

**The Occupational Structure of Employment in the
State's Biopharmaceutical Industries in 2003:
Comparisons with The Occupational Employment
Structure in All Industries and Selected Industrial
Sectors of the State**

PhRMA Research Paper No. 6

Prepared by:

Paulo Tobar

Andrew Sum

Center for Labor Market Studies

Northeastern University

Boston, MA

Prepared for:

**The Pharmaceutical Research and Manufacturers of America
(PhRMA)**

January 2007

Introduction:

The direct labor market impacts of a given industry are influenced by a variety of factors, including the occupational characteristics of the jobs in the industries, their wage/salary levels, and the hiring/training policies of the firms comprising the industry.¹ The occupational structure of employment in an industry has a major influence on the educational and skill requirements for entry into those jobs. Firms that create a high share of jobs in professional, managerial, and technical occupations will tend to hire an above average share of college graduates and workers with stronger literacy and numeracy proficiencies.² These jobs also typically pay annual wages well above the annual average for all workers and raise the annual earnings of workers in the state. Skilled, blue collar production jobs also tend to pay above average wages for workers with only a high school education. Given the importance of identifying the labor market impacts of biopharmaceutical industries, we will devote several research papers to the demographic/socioeconomic characteristics of workers in biopharmaceutical industries, the occupational characteristics of their jobs, and the wage and salaries of workers employed in these industries.

In this research paper, we analyze the occupational staffing patterns of biopharmaceutical industries based in our state and compare them with those of other industries across Massachusetts. These occupational staffing patterns are based on a tabulation of the employment distribution by occupation within a given industry located in the state of Massachusetts. Some of the workers in these industries may commute to their job from outside Massachusetts. The source of the data underlying the analyses of occupational employment in selected industries is the Massachusetts Industry Staffing patterns data provided by the Massachusetts Department of Workforce Development.³ The occupational staffing pattern data for industries are based on the Occupational Employment Statistics (OES) survey, which is conducted semiannually by the

¹ The indirect impacts are dependent upon inter-industry links between the industry and other industries across the state as well as the size of the output and employment multipliers. Important segments of the bio-pharmaceutical industries in Massachusetts have very high employment multipliers. These will be revealed in a future research paper.

² For a detailed review of the variations in literacy and quantitative proficiencies of workers across occupations in the U.S., see: (i) Andrew Sum, Literacy in the Labor Force, National Center for Education Statistics, Washington, D.C., 1999, (ii) Andrew Sum, Irwin Kirsch and Kentaro Yamamoto, Pathways to Labor Market Success, Policy Information Center, Educational Testing Service, Princeton, 2004.

³ Massachusetts Department of Workforce Development, Massachusetts Industry Staffing Patterns, Boston, September 2005.

Massachusetts Department of Workforce Development. The findings appearing in this paper correspond to the year 2003 and are based on responses to the OES surveys by more than 28,000 private and public employers in the state. The data in the statewide analysis include all industries in the state that employ at least 5,000 workers, every occupational group in which at least 100 workers are employed, and every industry/occupational group whose employment percentage is equal or higher than one percent. The North American Industry Classification System (NAICS) and the Standard Occupational Classification System (SOC) are the coding systems used to identify and classify the industries and occupations included in the Massachusetts staffing patterns matrix.

As mentioned above, our analysis of occupational staffing patterns is focused on the industries comprising the biopharmaceutical industrial sector of the state economy. We have identified a set of three 4-digit NAICS industries that contain all firms in the biopharmaceutical industries of our state. The industries included in our analysis are: Pharmaceutical and Medicine Manufacturing (NAICS 3254), Medical Equipment and Supplies Manufacturing (NAICS 3391), and Scientific Research and Development Services (NAICS 5417). Comparisons of the occupational staffing patterns of the biopharmaceutical industrial sector at the state level will be compared to those of all industries in the state and in selected sectors, such as manufacturing. In a few cases we will compare the occupational staffing patterns of biopharmaceutical industries in our state with those of their counterparts across the entire country. These comparisons of occupational staffing patterns at the state level will help us to understand the types of jobs held by workers in this set of industries, compare them to those throughout the state, and identify whether the biopharmaceutical industries have an above average concentration of jobs in certain occupations e.g., college labor market jobs in the professional, managerial and technical occupations.

Table 1:
A Description of the Occupational Distribution of Employment in All Biopharmaceutical
Industries and Individual Biopharmaceutical Industries of Massachusetts, 2003
(in %)

Occupational Group	(A) All Biopharmaceutical Industries	(B) NAICS 3254	(C) NAICS 3391	(D) NAICS 5417
All Workers (in 1000s)	55.7	8.8	13.1	33.8
Management, Professional and Technical Occupations	56.7	48.1	29.7	69.4
Management	13.0	19.0	12.1	11.8
Business and Financial Operations	7.7	3.9	4.2	10.1
Computer and Mathematical Science Occupations	10.5	3.1	1.9	15.7
Architecture and Engineering	10.4	5.1	10.4	11.9
Life, Physical, and Social Science	7.1	17.0	1.1	6.9
Legal	5.0	0.0	0.0	8.3
Education, Training, and Library	0.2	0.0	0.0	0.4
Arts, Design, Entertainment, Sports, and Media	2.2	0.0	0.0	3.7
Healthcare Practitioner and Technical	0.4	0.0	0.0	0.7
Service, Sales and Office Occupations	22.9	28.2	15.5	24.4
Healthcare Support	0.6	0.0	0.0	0.9
Building and Grounds Cleaning and Maintenance	0.2	0.0	0.0	0.4
Sales and Related	5.2	13.4	3.1	3.8
Office and Administrative Support	17.0	14.9	12.4	19.3
Construction, Maintenance, Repair, and Production Occupations	18.2	19.7	52.8	4.5
Construction and Extraction	0.4	0.0	0.0	0.7
Installation, Maintenance, and Repair	1.4	2.4	1.8	1.0
Production	14.9	15.2	48.9	1.7
Transportation and Material Moving	1.5	2.2	2.1	1.1
All Other Occupations*	2.2	4.0	2.0	1.7

Source: Massachusetts Department of Workforce Development, "Industry Staffing Patterns"

*Note: Occupational Employment shares for Massachusetts do not add to 100% because some of the occupations were not identified. Some of these occupations could have been in the professional, managerial and technical occupations; therefore the share of employment in these occupations could be higher than was showed.

The occupational staffing patterns of all biopharmaceutical industries and individual biopharmaceutical industries in Massachusetts during 2003 are displayed above in Table 1. The occupational distribution of employment in these three biopharmaceutical industries indicates a high level of skill for a majority of the workers employed by them. Overall, employment in the biopharmaceutical industries combined was highly concentrated in the management, professional and technical occupations. Of the 55,700 jobs in these three industries in 2003, slightly more than fifty-six percent (56.7%) were categorized under the management, professional and technical occupations, followed by service, sales and office occupations (22.9%) and construction, maintenance and repair, and production occupations, with an 18.2% share of the total number of jobs. A similar occupational pattern is observed within two of the three individual biopharmaceutical industries. In the Medical Equipment and Supplies manufacturing industry (NAICS 3391), however, the majority of the jobs were in the blue collar construction, maintenance and production occupations, with such jobs accounting for just under 53 percent of all jobs in the industry. Among the high level professional and management occupations, the specific occupations accounting for a relatively high share of total employment in the biopharmaceutical industries of the state were computer and mathematical science occupations (10%), architecture and engineering occupations (10%), and management occupations (13%). Within the pharmaceutical manufacturing industries, high level sales positions represented 13% of employment in the industry.

A Comparison of Occupational Staffing Patterns in Biopharmaceutical Industries in Massachusetts and the U.S.

Data on the occupational staffing patterns of firms in biopharmaceutical industries in the nation also are available from the national OES program of the U.S. Bureau of Labor Statistics. We have compiled data on occupational employment in the three biopharmaceutical industries across the entire nation and constructed an occupational profile for the biopharmaceutical sector. Findings on the occupational distribution of employment in the biopharmaceutical industries of the U.S. and Massachusetts are displayed in Table 2.

During 2003, total employment in biopharmaceutical industries was 1.134 million of which 55,700 were located in Massachusetts. The state was home for 5 per cent of all jobs in biopharmaceutical industries in 2003 even though Massachusetts held only 2.5% of all wage and

salary jobs across the country during that year.⁴ As revealed in an earlier paper, Massachusetts is a major exporter of biopharmaceutical related goods and services. The occupational mix of jobs in biopharmaceutical industries in Massachusetts is somewhat different than that for the nation. A higher share of the jobs in biopharmaceutical industries in our state were in the professional/technical and managerial occupations than was the case across the country (56.7% vs. 52.4%). Biopharmaceutical industries in Massachusetts also employed a higher share of workers in sales/office occupations than their counterparts across the nation (23% vs. 18%). Both sales and office occupations account for a higher share of employment in Massachusetts industries. Many of these sales occupations are high level sales positions that are frequently filled by college graduates.

On the other end of the occupational distribution dominated by blue collar production and craft positions, Massachusetts industries employ a considerably lower share of such workers than their U.S. counterparts (18% vs. 29%), with the bulk of the difference due to a much lower share of production workers in such industries (15% in Massachusetts vs. nearly 24% in the U.S.). The greater research and development orientation of Massachusetts biopharmaceutical firms account for a major part of the differences between the state and national occupational staffing patterns in these industries.

⁴ During 2003, there were 130 million wage and salary jobs on the payrolls of private firms and government agencies across the nation of which 3.135 million were located in Massachusetts.

Table 2:
A Comparison of the Occupational Distribution of Employment in
All Biopharmaceutical Industries in Massachusetts and the U.S., 2003
(in %)

Occupational Group	(A)	(B)
	U.S.	MA
All Workers (in 1000s)	1,134.0	55.7
Management, Professional and Technical Occupations	52.4	56.7
Management	10.5	13.0
Computer and Mathematical Science	7.0	10.5
Architecture and Engineering	9.4	10.4
Business and Financial Operations	6.5	7.7
Life, Physical, and Social Science	14.8	7.1
Legal	0.3	5.0
Arts, Design, Entertainment, Sports, and Media	1.2	2.2
Healthcare Practitioner and Technical	1.6	0.4
Education, Training, and Library	0.8	0.2
Community and Social Services	0.3	0.0
Service, Sales and Office Occupations	18.2	22.9
Office and Administrative Support	14.0	17.0
Sales and Related	2.6	5.2
Healthcare Support	0.4	0.6
Building and Grounds Cleaning and Maintenance	0.7	0.2
Protective Service	0.3	0.0
Food Preparation and Serving Related	0.1	0.0
Personal Care and Service	0.1	0.0
Construction, Maintenance and Repair; Production Occupations	29.3	18.2
Production	23.8	14.9
Transportation and Material Moving	2.8	1.5
Installation, Maintenance, and Repair	2.3	1.4
Construction and Extraction	0.4	0.4
All Other Occupations*	--	2.2

Source: (i) U.S. Bureau of Labor Statistics, “National OES Occupational Staffing Patterns Data by Industry”; (ii) Massachusetts Department of Workforce Development, “Industry Staffing Patterns”.

*Note: Occupational Employment shares for Massachusetts do not add to 100% because some of the occupations were not identified. Some of these occupations could have been in the professional, managerial and technical occupations; therefore the share of employment in these occupations could be higher than was showed.

A comparison of the occupational distribution of employment in all industries of Massachusetts and biopharmaceutical industries in 2003 is presented in Table 3. The findings presented in Table 3 corroborate what we had noted earlier about the high concentration of employment in biopharmaceutical industries in occupations that demand a high level of educational attainment and skill from the workforce. In all Massachusetts industries, the occupations accounting for the highest share of total employment in 2003 were the sales, service, and office occupations representing 47% of total employment, followed by management, professional and technical occupations at 34% and construction, maintenance, repair and production occupations accounting for about 19% of total employment across the state.

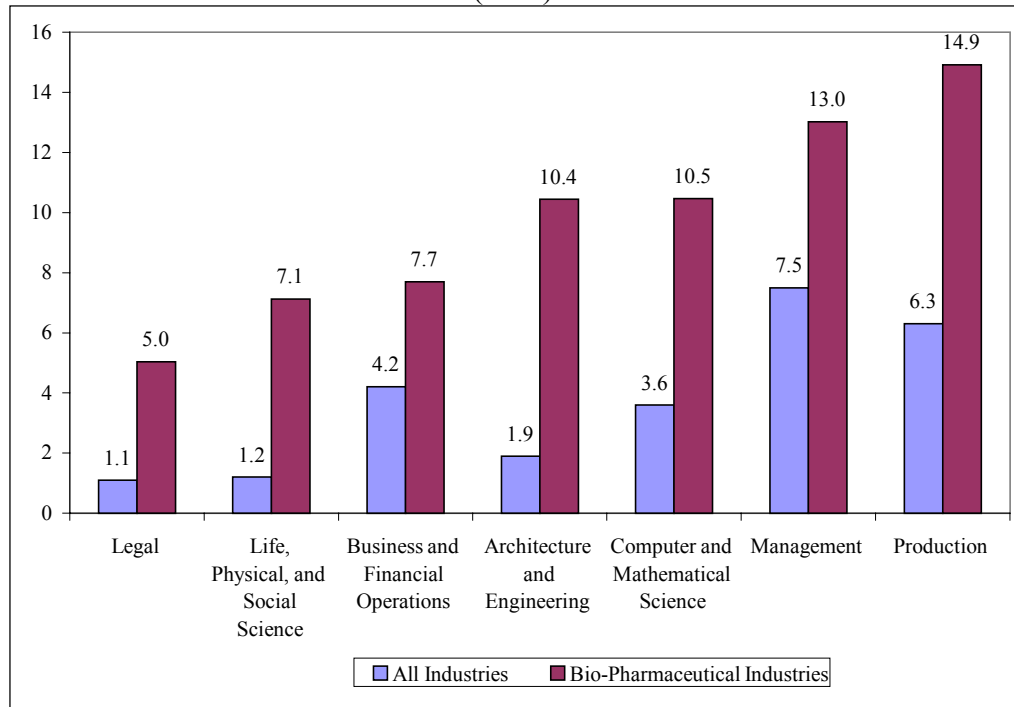
Table 3:
A Comparison of the Occupational Distribution of Employment in All Industries of
Massachusetts and Biopharmaceutical Industries, 2003
(In %)

Occupational Group	(A) All Industries	(B) Biopharmaceutical Industries
All Workers (in 1000s)	3,187	55.7
Management, Professional and Technical Occupations	34.3	56.7
Management	7.5	13.0
Computer and Mathematical Science	3.6	10.5
Architecture and Engineering	1.9	10.4
Business and Financial Operations	4.2	7.7
Life, Physical, and Social Science	1.2	7.1
Legal	1.1	5.0
Arts, Design, Entertainment, Sports, and Media	1.3	2.2
Healthcare Practitioner and Technical	5.7	0.4
Education, Training, and Library	6.2	0.2
Community and Social Services	1.6	0.0
Service, Sales and Office Occupations	47.1	22.9
Office and Administrative Support	18.1	17.0
Sales and Related	9.9	5.2
Healthcare Support	2.7	0.6
Building and Grounds Cleaning and Maintenance	4.0	0.2
Protective Service	2.0	0.0
Food Preparation and Serving Related	8.1	0.0
Personal Care and Service	2.3	0.0

Occupational Group	(A) All Industries	(B) Biopharmaceutical Industries
Construction, Maintenance, Repair, Production Occupations	18.6	18.2
Production	6.3	14.9
Transportation and Material Moving	5.4	1.5
Installation, Maintenance, and Repair	3.2	1.4
Construction and Extraction	3.6	0.4
Farming, Fishing, and Forestry	0.1	0.0

Massachusetts biopharmaceutical industries were characterized by a quite different occupational distribution of employment than all Massachusetts combined. In the state's biopharmaceutical industries, the occupational group that accounted for the largest share of employment was the management, professional and technical occupations that employed just under 57% of all workers in these industries. This employment share was 22 percentage points higher than that for all industries in Massachusetts. This much higher share of professional, technical and management jobs indicates a high level of concentration of jobs that typically require four or more years of college. This high share of employment in college labor market jobs is particularly valuable in creating a demand for graduates from the state's higher education system, providing incentives for them to remain in the state. The biopharmaceutical industries also employed an above share of production workers (15% vs. 6% statewide), an occupational group that has been characterized by steep job declines in our state over the past two decades. The sharp decline in good paying, blue collar jobs has contributed in an important way to the deterioration in the real annual earnings of males with 12 or fewer years of schooling with its adverse social and economic consequences.

Chart 1:
Comparison of the Occupational Distributions of Employment in All Industries of Massachusetts
and Biopharmaceutical Industries, Occupations with the Highest Share of Total Employment in
the Biopharmaceutical Industries, 2003
(in %)



In Chart 1, we identify the seven individual occupational groups that accounted for the highest share of employment in Massachusetts biopharmaceutical industries and compare their shares of employment in biopharmaceutical industries with those for all industries combined in the state. Six of these seven occupations required a high level of educational attainment, and each of them accounted for a larger share of employment in biopharmaceutical industries than they did in all industries combined across the state. The one major exception to this pattern was production occupations. They were 2.4 times as concentrated in biopharmaceutical industries, primarily the manufacturing segments, than in the economy as a whole.

The Occupational Distribution of Employment in the State’s Manufacturing Industrial Sector and in Biopharmaceutical Manufacturing Industries

In 2003, there were slightly over 326,000 jobs in the manufacturing sector of the state of Massachusetts. The percent distribution of jobs in the state’s manufacturing sector across major occupational groups is displayed in Table 4. The occupational group with the highest percentage

share of jobs in the state’s manufacturing industries during 2003 were production occupations (42.6%), followed by office and administrative support (12.1%), architecture and engineering (9.9%), and management (9.1%). The life, physical, and social science occupations combined represented only a small fraction (1.3%) of the jobs in the manufacturing sector.

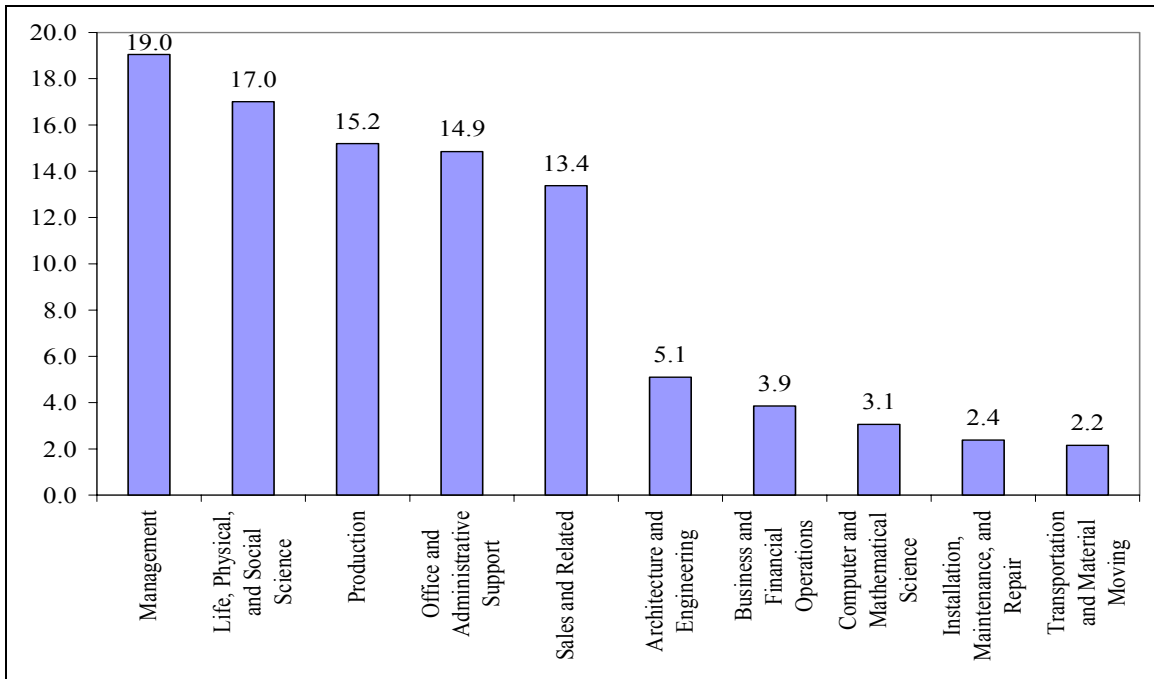
Table 4:
Percent Distribution of Massachusetts Jobs in the Overall Manufacturing Sector, Pharmaceutical and Medicine Manufacturing (NAICS 3254), and Medical Equipment and Supplies Manufacturing (NAICS 3391) by Major Occupational Group, 2003
(in %)

Occupational Group	(A) All Manufacturing	(B) NAICS 3254	(C) NAICS 3391	(D) Biopharmaceutical Manufacturing (B&C)
Total Jobs, all occupations	326,110	8,820	13,090	21,910
Production	42.6	15.2	48.9	35.3
Management	9.1	19.0	12.1	14.9
Office and Administrative Support	12.1	14.9	12.4	13.4
Architecture and Engineering	9.9	5.1	10.4	8.3
Life, Physical, and Social Science	1.3	17.0	1.1	7.5
Sales and Related	3.9	13.4	3.1	7.3
Business and Financial Operations	3.5	3.9	4.2	4.1
Computer and Mathematical Science	4.5	3.1	1.9	2.4
Transportation and Material Moving	6.1	2.2	2.1	2.1
Installation, Maintenance, and Repair	3.5	2.4	1.8	2.1

Two of the three biopharmaceutical industries are part of the state’s overall manufacturing base a key element of the state’s export base that sells goods and services to outside of the state. These two industries were the Pharmaceutical and Medicine manufacturing industry (NAICS 3254) and the Medical Equipment and Supplies manufacturing (NAICS 3391) industry. These two industries employed just under 7% of all manufacturing workers in the state. The distribution of employment by occupation in these two industries is quite different than that found for the aggregate manufacturing sector. In the state’s Pharmaceutical and Medicine manufacturing industries sector, the occupations that generated the largest share of employment were Management occupations (19%), Life, Physical, and Social Science occupations (17%), and Sales occupations (13%). Chart 2) In the state’s overall manufacturing

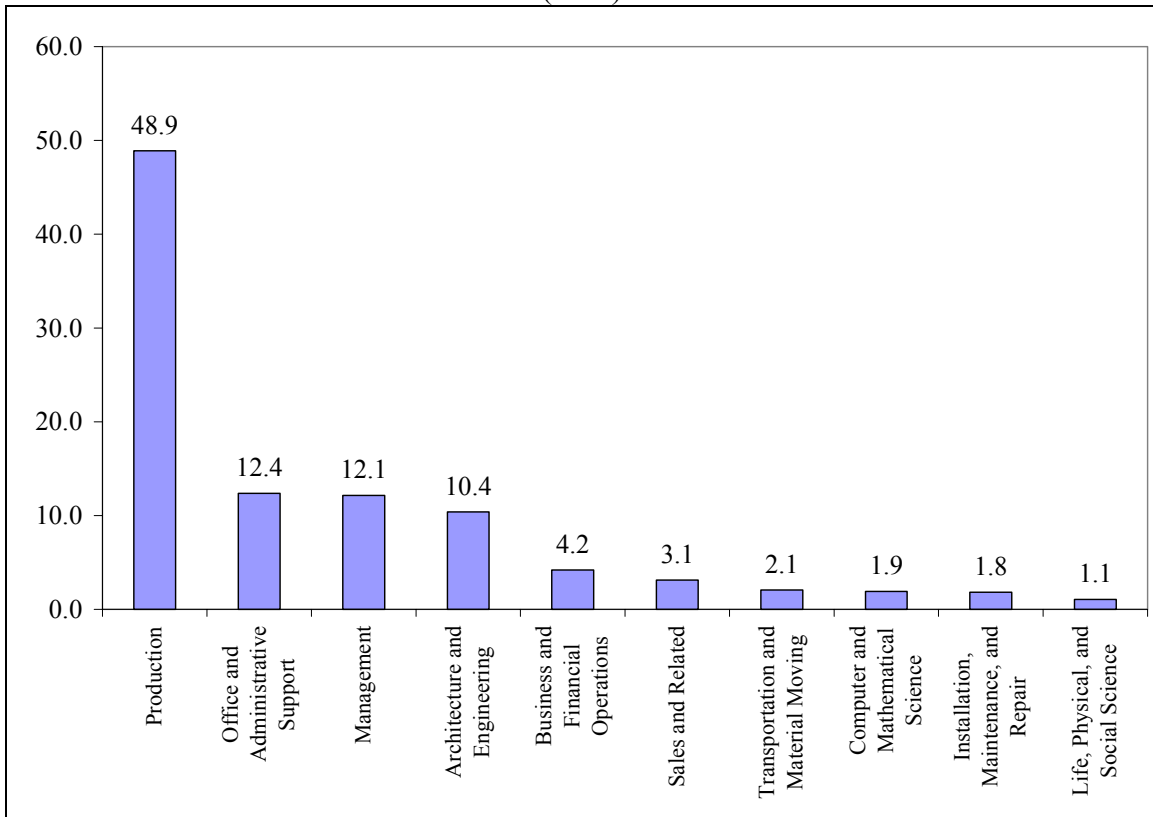
sector, production occupations accounted for the largest share of employment (42%), a share three times higher than that found in the Pharmaceutical and Medicine manufacturing industries of the state. This finding implies a much higher demand for college educated workers in the pharmaceutical manufacturing industries than in the average manufacturing industry of the state.

Chart 2:
Percent Distribution of Massachusetts Jobs in the Pharmaceutical and Medicine
Manufacturing (NAICS 3254) Industries by Major Occupational Sector, 2003
 (in %)



In the medical equipment and supplies manufacturing industries, the staffing patterns by major occupational group were more similar to that of the aggregate manufacturing sector of the state. Similar to findings for the manufacturing sector, the occupations that accounted for the largest share of employment within the medical equipment and supplies manufacturing industry, were production occupations, representing 49% of the jobs while office/administrative support occupations and management occupations represented about 12% of the jobs in the industry. (See Table 4 and Chart 3) Another set of occupations with a relatively high share of employment in this industry (NAICS 3391) were the architectural and engineering occupations (10%).

Chart 3:
Percent Distribution of Massachusetts Jobs in the Medical Equipment and Supplies Manufacturing (NAICS 3391) Industries by Major Occupational Group, 2003
 (in %)



The Occupational Structure of Employment in the State’s Scientific Research and Development Services Industry

An analysis of the occupational employment distribution also was conducted for the Scientific Research and Development Services industry (NAICS 5417), a major segment of the biopharmaceutical sector.⁵ A comparison of the staffing patterns by major occupation for this industry and the overall Professional, Scientific and Technical Services (NAICS 54) sector of which it is a part is shown in Table 5.

⁵ As noted in our earlier research paper on the definitions of the bio-pharmaceutical industries, this industrial sector also includes firms not engaged in pharmaceutical and medical research.

Table 5:
Percent Distribution of Jobs in the Overall Professional, Scientific and Technical Services Sector
and the Scientific Research and Development Services Industry (NAICS 5417) of Massachusetts
by Major Occupational Group, 2003
(in %)

Occupational Group	(A) Professional, Scientific and Technical Services	(B) NAICS 5417
All	218,610	33,800
Management, Professional and Technical	68.4	69.4
Computer and Mathematical Science	18.6	15.7
Architecture and Engineering	5.2	11.9
Management	11.7	11.8
Business and Financial Operations	12.2	10.1
Legal	11.1	8.3
Life, Physical, and Social Science	4.6	6.9
Arts, Design, Entertainment, Sports, and Media	3.9	3.7
Healthcare Practitioner and Technical	0.9	0.7
Education, Training, and Library	0.2	0.4
Service, Sales and Office	27.1	24.4
Office and Administrative Support	22.3	19.3
Sales and Related	4.2	3.8
Healthcare Support	0.3	0.9
Building and Grounds Cleaning and Maintenance	0.3	0.4
Construction, Maintenance, Repair, and Production	4.3	4.5
Production	1.5	1.7
Transportation and Material Moving	1.3	1.1
Installation, Maintenance, and Repair	0.9	1.0
Construction and Extraction	0.6	0.7

The overall Professional, Scientific, and Technical Services industry employed 218,610 workers in 2003 of which 33,800 or 15% were located in NAICS 5417, the Scientific Research and Development Services Industry. (Table 5) The distribution of employment by major occupational group in the Scientific Research and Development Services industry (NAICS 5417) was quite similar to that of the aggregate sector, the Scientific and Technical Services Industry (NAICS 54). Managerial, professional and technical occupations combined accounted for the highest share of employment in these two industries with slightly over 69% of the jobs in NAICS 5417 falling in this occupational group. Other occupational groups and individual occupations

with high shares of jobs in these two industrial sectors in 2003 were Office and Administrative Support occupations, followed by Computer and Mathematical Science occupations, Management occupations, and Business and Financial Operations occupations. The research and development services industry contained an above average share of jobs in the engineering (12%) and life and physical sciences occupations (7%). The occupational employment distribution of jobs in both of these sectors indicates a dependency on workers with a high level of formal education. As noted earlier, workers with higher levels of education earn considerably more than their peers with only a high school education. These higher earnings levels are accompanied by higher productivity levels and higher tax receipts for the state and federal government. The higher earnings of workers in those jobs increase their ability to purchase other local goods and services, thereby increasing the size of the employment multipliers in biopharmaceutical industries. The overall economic impact of these industries in the state will be found to be quite high. Our next few papers will examine the demographic/socioeconomic characteristics of workers in biopharmaceutical industries, including their age, gender, race-ethnic, and educational backgrounds, and their annual earnings.

Chart 4:
Percent Distribution of Jobs in the Scientific Research and Development Services (NAICS 5417)
Industries of Massachusetts by Major Occupational Group, 2003
 (in %)

