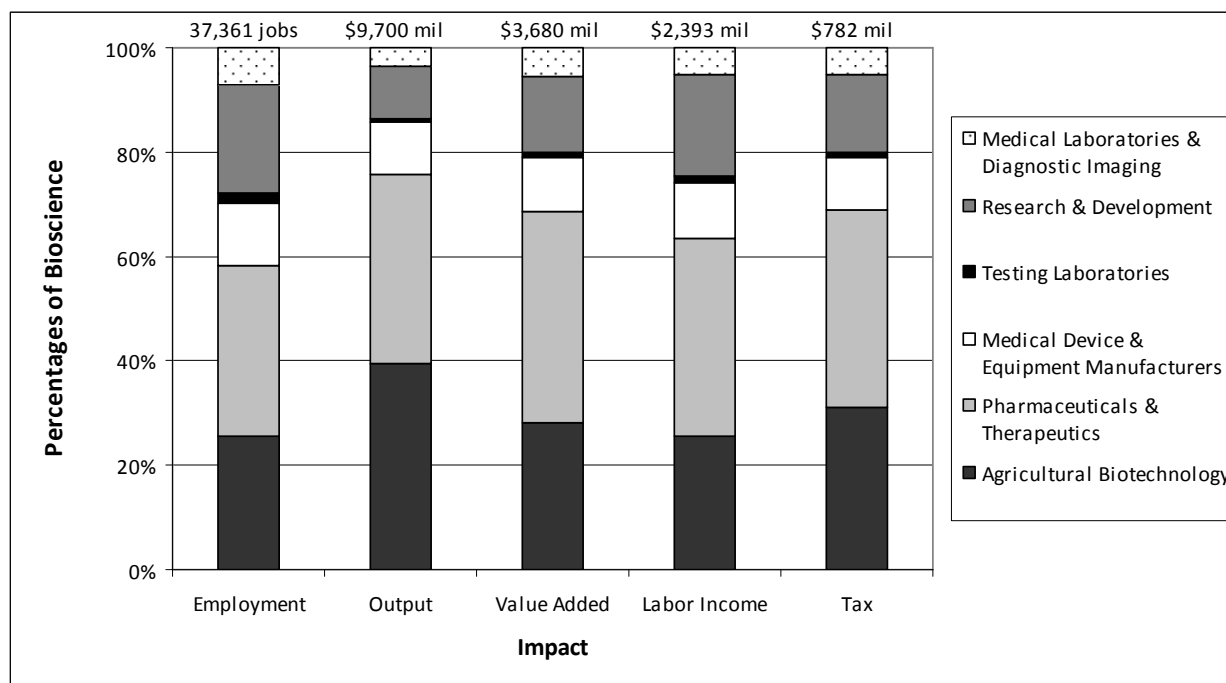
| | Employment | Output | Value Added | Labor Income | Tax |
|---|------------|-----------|-------------|--------------|---------|
| Agricultural Biotechnology | 9,508 | \$3,814.7 | \$1,039.9 | \$612.1 | \$243.9 |
| Medical Device & Equipment Manufacturers | 4,468 | \$965.4 | \$379.8 | \$254.8 | \$78.3 |
| Medical Laboratories & Diagnostic Imaging | 2,713 | \$337.1 | \$202.1 | \$121.8 | \$40.6 |
| Pharmaceuticals & Therapeutics | 12,267 | \$3,542.3 | \$1,485.4 | \$903.6 | \$294.6 |
| Research & Development | 7,737 | \$971.7 | \$531.0 | \$465.6 | \$115.7 |
| Testing Laboratories | 667 | \$68.8 | \$41.8 | \$35.2 | \$8.9 |
| Total Bioscience | 37,361 | \$9,699.9 | \$3,680.0 | \$2,393.2 | \$782.1 |

Output, Value Added, Labor Income and Tax in millions of dollars.

The Pharmaceuticals & Therapeutics subsector had the most impact not only in employment, but also measured in value added, labor income and tax revenues (Figure 15).

Unique to Central Ohio is Research & Development, which is the third-ranked subsector in bioscience impact in the region. R&D accounts for 21% of employment impact in Central Ohio, while it accounts for only 10% of employment impact statewide. In contrast to the larger subsectors, the Testing Laboratories subsector and the Medical Laboratories & Diagnostic Imaging Centers have the least impact in the Central region based on all measures of economic impact; this is consistent with the findings for the whole state. The two subsectors combined account for only 9% of employment impact, 4% of output impact, 7% of value-added and labor income impact, and 6% of tax impact.

Figure 15: Percentage of Economic Impact by Bioscience Subsector in the Central Region, 2008



Economic Impact of Bioscience in Southwest Ohio

The economic impact of bioscience in Southwest Ohio in 2008 was 30,285 jobs, \$8.9 billion in output, \$3.1 billion in value added, and \$1.9 billion in labor income (Table 22). Of the employment impact, 35% was attributed to direct impact, 39% to indirect impact, and 26% to induced impact. Of the value-added impact of bioscience in Central Ohio, 50% was attributable to direct impact, 33% to indirect impact, and 16% to induced impact.

Table 22: Economic Impact of Bioscience in the Southwest Region (by Direct, Indirect, and Induced Impacts), 2008

| | Employment | Output | Value Added | Labor Income |
|--------------|---------------|------------------|------------------|------------------|
| Direct | 10,688 | \$5,763.3 | \$1,536.4 | \$957.5 |
| Indirect | 11,690 | \$2,316.8 | \$1,026.8 | \$685.0 |
| Induced | 7,907 | \$878.1 | \$504.1 | \$287.1 |
| Total | 30,285 | \$8,958.2 | \$3,067.3 | \$1,929.6 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Impact of tax revenues in Southwest Ohio amounted to \$667.1 million, of which 63% went to the federal government and 37%, or \$250 million, remained in Ohio and the local governments in the region.

According to all measures of impact, the Agricultural Biotechnology is the subsector with the most impact on Southwest Ohio. It is followed by Pharmaceuticals & Therapeutics which has the second-highest impact and Medical Device & Equipment Manufacturers with the third-largest impact on Southwest Ohio (Table 23).

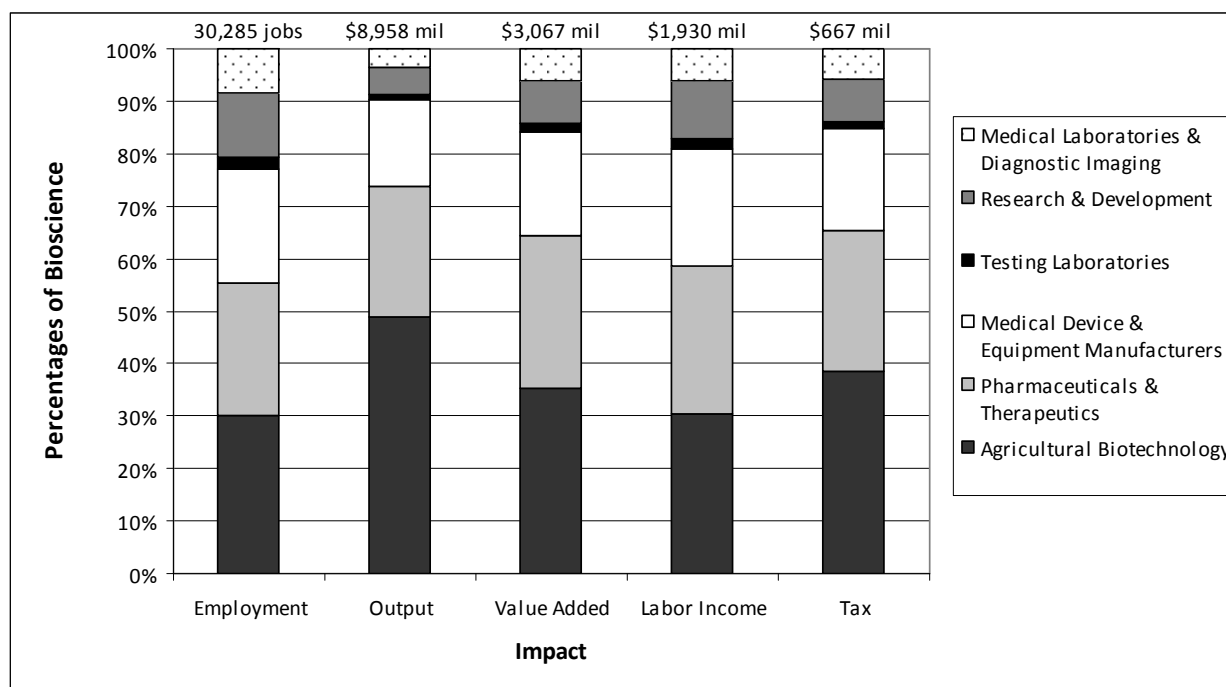
Table 23: Economic Impact of Bioscience by Subsector in the Southwest Region, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|------------|-----------|-------------|--------------|---------|
| Agricultural Biotechnology | 9,098 | \$4,372.8 | \$1,082.5 | \$584.9 | \$256.0 |
| Medical Device & Equipment Manufacturers | 6,571 | \$1,494.0 | \$609.7 | \$428.0 | \$128.9 |
| Medical Laboratories & Diagnostic Imaging | 2,535 | \$319.4 | \$191.2 | \$115.7 | \$38.6 |
| Pharmaceuticals & Therapeutics | 7,668 | \$2,234.9 | \$891.0 | \$546.1 | \$179.7 |
| Research & Development | 3,701 | \$459.3 | \$245.5 | \$214.7 | \$53.8 |
| Testing Laboratories | 711 | \$77.8 | \$47.5 | \$40.2 | \$10.1 |
| Total Bioscience | 30,285 | \$8,958.2 | \$3,067.3 | \$1,929.6 | \$667.1 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Agricultural Biotechnology accounts for 30% of bioscience employment impact in Southwest Ohio, 49% of output impact, 35% of value-added impact, 30% of labor income impact, and 38% of tax impact (Figure 16). The subsector with the lowest impact in the Southwest region and the state overall is Testing Laboratories which accounts for only 1% to 2% of the bioscience economic impact.

Figure 16: Percentage of Economic Impact by Bioscience Subsector in the Southwest Region, 2008



Economic Impact of Bioscience in the West Central, Northwest, and Southeast Ohio Regions

The three remaining regions account for a small piece of Ohio bioscience sector. Ranked by the size of the bioscience sector, they include the West Central, Northwest and Southeast regions. In all three, the Agricultural Biotechnology subsector has the largest impact. Medical Device & Equipment Manufacturers ranked second-highest in two of the small regions. In contrast to the state as a whole, Medical Laboratories & Diagnostic Imaging Centers was the second- highest ranking subsector in Northwest Ohio and third-highest in the West Central region. These high rankings for the subsector with the lowest annual wages among bioscience are due to the lack of other bioscience industries in these regions. Testing Laboratories has the smallest impact in terms of output in all three regions and also had the lowest employment in two of the regions.

Tables 24, 25 and 26 show the total economic impact of bioscience and its subsectors in each of the three small regions.

Table 24: Economic Impact of Bioscience by Subsector in the West Central 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|------------|-----------|-------------|--------------|---------|
| Agricultural Biotechnology | 5,739 | \$2,044.2 | \$479.6 | \$288.8 | \$113.9 |
| Medical Device & Equipment Manufacturers | 4,185 | \$818.5 | \$353.4 | \$241.5 | \$74.6 |
| Medical Laboratories & Diagnostic Imaging | 1,607 | \$202.2 | \$121.2 | \$73.8 | \$24.5 |
| Pharmaceuticals & Therapeutics | 398 | \$114.1 | \$45.8 | \$28.1 | \$9.3 |
| Research & Development | 1,378 | \$168.8 | \$90.4 | \$81.1 | \$20.2 |
| Testing Laboratories | 256 | \$23.8 | \$14.1 | \$12.0 | \$3.0 |
| Total Bioscience | 13,563 | \$3,371.6 | \$1,104.4 | \$725.2 | \$245.6 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Table 25: Economic Impact of Bioscience by Subsector in the Northwest Region, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|------------|-----------|-------------|--------------|---------|
| Agricultural Biotechnology | 4,566 | \$1,988.6 | \$392.0 | \$219.4 | \$92.0 |
| Pharmaceuticals & Therapeutics | 147 | \$40.8 | \$12.2 | \$7.4 | \$2.5 |
| Medical Device & Equipment Manufacturers | 898 | \$176.5 | \$74.8 | \$49.7 | \$15.7 |
| Testing Laboratories | 309 | \$28.0 | \$16.8 | \$14.4 | \$3.7 |
| Research & Development | 686 | \$78.9 | \$38.9 | \$34.5 | \$8.5 |
| Medical Laboratories & Diagnostic Imaging | 1,180 | \$140.3 | \$81.8 | \$49.6 | \$16.6 |
| Total Bioscience | 7,785 | \$2,453.0 | \$616.5 | \$375.0 | \$139.0 |

Output, Value Added, Labor Income and Tax in millions of dollars.

Table 26: Economic Impact of Bioscience by Subsector in the Southeast Region, 2008

| | Employment | Output | Value Added | Labor Income | Tax |
|---|--------------|------------------|----------------|----------------|---------------|
| Agricultural Biotechnology | 1,758 | \$873.9 | \$173.5 | \$94.3 | \$42.6 |
| Medical Device & Equipment Manufacturers | 1,115 | \$212.1 | \$91.7 | \$56.1 | \$18.7 |
| Medical Laboratories & Diagnostic Imaging | 190 | \$20.3 | \$11.6 | \$7.0 | \$2.3 |
| Pharmaceuticals & Therapeutics | 542 | \$155.3 | \$37.3 | \$25.6 | \$8.1 |
| Research & Development | 71 | \$7.8 | \$3.6 | \$3.3 | \$0.8 |
| Testing Laboratories | 54 | \$4.1 | \$2.4 | \$2.1 | \$0.5 |
| Total Bioscience | 3,729 | \$1,273.4 | \$320.0 | \$188.4 | \$73.2 |

Output, Value Added, Labor Income and Tax in millions of dollars.

CONCLUDING COMMENTS

The bioscience sector consists primarily of various companies that utilize knowledge of the way plants, animals, and humans function. These companies are involved in production, research, development, and/or testing. The industry extends across different markets and includes manufacturing, services, research, and healthcare activities.

Bioscience is a globally competitive sector. Two large centers of excellence in the United States are California and the Northeast corridor from Washington DC to Boston. The bioscience sector has been growing in Ohio. Two critical elements are needed to continue and expand this industry – a strong research capability and the ability to transform this research into profitable commercial activity. These elements are important for the attraction of companies from other regions of the U.S., or from other counties, as well as for starting new companies in Ohio and increasing their probability of survival and growth. A key factor that is necessary for commercialization is access to capital across the continuum from pre-seed funding to venture capital and private equity. In the last few years Ohio has increased research funding at its universities and nationally known healthcare institutions. There are also additional initiatives that support commercialization and promote startup companies in bioscience, such as BioEnterprise in Northeast Ohio, BioStart in Cincinnati, Edison Biotechnology Institute in Athens, TechColumbus, and Akron Global Business Accelerator. Through funding from Ohio's Third Frontier, there are regional Entrepreneurial Signature Programs like JumpStart, CincyTechUSA and Launch that work with startup bioscience companies. There are also additional venture companies which are opening offices and investing in new companies in Ohio. The bioscience sector builds on the state's strength in healthcare, research and development, and agriculture.

The bioscience sector, as defined in this study, employed 55,635 people in Ohio in 2008, with a payroll of \$3.9 billion. Moreover, employment in the bioscience sector in Ohio grew nearly 18% from 2000 to 2008, while the whole economy contracted losing 4.2% of total employment. On average, the bioscience sector employs high-skill, high-wage employees, as is evidenced by an average wage of over \$70,000. Moreover, average wage in the bioscience sector grew by over 10% since 2000, after adjusting for inflation. The total employment impact of the bioscience sector in Ohio is 162,859 jobs.

The bioscience sector is projected to continue to grow nationally and internationally. It is expected that Ohio will participate in the future growth of the global bioscience industry.

APPENDIX

APPENDIX A: DESCRIPTION OF EXAMINATION OF LARGE BIOSCIENCE COMPANIES

All companies with over 500 employees in the state of Ohio were examined prior to their inclusion in the final data set. Four large companies were examined in detail: Invacare, STERIS, Cardinal Health, and Philips Medical Systems. These four companies serve as an example of the level of detail that was paid to ensuring that the data set reflects the activity attributable to the bioscience industry.

For Invacare, the headquarters function is contained in its own building and therefore is not included in the analysis. This site is coded as a headquarters and contains functions that are related to administration and not the bioscience industry. Two other sites were excluded because they focus solely on wholesale. Six total sites for Invacare are included in the analysis including all sites from the BioOhio data set.

For STERIS, the headquarters building contains about one third of their Ohio employment, so this location was included in the analysis as it is impossible to separate out the bioscience employment from the administrative employment. A nearby site which houses their customer service center was omitted. Four other sites were excluded as they focus only on wholesale or warehousing. Two sites from the original BioOhio data set are not included because they were not found in the QCEW database. In all, three sites were included in the analysis.

There were two Cardinal Health sites identified by BioOhio that did not have bioscience NAICS codes assigned to them. The first site was a headquarters site (which accounts for about one half of their employment); it was assigned an administrative NAICS. The other site without a bioscience NAICS code was one that performs financial services. Both of these sites were not included in the bioscience analysis because their functions are related to administration and not the bioscience industry. One site from the BioOhio data set was not found in the QCEW database and is therefore not included. A total of three Cardinal Health locations are included.

For Philips Medical Systems, most of the company's locations throughout Ohio were already coded with bioscience NAICS. Over time, keeping all of the locations in the study evened out the large changes in employment that are visible in the various locations, which is most likely because of employees changing locations. All of the sites in the BioOhio data set for Philips Medical Systems were included in the analysis. A total of six locations of Philips Medical Systems are part of the final data set.

APPENDIX B: ECONOMIC IMPACT OF BIOSCIENCE IN OHIO & SIX REGIONS, 2008

Tables B-1 – B-7

APPENDIX Table B-1: Economic Impact of Bioscience in Ohio, 2008

| | Value Added | | | | Labor Income | | | |
|---|------------------------|------------------------|------------------------|-------------------------|------------------------|------------------------|------------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$2,178,210,308 | \$3,307,305,084 | \$1,032,115,016 | \$6,517,630,411 | \$1,073,193,545 | \$1,958,769,453 | \$585,413,132 | \$3,617,376,075 |
| Pharmaceuticals & Therapeutics | \$1,674,758,548 | \$976,241,418 | \$554,070,411 | \$3,205,070,258 | \$943,809,524 | \$707,094,614 | \$314,267,450 | \$1,965,171,505 |
| Medical Device & Equipment Manufacturers | \$1,672,463,028 | \$925,207,227 | \$622,186,144 | \$3,219,856,406 | \$1,190,355,284 | \$634,811,517 | \$352,902,438 | \$2,178,069,253 |
| Testing Laboratories | \$192,339,104 | \$45,823,585 | \$74,586,966 | \$312,749,654 | \$189,426,680 | \$30,338,006 | \$42,305,476 | \$262,070,162 |
| Research & Development | \$584,402,496 | \$240,870,138 | \$269,616,927 | \$1,094,889,514 | \$639,417,024 | \$158,019,771 | \$152,925,841 | \$950,362,713 |
| Medical Laboratories & Diagnostic Imaging | \$541,801,856 | \$157,147,305 | \$145,543,513 | \$844,492,624 | \$328,302,144 | \$99,472,750 | \$82,551,917 | \$510,326,827 |
| Total Bioscience | \$6,843,974,908 | \$5,652,594,737 | \$2,698,118,841 | \$15,194,688,621 | \$4,364,503,833 | \$3,588,506,102 | \$1,530,366,166 | \$9,483,376,098 |

| | Employment | | | | Output | | | |
|---|---------------|---------------|---------------|----------------|-------------------------|-------------------------|------------------------|-------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 8,595 | 37,260 | 16,952 | 62,807 | \$15,387,706,768 | \$9,102,466,225 | \$1,864,303,061 | \$26,354,475,799 |
| Pharmaceuticals & Therapeutics | 8,821 | 10,765 | 9,100 | 28,686 | \$4,899,256,512 | \$2,118,501,798 | \$1,000,814,004 | \$8,018,572,055 |
| Medical Device & Equipment Manufacturers | 16,383 | 11,417 | 10,219 | 38,019 | \$5,248,572,776 | \$1,963,988,917 | \$1,123,851,367 | \$8,336,413,096 |
| Testing Laboratories | 3,113 | 684 | 1,225 | 5,022 | \$306,514,824 | \$83,294,867 | \$134,725,967 | \$524,535,648 |
| Research & Development | 8,332 | 3,802 | 4,428 | 16,562 | \$1,130,147,072 | \$443,389,954 | \$487,007,408 | \$2,060,544,458 |
| Medical Laboratories & Diagnostic Imaging | 7,061 | 2,312 | 2,390 | 11,763 | \$887,132,416 | \$284,571,402 | \$262,894,427 | \$1,434,598,231 |
| Total Bioscience | 52,304 | 66,240 | 44,314 | 162,859 | \$27,859,329,568 | \$13,996,213,954 | \$4,873,595,923 | \$46,729,139,789 |

| | Tax | | |
|---|-----------------------------------|--|------------------------|
| | Federal Government Non Defense | State/Local Government Non Education | Total |
| Agricultural Biotechnology | \$858,103,088 | \$689,716,942 | \$1,547,820,030 |
| Pharmaceuticals & Therapeutics | \$427,728,285 | \$224,604,385 | \$652,332,670 |
| Medical Device & Equipment Manufacturers | \$449,194,188 | \$232,724,205 | \$681,918,393 |
| Testing Laboratories | \$46,431,109 | \$21,031,545 | \$67,462,654 |
| Research & Development | \$165,565,857 | \$76,705,901 | \$242,271,758 |
| Medical Laboratories & Diagnostic Imaging | \$113,186,222 | \$59,192,171 | \$172,378,393 |
| Total Bioscience | \$2,060,208,661 | \$1,303,975,120 | \$3,364,183,781 |

Appendix Table B-2: Economic Impact of Bioscience in the Northeast Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|------------------------|------------------------|----------------------|------------------------|------------------------|------------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$1,077,776,467 | \$1,237,122,184 | \$411,589,266 | \$2,726,487,967 | \$486,123,474 | \$757,918,233 | \$234,259,104 | \$1,478,300,803 |
| Pharmaceuticals & Therapeutics | \$336,962,853 | \$174,574,758 | \$104,345,652 | \$615,883,261 | \$193,190,778 | \$125,787,294 | \$59,389,104 | \$378,367,172 |
| Medical Device & Equipment Manufacturers | \$825,683,430 | \$457,168,890 | \$299,242,300 | \$1,582,094,599 | \$583,349,993 | \$318,921,624 | \$170,316,003 | \$1,072,587,601 |
| Testing Laboratories | \$110,620,012 | \$27,209,040 | \$42,186,066 | \$180,015,117 | \$109,080,232 | \$18,509,432 | \$24,010,516 | \$151,600,177 |
| Research & Development | \$68,298,784 | \$27,044,542 | \$30,639,735 | \$125,983,060 | \$74,790,544 | \$18,213,271 | \$17,438,839 | \$110,442,660 |
| Medical Laboratories & Diagnostic Imaging | \$133,744,176 | \$38,339,513 | \$34,920,743 | \$207,004,412 | \$81,055,896 | \$24,400,949 | \$19,875,400 | \$125,332,248 |
| Total Bioscience | \$2,553,085,722 | \$1,961,458,973 | \$922,923,764 | \$5,437,468,527 | \$1,527,590,917 | \$1,263,750,827 | \$525,288,953 | \$3,316,630,736 |

| | Employment | | | | Output | | | |
|---|---------------|---------------|---------------|---------------|-------------------------|------------------------|------------------------|-------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 3,474 | 14,260 | 6,961 | 24,695 | \$7,057,768,364 | \$3,254,131,731 | \$736,150,929 | \$11,048,050,469 |
| Pharmaceuticals & Therapeutics | 1,746 | 1,987 | 1,765 | 5,498 | \$985,563,368 | \$372,132,821 | \$186,628,139 | \$1,544,324,313 |
| Medical Device & Equipment Manufacturers | 8,055 | 5,788 | 5,061 | 18,903 | \$2,765,363,346 | \$1,002,364,142 | \$535,211,940 | \$4,302,939,460 |
| Testing Laboratories | 1,794 | 430 | 714 | 2,938 | \$177,981,828 | \$50,389,663 | \$75,452,163 | \$303,823,651 |
| Research & Development | 988 | 444 | 518 | 1,950 | \$132,937,040 | \$49,999,533 | \$54,800,903 | \$237,737,478 |
| Medical Laboratories & Diagnostic Imaging | 1,809 | 582 | 591 | 2,981 | \$220,122,080 | \$69,150,157 | \$62,457,741 | \$351,729,984 |
| Total Bioscience | 17,865 | 23,490 | 15,609 | 56,965 | \$11,339,736,026 | \$4,798,168,235 | \$1,650,701,796 | \$17,788,605,873 |

| | Tax | | | Total |
|---|-----------------------------------|--|--|------------------------|
| | Federal Government Non Defense | State/Local Government Non Education | | |
| Agricultural Biotechnology | \$356,644,285 | \$294,204,013 | | \$650,848,298 |
| Pharmaceuticals & Therapeutics | \$82,024,527 | \$42,658,280 | | \$124,682,807 |
| Medical Device & Equipment Manufacturers | \$221,844,206 | \$113,351,133 | | \$335,195,339 |
| Testing Laboratories | \$26,664,254 | \$12,013,775 | | \$38,678,029 |
| Research & Development | \$19,099,203 | \$8,745,983 | | \$27,845,186 |
| Medical Laboratories & Diagnostic Imaging | \$27,827,291 | \$14,403,736 | | \$42,231,027 |
| Total Bioscience | \$734,103,777 | \$485,376,924 | | \$1,219,480,701 |

Appendix Table B-3: Economic Impact of Bioscience in the Central Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|------------------------|------------------------|----------------------|------------------------|------------------------|----------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$373,029,640 | \$499,513,095 | \$167,336,676 | \$1,039,879,401 | \$217,369,280 | \$300,867,527 | \$93,857,150 | \$612,093,965 |
| Pharmaceuticals & Therapeutics | \$825,317,674 | \$415,708,413 | \$244,369,368 | \$1,485,395,468 | \$461,944,186 | \$304,589,004 | \$137,063,703 | \$903,596,890 |
| Medical Device & Equipment Manufacturers | \$209,810,531 | \$100,153,340 | \$69,822,827 | \$379,786,701 | \$147,582,418 | \$68,061,104 | \$39,162,712 | \$254,806,243 |
| Testing Laboratories | \$26,440,987 | \$5,809,689 | \$9,584,355 | \$41,835,030 | \$26,016,583 | \$3,847,579 | \$5,375,745 | \$35,239,909 |
| Research & Development | \$293,968,832 | \$110,672,930 | \$126,392,597 | \$531,034,371 | \$321,807,840 | \$72,941,179 | \$70,891,998 | \$465,641,004 |
| Medical Laboratories & Diagnostic Imaging | \$131,892,296 | \$36,938,468 | \$33,264,203 | \$202,094,968 | \$79,997,312 | \$23,173,339 | \$18,657,493 | \$121,828,150 |
| Total Bioscience | \$1,860,459,959 | \$1,168,795,897 | \$650,770,015 | \$3,680,025,804 | \$1,254,717,619 | \$773,479,701 | \$365,008,799 | \$2,393,206,086 |

| | Employment | | | | Output | | | |
|---|---------------|---------------|---------------|---------------|------------------------|------------------------|------------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 1,691 | 5,195 | 2,622 | 9,508 | \$2,384,407,496 | \$1,141,610,455 | \$288,685,748 | \$3,814,703,686 |
| Pharmaceuticals & Therapeutics | 3,907 | 4,531 | 3,829 | 12,267 | \$2,259,629,278 | \$861,077,464 | \$421,580,878 | \$3,542,287,617 |
| Medical Device & Equipment Manufacturers | 2,118 | 1,256 | 1,094 | 4,468 | \$640,877,892 | \$204,067,806 | \$120,456,847 | \$965,402,517 |
| Testing Laboratories | 432 | 85 | 150 | 667 | \$42,031,638 | \$10,246,551 | \$16,534,726 | \$68,812,915 |
| Research & Development | 4,026 | 1,731 | 1,981 | 7,737 | \$558,342,336 | \$195,268,671 | \$218,049,813 | \$971,660,760 |
| Medical Laboratories & Diagnostic Imaging | 1,665 | 527 | 521 | 2,713 | \$215,023,072 | \$64,657,864 | \$57,386,709 | \$337,067,647 |
| Total Bioscience | 13,839 | 13,325 | 10,197 | 37,361 | \$6,100,311,712 | \$2,476,928,722 | \$1,122,694,716 | \$9,699,935,169 |

| | Tax | | | Total |
|---|-----------------------------------|--|--|----------------------|
| | Federal Government Non Defense | State/Local Government Non Education | | |
| Agricultural Biotechnology | \$137,129,717 | \$106,800,486 | | \$243,930,203 |
| Pharmaceuticals & Therapeutics | \$192,055,983 | \$102,575,263 | | \$294,631,246 |
| Medical Device & Equipment Manufacturers | \$51,150,083 | \$27,150,424 | | \$78,300,507 |
| Testing Laboratories | \$6,116,853 | \$2,809,741 | | \$8,926,594 |
| Research & Development | \$78,632,198 | \$37,068,005 | | \$115,700,203 |
| Medical Laboratories & Diagnostic Imaging | \$26,472,448 | \$14,158,908 | | \$40,631,356 |
| Total Bioscience | \$491,557,273 | \$290,562,824 | | \$782,120,097 |

Appendix Table B-4: Economic Impact of Bioscience in the Southwest Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|------------------------|------------------------|----------------------|------------------------|----------------------|----------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$450,260,029 | \$478,902,947 | \$153,311,152 | \$1,082,474,104 | \$196,114,103 | \$301,488,487 | \$87,316,161 | \$584,918,759 |
| Pharmaceuticals & Therapeutics | \$470,338,508 | \$279,427,048 | \$141,195,975 | \$890,961,563 | \$262,536,117 | \$203,135,088 | \$80,416,064 | \$546,087,247 |
| Medical Device & Equipment Manufacturers | \$327,841,026 | \$169,209,036 | \$112,664,837 | \$609,714,905 | \$248,121,896 | \$115,708,609 | \$64,166,665 | \$427,997,163 |
| Testing Laboratories | \$29,824,669 | \$7,124,156 | \$10,549,522 | \$47,498,347 | \$29,446,379 | \$4,738,704 | \$6,008,336 | \$40,193,420 |
| Research & Development | \$133,247,944 | \$56,174,574 | \$56,040,368 | \$245,462,891 | \$145,637,744 | \$37,142,226 | \$31,916,990 | \$214,696,967 |
| Medical Laboratories & Diagnostic Imaging | \$124,872,592 | \$35,988,391 | \$30,366,192 | \$191,227,171 | \$75,629,296 | \$22,784,858 | \$17,294,626 | \$115,708,773 |
| Total Bioscience | \$1,536,384,768 | \$1,026,826,146 | \$504,128,054 | \$3,067,338,938 | \$957,485,534 | \$684,997,963 | \$287,118,842 | \$1,929,602,363 |

| | Employment | | | | Output | | | |
|---|---------------|---------------|--------------|---------------|------------------------|------------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 1,377 | 5,317 | 2,405 | 9,098 | \$2,897,196,460 | \$1,208,521,947 | \$267,049,487 | \$4,372,767,964 |
| Pharmaceuticals & Therapeutics | 2,568 | 2,886 | 2,215 | 7,668 | \$1,400,804,870 | \$588,124,853 | \$245,946,435 | \$2,234,876,186 |
| Medical Device & Equipment Manufacturers | 2,806 | 1,998 | 1,767 | 6,571 | \$954,267,252 | \$343,489,241 | \$196,248,401 | \$1,494,004,914 |
| Testing Laboratories | 439 | 106 | 166 | 711 | \$47,094,026 | \$12,351,209 | \$18,375,962 | \$77,821,197 |
| Research & Development | 1,951 | 871 | 879 | 3,701 | \$260,848,448 | \$100,857,469 | \$97,615,465 | \$459,321,382 |
| Medical Laboratories & Diagnostic Imaging | 1,547 | 512 | 476 | 2,535 | \$203,067,456 | \$63,419,394 | \$52,894,210 | \$319,381,070 |
| Total Bioscience | 10,688 | 11,690 | 7,907 | 30,285 | \$5,763,278,512 | \$2,316,763,980 | \$878,129,957 | \$8,958,172,663 |

| | Tax | | |
|---|-----------------------------------|--|----------------------|
| | Federal Government Non Defense | State/Local Government Non Education | Total |
| Agricultural Biotechnology | \$141,545,151 | \$114,483,741 | \$256,028,892 |
| Pharmaceuticals & Therapeutics | \$119,757,560 | \$59,952,579 | \$179,710,139 |
| Medical Device & Equipment Manufacturers | \$86,093,086 | \$42,788,390 | \$128,881,476 |
| Testing Laboratories | \$7,034,272 | \$3,053,130 | \$10,087,402 |
| Research & Development | \$37,394,541 | \$16,401,527 | \$53,796,068 |
| Medical Laboratories & Diagnostic Imaging | \$25,670,933 | \$12,945,324 | \$38,616,257 |
| Total Bioscience | \$417,495,545 | \$249,624,687 | \$667,120,232 |

Appendix Table B-5: Economic Impact of Bioscience in the West Central Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|----------------------|----------------------|----------------------|------------------------|----------------------|----------------------|----------------------|----------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$162,415,671 | \$242,322,191 | \$74,908,689 | \$479,646,553 | \$101,314,297 | \$144,352,638 | \$43,120,745 | \$288,787,669 |
| Pharmaceuticals & Therapeutics | \$24,833,650 | \$13,800,892 | \$7,119,962 | \$45,754,504 | \$13,797,010 | \$10,166,246 | \$4,098,602 | \$28,061,859 |
| Medical Device & Equipment Manufacturers | \$211,785,429 | \$79,370,668 | \$62,216,067 | \$353,372,167 | \$150,871,245 | \$54,783,217 | \$35,814,423 | \$241,468,889 |
| Testing Laboratories | \$9,169,452 | \$1,796,480 | \$3,089,543 | \$14,055,475 | \$8,954,611 | \$1,222,264 | \$1,778,469 | \$11,955,344 |
| Research & Development | \$52,392,604 | \$17,211,011 | \$20,746,404 | \$90,350,020 | \$57,157,472 | \$12,036,577 | \$11,942,562 | \$81,136,612 |
| Medical Laboratories & Diagnostic Imaging | \$82,300,224 | \$19,865,206 | \$19,040,772 | \$121,206,199 | \$49,842,828 | \$12,962,569 | \$10,960,701 | \$73,766,100 |
| Total Bioscience | \$542,897,030 | \$374,366,457 | \$187,121,441 | \$1,104,384,922 | \$381,937,463 | \$235,523,515 | \$107,715,502 | \$725,176,481 |

| | Employment | | | | Output | | | |
|---|--------------|--------------|--------------|---------------|------------------------|----------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 951 | 3,529 | 1,260 | 5,739 | \$1,378,357,521 | \$532,863,948 | \$132,942,759 | \$2,044,164,267 |
| Pharmaceuticals & Therapeutics | 127 | 152 | 120 | 398 | \$70,889,424 | \$30,618,921 | \$12,636,007 | \$114,144,350 |
| Medical Device & Equipment Manufacturers | 2,098 | 1,041 | 1,046 | 4,185 | \$544,098,994 | \$163,941,550 | \$110,416,665 | \$818,457,190 |
| Testing Laboratories | 179 | 25 | 52 | 256 | \$14,636,165 | \$3,645,693 | \$5,483,102 | \$23,764,959 |
| Research & Development | 733 | 296 | 349 | 1,378 | \$100,448,048 | \$31,525,311 | \$36,819,242 | \$168,792,602 |
| Medical Laboratories & Diagnostic Imaging | 980 | 306 | 320 | 1,607 | \$133,160,800 | \$35,279,934 | \$33,792,207 | \$202,232,940 |
| Total Bioscience | 5,068 | 5,349 | 3,147 | 13,563 | \$2,241,590,952 | \$797,875,396 | \$332,089,985 | \$3,371,556,311 |

| | Tax | | | Total |
|---|-----------------------------------|--|--|----------------------|
| | Federal Government Non Defense | State/Local Government Non Education | | |
| Agricultural Biotechnology | \$64,995,277 | \$48,890,595 | | \$113,885,872 |
| Pharmaceuticals & Therapeutics | \$6,217,607 | \$3,113,334 | | \$9,330,941 |
| Medical Device & Equipment Manufacturers | \$49,965,808 | \$24,631,245 | | \$74,597,053 |
| Testing Laboratories | \$2,127,357 | \$903,753 | | \$3,031,110 |
| Research & Development | \$14,129,389 | \$6,060,972 | | \$20,190,361 |
| Medical Laboratories & Diagnostic Imaging | \$16,313,065 | \$8,218,498 | | \$24,531,563 |
| Total Bioscience | \$153,748,508 | \$91,818,399 | | \$245,566,907 |

Appendix Table B-6: Economic Impact of Bioscience in the Northwest Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------|----------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$125,370,037 | \$211,814,076 | \$54,784,878 | \$391,968,983 | \$68,777,010 | \$119,446,135 | \$31,139,730 | \$219,362,870 |
| Pharmaceuticals & Therapeutics | \$6,598,778 | \$3,775,813 | \$1,829,341 | \$12,203,932 | \$3,673,888 | \$2,724,875 | \$1,039,800 | \$7,438,563 |
| Medical Device & Equipment Manufacturers | \$47,013,659 | \$15,479,474 | \$12,342,655 | \$74,835,783 | \$32,551,010 | \$10,125,898 | \$7,015,603 | \$49,692,511 |
| Testing Laboratories | \$11,756,421 | \$1,426,884 | \$3,579,236 | \$16,762,542 | \$11,483,766 | \$928,728 | \$2,034,455 | \$14,446,949 |
| Research & Development | \$21,936,842 | \$8,377,929 | \$8,584,731 | \$38,899,501 | \$24,054,086 | \$5,522,369 | \$4,879,488 | \$34,455,942 |
| Medical Laboratories & Diagnostic Imaging | \$56,937,624 | \$12,531,331 | \$12,366,604 | \$81,835,558 | \$34,484,964 | \$8,057,350 | \$7,029,160 | \$49,571,474 |
| Total Bioscience | \$269,613,360 | \$253,405,501 | \$93,487,446 | \$616,506,306 | \$175,024,723 | \$146,805,353 | \$53,138,236 | \$374,968,304 |

| | Employment | | | | Output | | | |
|---|--------------|--------------|--------------|--------------|------------------------|----------------------|----------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 770 | 2,800 | 996 | 4,566 | \$1,266,474,318 | \$618,209,597 | \$103,921,275 | \$1,988,605,210 |
| Pharmaceuticals & Therapeutics | 63 | 50 | 33 | 147 | \$28,322,882 | \$8,962,402 | \$3,470,070 | \$40,755,356 |
| Medical Device & Equipment Manufacturers | 451 | 223 | 224 | 898 | \$120,213,190 | \$32,868,533 | \$23,412,754 | \$176,494,477 |
| Testing Laboratories | 222 | 22 | 65 | 309 | \$18,467,815 | \$2,694,669 | \$6,789,451 | \$27,951,934 |
| Research & Development | 376 | 155 | 156 | 686 | \$46,280,340 | \$16,376,041 | \$16,284,275 | \$78,940,658 |
| Medical Laboratories & Diagnostic Imaging | 735 | 220 | 225 | 1,180 | \$93,111,544 | \$23,694,076 | \$23,458,139 | \$140,263,756 |
| Total Bioscience | 2,617 | 3,469 | 1,699 | 7,785 | \$1,572,870,089 | \$702,805,291 | \$177,335,964 | \$2,453,011,344 |

| | Tax | | | Total |
|---|-----------------------------------|--|--|----------------------|
| | Federal Government Non Defense | State/Local Government Non Education | | |
| Agricultural Biotechnology | \$52,116,340 | \$39,836,264 | | \$91,952,604 |
| Pharmaceuticals & Therapeutics | \$1,646,232 | \$869,809 | | \$2,516,041 |
| Medical Device & Equipment Manufacturers | \$10,581,700 | \$5,160,915 | | \$15,742,615 |
| Testing Laboratories | \$2,652,470 | \$1,074,296 | | \$3,726,766 |
| Research & Development | \$5,854,030 | \$2,661,787 | | \$8,515,817 |
| Medical Laboratories & Diagnostic Imaging | \$11,020,750 | \$5,552,806 | | \$16,573,556 |
| Total Bioscience | \$83,871,522 | \$55,155,876 | | \$139,027,398 |

Appendix Table B-7: Economic Impact of Bioscience in the Southeast Region, 2008

| | Value Added | | | | Labor Income | | | |
|---|----------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | \$66,221,406 | \$85,464,535 | \$21,815,796 | \$173,501,736 | \$33,962,504 | \$48,175,052 | \$12,166,658 | \$94,304,216 |
| Pharmaceuticals & Therapeutics | \$20,675,275 | \$10,760,998 | \$5,829,395 | \$37,265,669 | \$15,282,272 | \$7,098,703 | \$3,251,100 | \$25,632,075 |
| Medical Device & Equipment Manufacturers | \$64,969,093 | \$13,804,999 | \$12,887,960 | \$91,662,052 | \$39,829,428 | \$9,071,795 | \$7,187,754 | \$56,088,977 |
| Testing Laboratories | \$1,753,804 | \$137,750 | \$474,456 | \$2,366,010 | \$1,712,797 | \$89,018 | \$264,610 | \$2,066,425 |
| Research & Development | \$2,228,004 | \$651,186 | \$769,244 | \$3,648,434 | \$2,445,656 | \$448,204 | \$428,988 | \$3,322,849 |
| Medical Laboratories & Diagnostic Imaging | \$8,479,113 | \$1,462,163 | \$1,612,993 | \$11,554,269 | \$5,134,628 | \$940,368 | \$899,561 | \$6,974,557 |
| Total Bioscience | \$164,326,695 | \$112,281,631 | \$43,389,844 | \$319,998,172 | \$98,367,285 | \$65,823,139 | \$24,198,672 | \$188,389,094 |

| | Employment | | | | Output | | | |
|---|--------------|--------------|------------|--------------|----------------------|----------------------|---------------------|------------------------|
| | Direct | Indirect | Induced | Total | Direct | Indirect | Induced | Total |
| Agricultural Biotechnology | 330 | 990 | 438 | 1,758 | \$508,628,400 | \$323,677,461 | \$41,561,683 | \$873,867,549 |
| Pharmaceuticals & Therapeutics | 258 | 166 | 117 | 542 | \$117,187,500 | \$26,982,777 | \$11,105,749 | \$155,276,030 |
| Medical Device & Equipment Manufacturers | 632 | 224 | 259 | 1,115 | \$154,865,674 | \$32,635,288 | \$24,553,289 | \$212,054,266 |
| Testing Laboratories | 42 | 3 | 10 | 54 | \$2,910,013 | \$280,711 | \$903,902 | \$4,094,626 |
| Research & Development | 43 | 13 | 16 | 71 | \$4,961,829 | \$1,384,983 | \$1,465,481 | \$7,812,292 |
| Medical Laboratories & Diagnostic Imaging | 131 | 26 | 32 | 190 | \$14,235,636 | \$2,946,871 | \$3,072,941 | \$20,255,447 |
| Total Bioscience | 1,435 | 1,422 | 872 | 3,729 | \$802,789,052 | \$387,908,082 | \$82,663,044 | \$1,273,360,138 |

| | Tax | | | Total |
|---|-----------------------------------|--|--|---------------------|
| | Federal Government Non Defense | State/Local Government Non Education | | |
| Agricultural Biotechnology | \$22,671,943 | \$19,977,400 | | \$42,649,343 |
| Pharmaceuticals & Therapeutics | \$5,272,782 | \$2,836,705 | | \$8,109,487 |
| Medical Device & Equipment Manufacturers | \$12,591,513 | \$6,144,478 | | \$18,735,991 |
| Testing Laboratories | \$375,150 | \$156,237 | | \$531,387 |
| Research & Development | \$547,303 | \$255,369 | | \$802,672 |
| Medical Laboratories & Diagnostic Imaging | \$1,549,546 | \$790,550 | | \$2,340,096 |
| Total Bioscience | \$43,008,237 | \$30,160,739 | | \$73,168,976 |