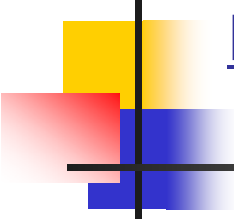


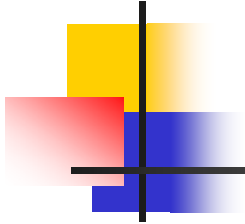
*The Economic, Labor Market, and  
Fiscal Performance and Impacts  
of the Biopharmaceutical-Related  
Industries of Massachusetts*

Center for Labor Market Studies  
Northeastern University

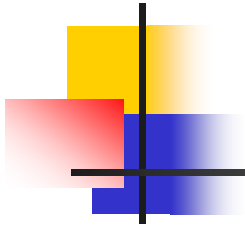


The Economic, Fiscal, Labor Market, and R&D  
Expenditure Performance of Biopharmaceutical-Related  
Industries and Their Workers in Massachusetts

- Biopharmaceutical activities cut across a number of different industrial sectors, not all of whose firms are involved in biopharmaceutical production, research, or marketing
- Employment trends in biopharmaceutical-related industries in Massachusetts and the U.S.; past, recent, and projected employment developments
- Massachusetts' comparative performance among the 50 states in biopharmaceutical employment levels, relative share of national biopharmaceutical employment, relative shares of state employment, payroll levels in biopharmaceutical industries, and payroll per worker



- Export base employment in biopharmaceutical-related industries; output, earnings, and employment multipliers
- Trends in the value of shipment/receipts from state biopharmaceutical industries
- Research and development expenditures by biopharmaceutical industries and individual PhRMA member companies
- A demographic/socioeconomic profile of workers in biopharmaceutical industries; their occupational characteristics



- The annual earnings levels of employed workers in biopharmaceutical industries; consequences for economic multiplier effects
- Fiscal impacts of workers in the state's biopharmaceutical industries
- The impacts of new drugs/medical treatments on life expectancy, the value of additional years of expected life, and other health expenditures.



## The Industries Containing Biopharmaceutical-Related Firms in Massachusetts and U.S. Economy

NAICS Code	Industry Title
3254	Pharmaceutical and Medicine Manufacturing
3391	Medical equipment and supplies manufacturing
54171	Scientific research and development services



## Key Findings on Employment Developments in the State's Biopharmaceutical- Related Industries and All Nonfarm Industries

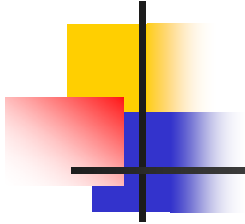
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1. Between 1990 and 2005, the payroll employment growth rates were

Total payroll employment	+7.5%
Biopharmaceutical-Related	+46%
	<u>6* faster</u>

2. Between 2000 and 2005, the payroll job growth rates of the two industries were as follows:

Total payroll employment <u>fell</u> by 118,000 or	-3.6%
Biopharmaceutical-Related	+12.4%



Projected 2004-2014 employment,

Total nonfarm employment

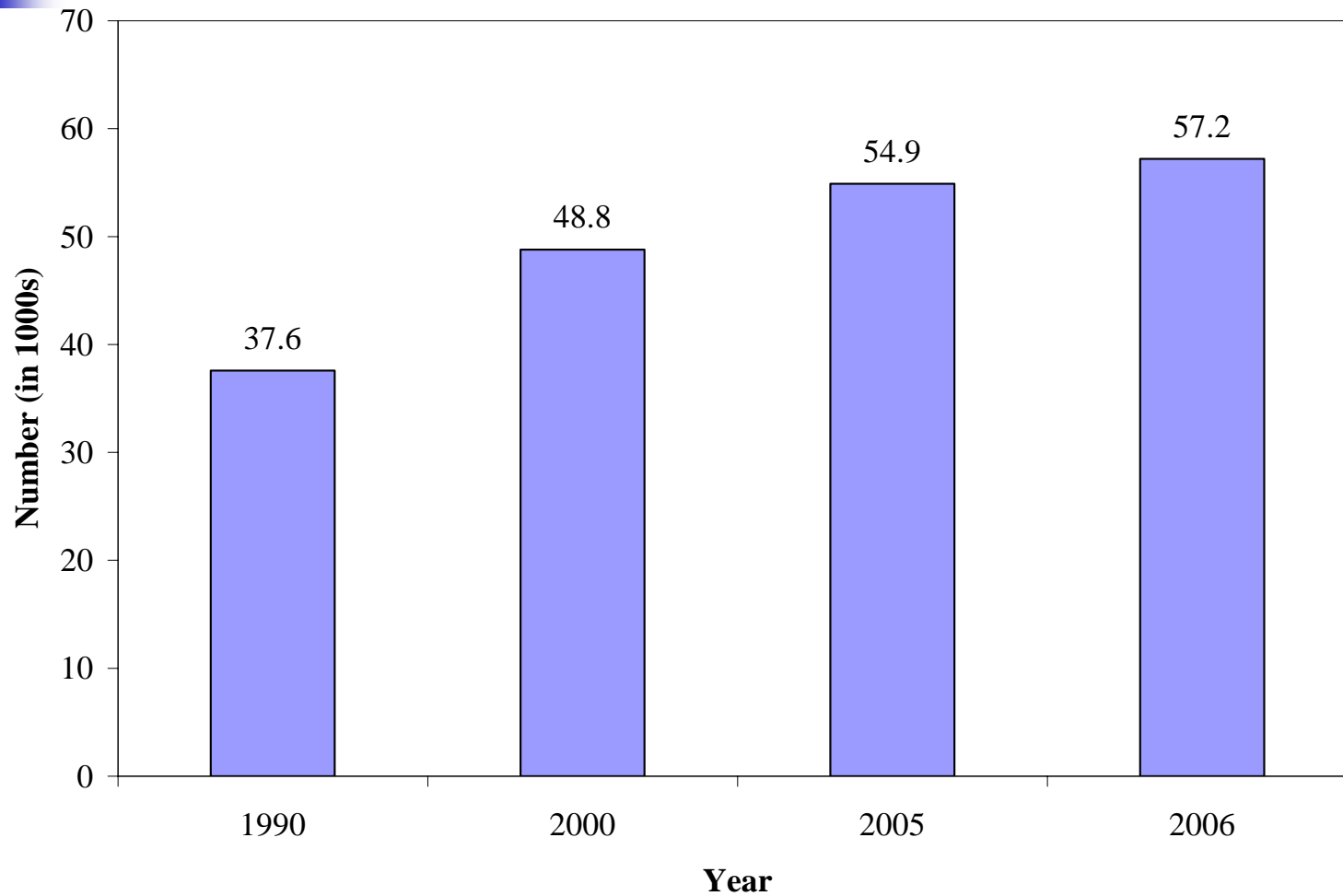
+7.8%

Biopharmaceutical-Related

+21.3%

Nearly 3\* faster growth in  
biopharmaceutical

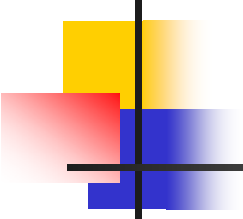
## Trends in Wage and Salary Employment in the State's Biopharmaceutical-Related Industries, 1990 to 2005





## Changes in Payroll Employment Levels in Biopharmaceutical-Related Industries of Massachusetts, 2000-2005

Industrial Sector	2000	2005	Absolute Change	Percent Change
Pharmaceutical Preparation Manufacturing	7,656	7,771	115	1.5%
Surgical and Medical Instrument Manufacturing	14,821	11,981	-2,840	-19.1%
Physical, Engineering, and Biological Research	26,369	35,192	8,823	33.4%
Total, Above 3 Industries	48,846	54,944	6,098	12.4%
All Manufacturing Industries	408,532	305,518	-103,014	-25.2%
Total, All Private Sector Industries	2,858,008	2,757,402	-100,606	-3.5%



## Projected Wage and Salary Employment Growth in Biopharmaceutical-Related Industries in Massachusetts, 2004-2014

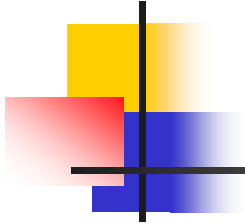
Industry Sector	2004	2014	Net New jobs	Growth Rate (in %)
Scientific research and development services	36,600	46,390	9,790	26.7
Medical equipment and supplies manufacturing	12,800	13,270	470	3.7
Pharmaceutical and medicine manufacturing	6,949	8,700	1,751	25.2
Total Above 3 Biopharmaceutical- Related Industries	56,349	68,360	12,011	21.3
Manufacturing, All	312,930	281,210	-31,720	-10.1
Total NonFarm	3,181,120	3,428,330	247,210	7.8



## Massachusetts' Rankings Among the 50 States on Selected Biopharmaceutical Indicators

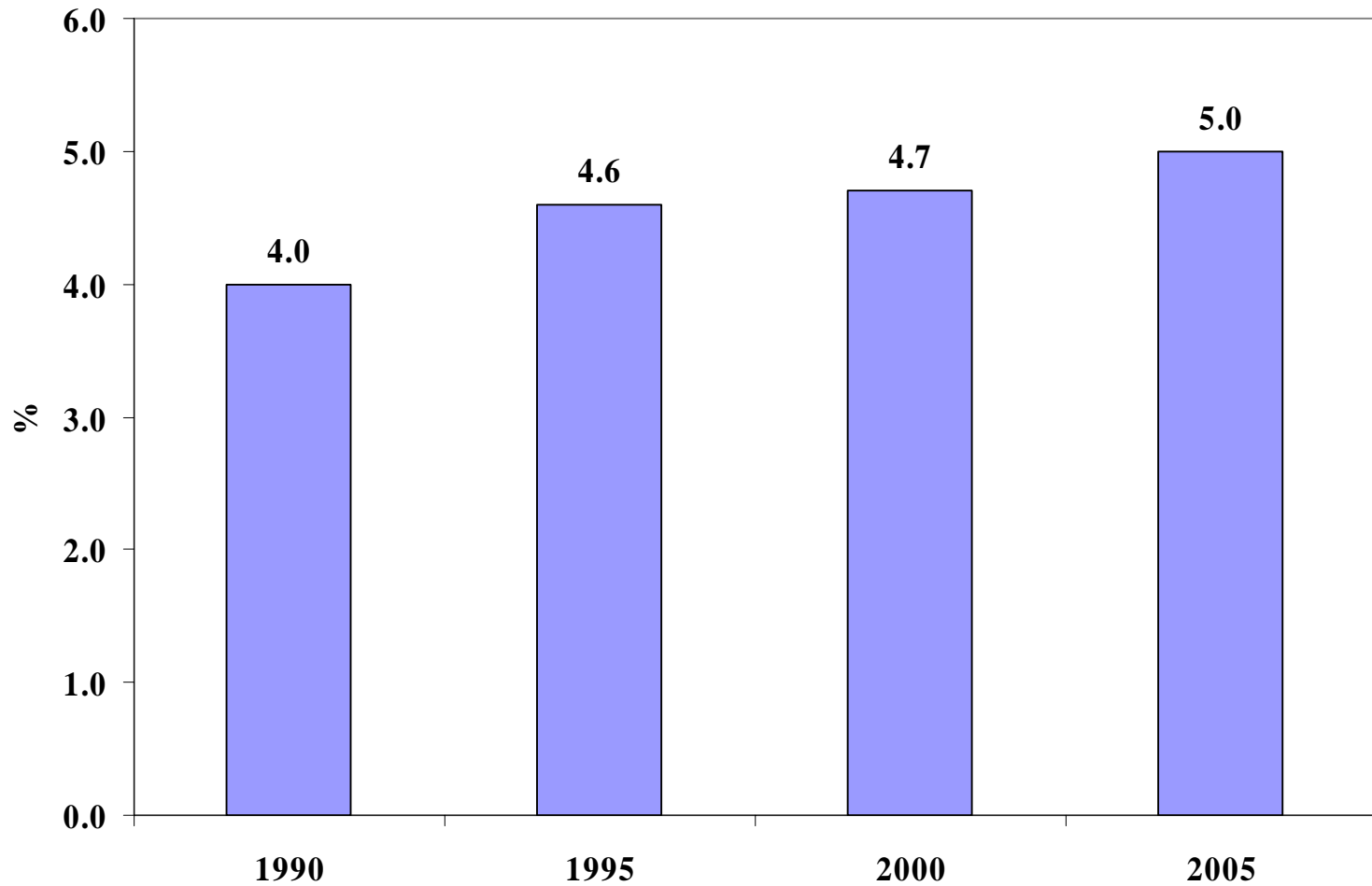
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- Massachusetts' share of all national jobs in these industries rose from 4.0% in 1990 to 4.7% in 2000 and to 5.0% in 2005 (one of the few industrial sectors where the state experienced a rising share of national jobs).
- Massachusetts had the 6<sup>th</sup> highest number of such jobs in 2005; we only ranked 13<sup>th</sup> among all 50 states in total payroll jobs.
- 2% of all private sector jobs in the state were in this sector; 3<sup>rd</sup> highest ratio in the country in 2005 (but still only 2%)

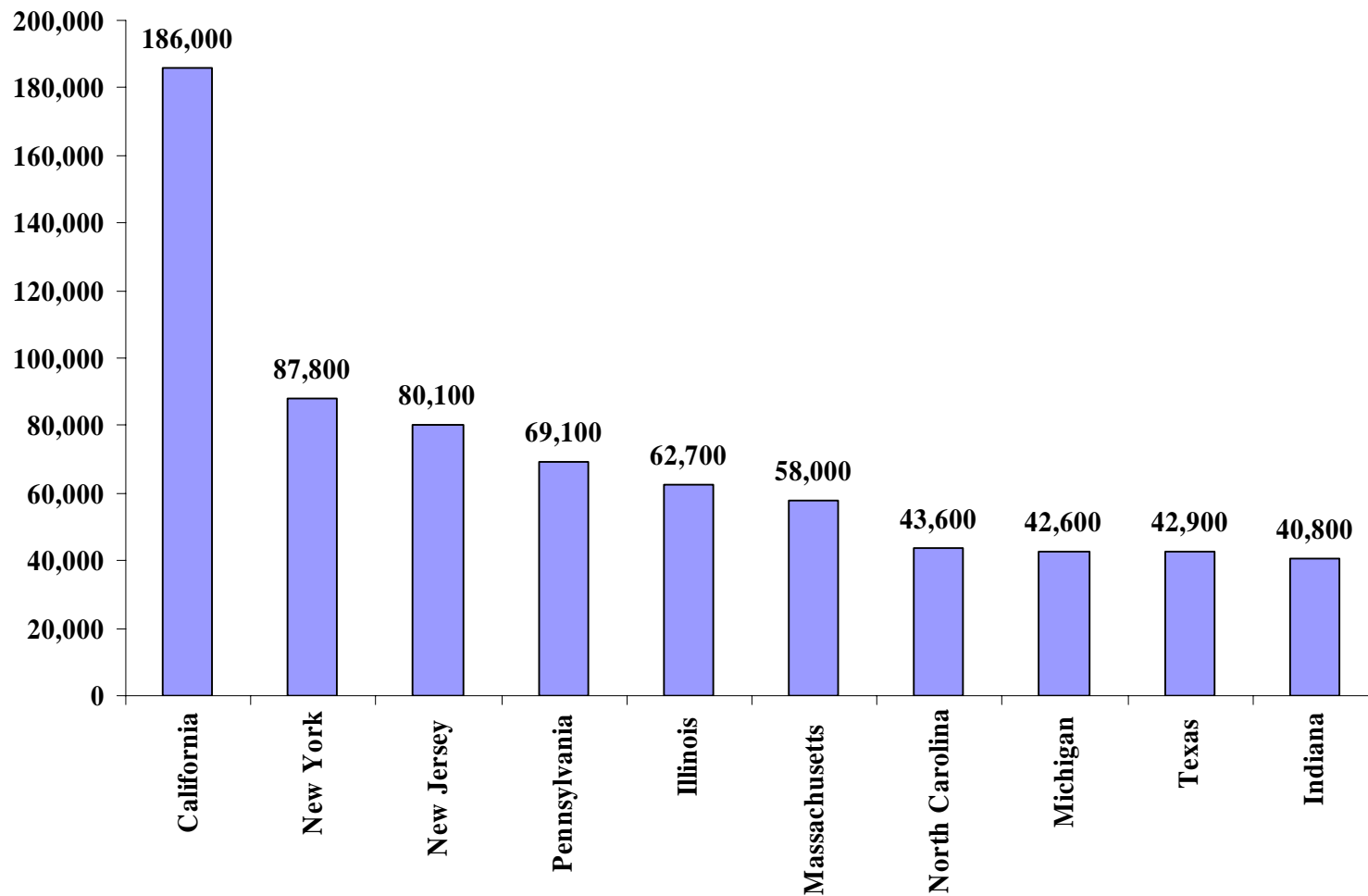


- We had 9 Pharmaceutical-related jobs per 1,000 residents in 2005; tied with New Jersey for the lead (tied for 1<sup>st</sup>)
- We had the 5<sup>th</sup> highest aggregate payroll in the industry at 5.1 billion in 2005; we had the 3<sup>rd</sup> highest payroll per worker (\$88,000 exceeded by only New Jersey and California)

Massachusetts' Share of National Employment in the  
Biopharmaceutical-Related Industries, 1990 to 2005  
(in %)

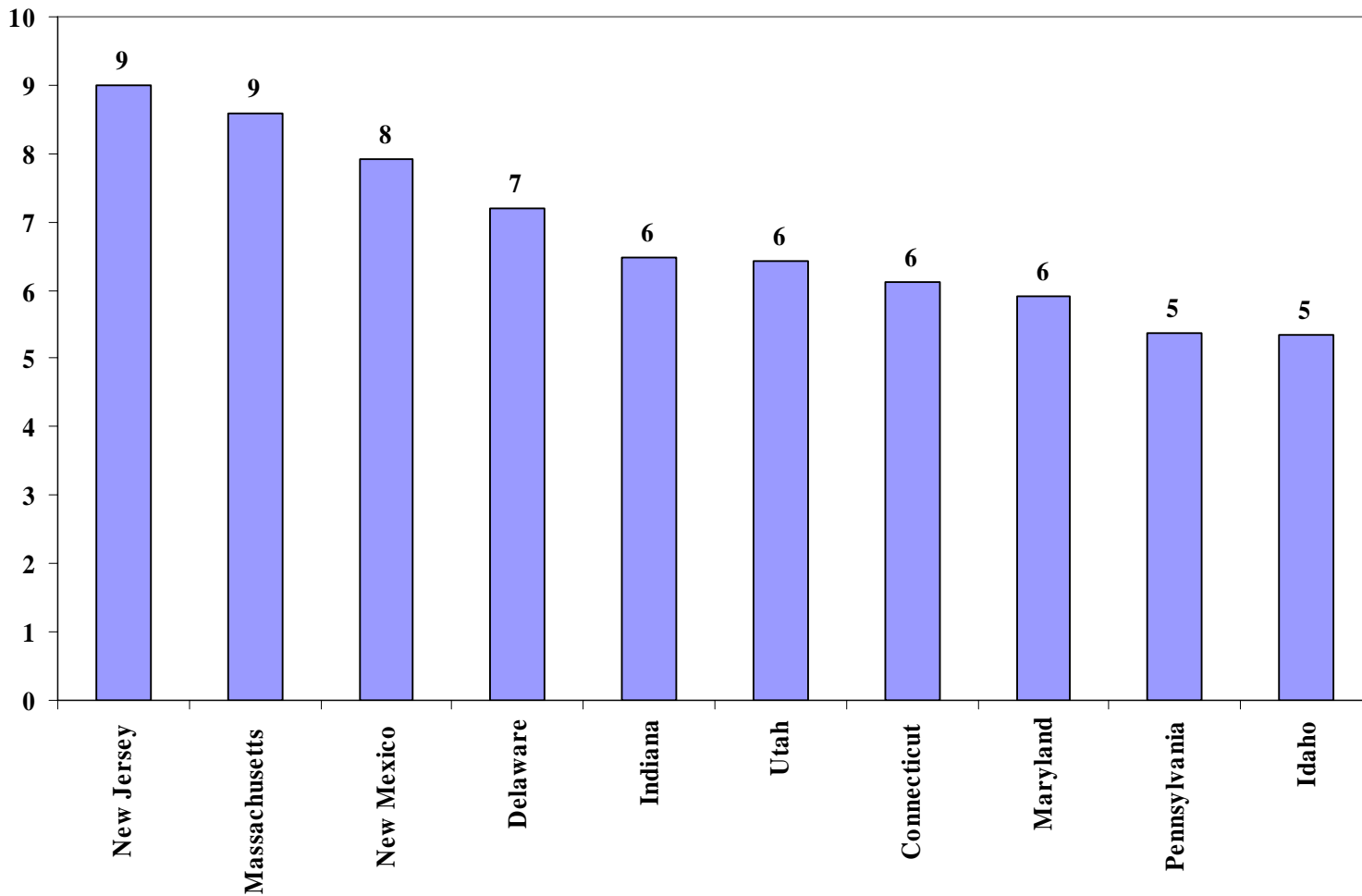


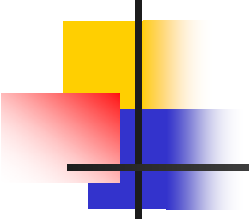
## States with the Highest Number of Bio-Pharmaceutical-Related Wage and Salary Jobs in 2005 (Revised Estimates)



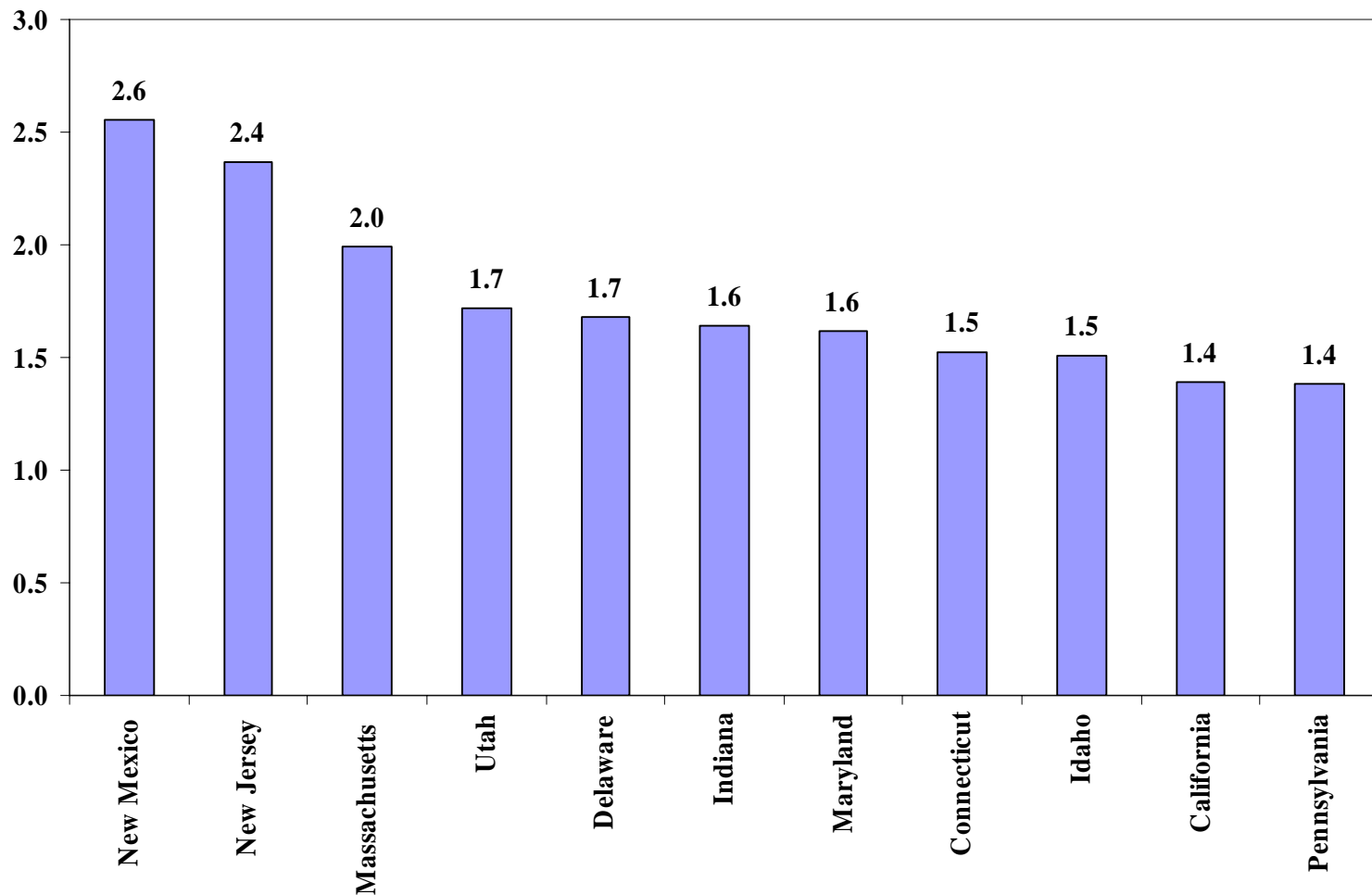


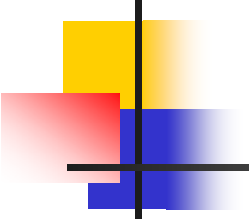
## Biopharmaceutical-Related Industry Jobs Per 1,000 Resident Population in the Top 10 States in 2005



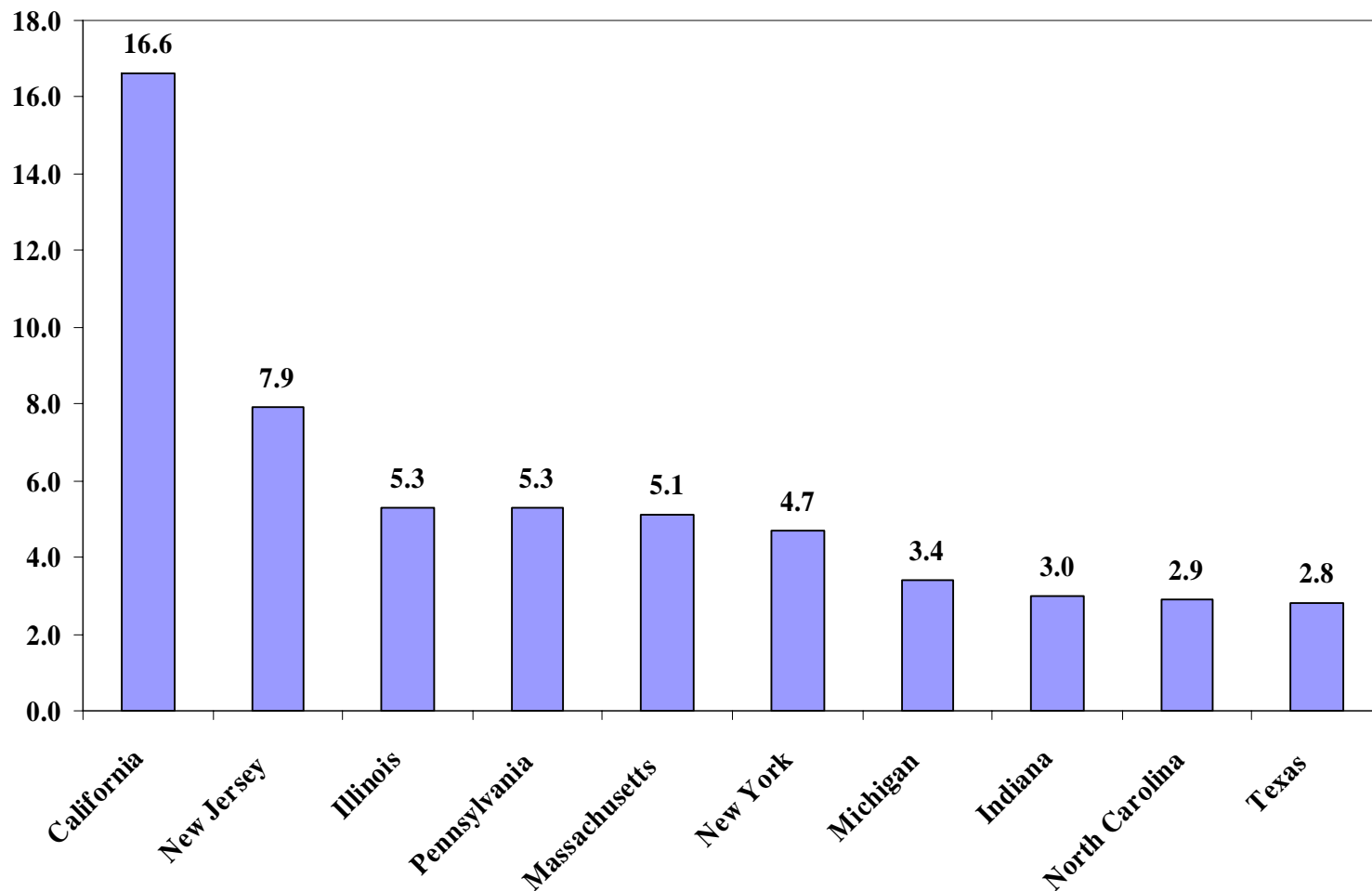


## Top 11 States Ranked by Their Biopharmaceutical-Related Industries' Share of Total Private Sector Wage and Salary Jobs, 2005



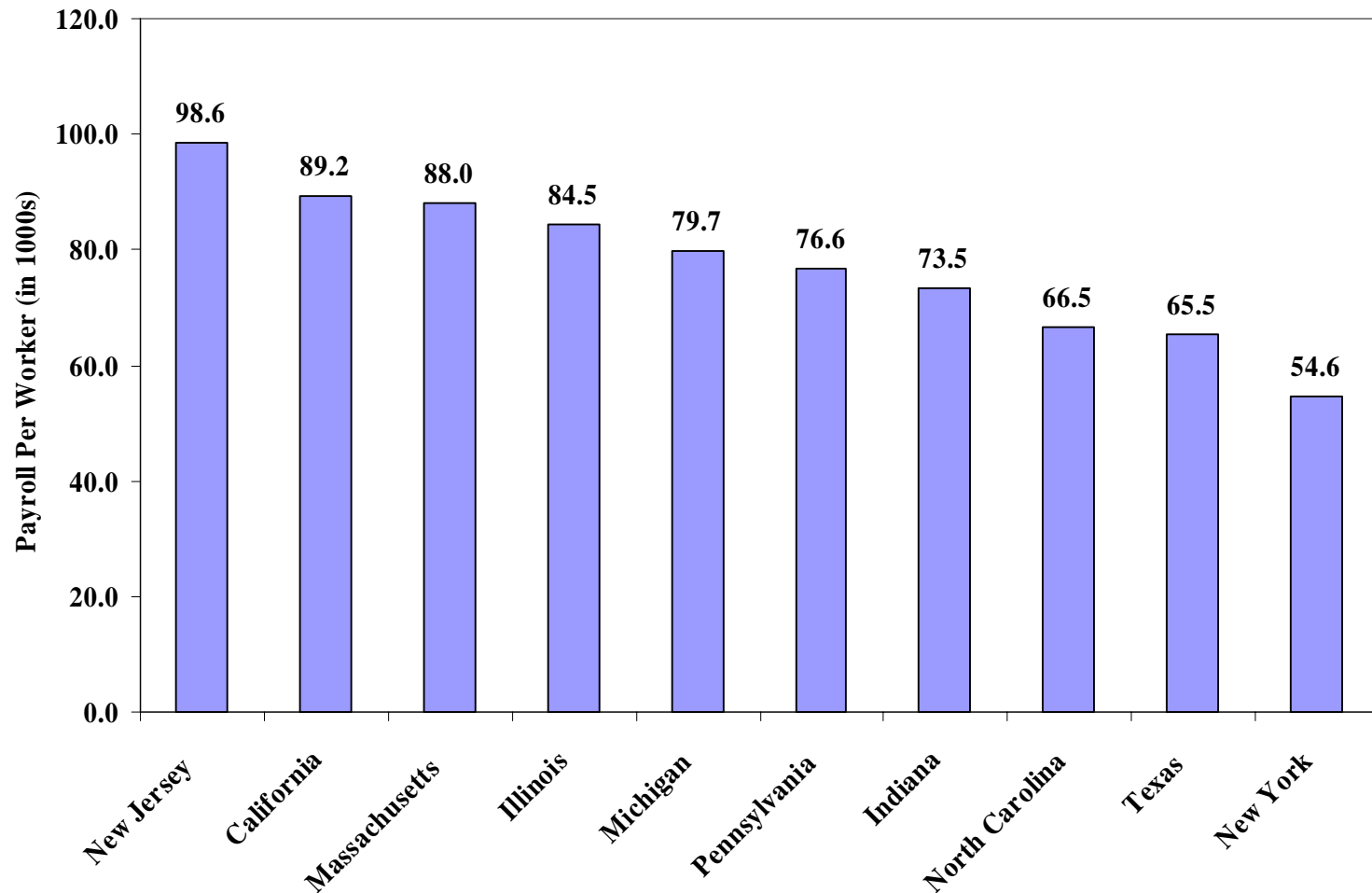


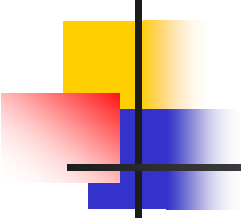
## Top 10 States with the Largest Aggregate Payroll in Bio-Pharmaceutical-Related Industries, 2005 (In Billions of Dollars)





## Payroll Per Worker in Biopharmaceutical-Related Industries in the Ten States With the Largest Number of Wage and Salary Workers in These Industries





## Trends in the Nominal Value of Shipments/ Receipts in Biopharmaceutical Related Industries in Massachusetts and the U.S., 1997-2002 (In 1,000)

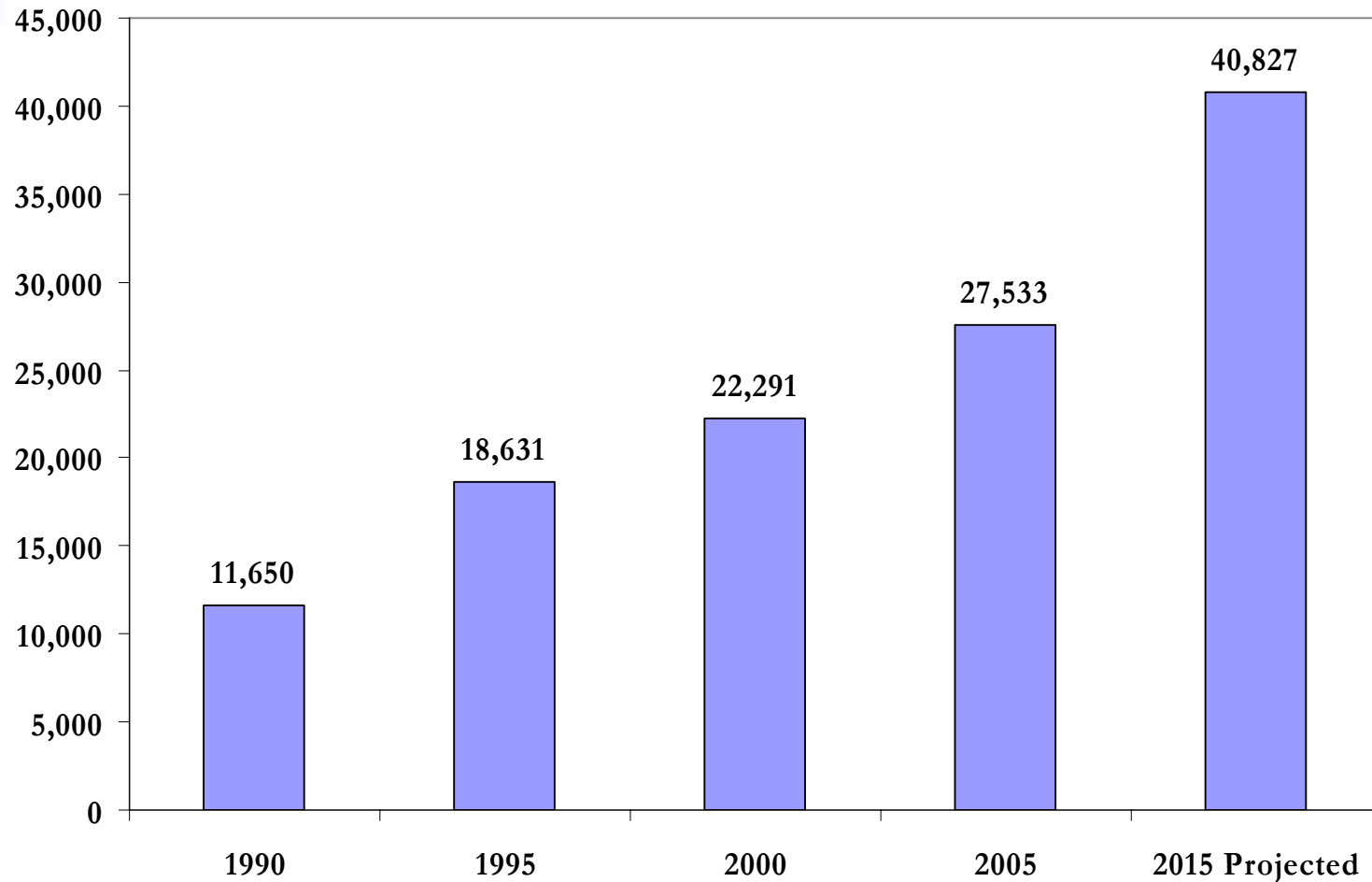
	1997	2002	Absolute Change	% Change
<b>Massachusetts</b>				
Pharmaceutical and Medicine Mfg. Industry (NAICS 3254)	\$2,124,000	\$3,632,725	\$1,508,725	71.0
Medical Instruments and Supplies Mfg. Industry (NAICS 3391)	\$2,008,850	\$3,072,093	\$1,063,243	52.9
Research and Development in the Physical, Engineering and Life Sciences (NAICS 54171)	\$2,595,285	\$4,496,928	\$1,901,643	73.3
All Biopharmaceutical Industries Combined	\$6,728,135	\$11,201,746	\$4,473,611	66.5
<b>United States</b>				
Pharmaceutical and Medicine Mfg. Industry (NAICS 3254)	\$92,932,786	\$140,557,276	\$47,624,490	51.2
Medical Instruments and Supplies Mfg. Industry (NAICS 3391)	\$44,893,840	\$61,928,760	\$17,034,920	37.9
Research and Development in the Physical, Engineering and Life Sciences (NAICS 54171)	\$34,145,927	\$60,453,069	\$26,307,142	77.0
All Biopharmaceutical Industries Combined	\$171,972,553	\$262,939,105	\$90,966,552	52.9



## Growth Rates of the Nominal Value of Shipments/ Receipts by Major Private Sector Industries in Massachusetts and the U.S., 1997-2002

Industry	MA	U.S.
<b>Biopharmaceutical-Related Industries</b>	<b>66.5</b>	<b>52.9</b>
Construction	52.6	40.6
Manufacturing	0.1	2.1
Wholesale trade	12.8	14.2
Retail trade	26.1	24.1
Transportation & warehousing	25.8	20.1
Real estate & rental & leasing	42.4	39.3
Professional, scientific, & technical services	54.8	45.8
Adm., support, waste management, remediation services	29.3	34.3
Educational services	20.1	50.2
Health care & social assistance	36.3	36.8
Arts, entertainment, & recreation	43.6	35.5
Accommodation & food services	27.0	28.3
Other services (except public administration)	23.0	13.6

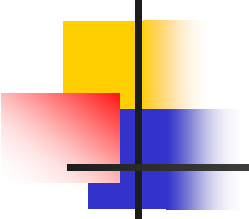
Trends in Basic or "Export" Wage and Salary  
Employment in Biopharmaceutical-Related Industries  
of Massachusetts, 1990-2005 and Projected 2015





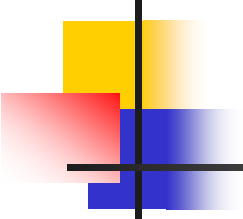
## Massachusetts State Exports to Other Countries, Total and Pharmaceutical ( in Millions of \$)

<b>Year</b>	<b>Description</b>		
	Total All Commodities	Pharmaceutical Products	Pharmaceutical Products % Share of Total
ANNUAL 2000	20,514.4	444.9	2.2
ANNUAL 2001	17,490.1	495.7	2.8
ANNUAL 2002	16,707.6	829.1	5.0
ANNUAL 2003	18,662.6	1,311.0	7.0
ANNUAL 2004	21,837.4	2,071.7	9.5
ANNUAL 2005	22,042.8	2,820.8	12.8
ANNUAL 2006	24,047.0	2,541.1	10.6
2007 Annualized Estimate	25,561.0	3,117.5	12.2



## Final Demand Output Multipliers in Biopharmaceutical-Related Industries of Massachusetts and the U.S., 1997/2004

Area	Pharmaceutical and Medicine Manufacturing	Surgical and Medical Instrument Manufacturing	Surgical Appliances and Supplies Manufacturing	Scientific Research and Development Services,
U.S.	2.769	2.861	2.862	3.101
Massachusetts	2.066	2.051	2.014	2.14
Mass. Ranking Among 50 states and D.C.	8 <sup>th</sup> Highest	12 <sup>th</sup> Highest	11 <sup>th</sup> Highest	17 <sup>th</sup> Highest



## Direct Effect Earnings Multipliers in Biopharmaceutical-Related Industries of Massachusetts and the U.S., 1997/2004

Area	Pharmaceutical and Medicine Manufacturing	Surgical and Medical Instrument Manufacturing	Surgical Appliances and Supplies Manufacturing	Scientific Research and Development Services,
U.S.	4.507	3.070	3.291	2.226
Massachusetts	3.281	2.299	2.386	1.715
Mass. Ranking Among 50 states and D.C.	7 <sup>th</sup> Highest	6 <sup>th</sup> Highest	7 <sup>th</sup> Highest	16 <sup>th</sup> Highest

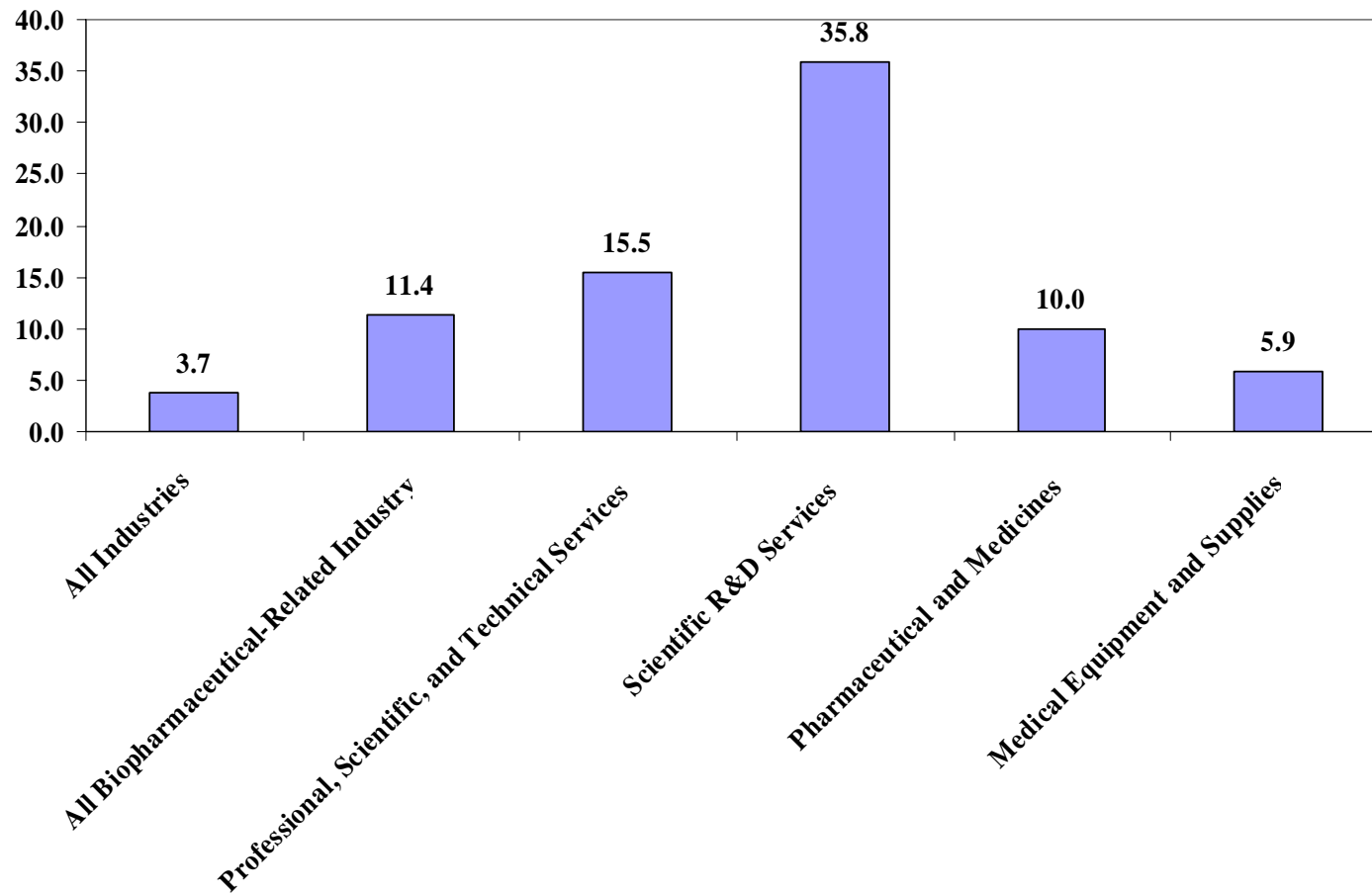


## Direct Effect Employment Multipliers in Biopharmaceutical-Related Industries of Massachusetts and the U.S., 1997/2004

Area	Pharmaceutical and Medicine Manufacturing	Surgical and Medical Instrument Manufacturing	Surgical Appliances and Supplies Manufacturing	Scientific Research and Development Services
U.S.	9.359	5.198	5.211	3.458
Massachusetts	6.033	3.500	2.979	2.414
Mass. Ranking Among 50 states and D.C.	8 <sup>th</sup> Highest	9 <sup>th</sup> Highest	18 <sup>th</sup> Highest	19 <sup>th</sup> Highest

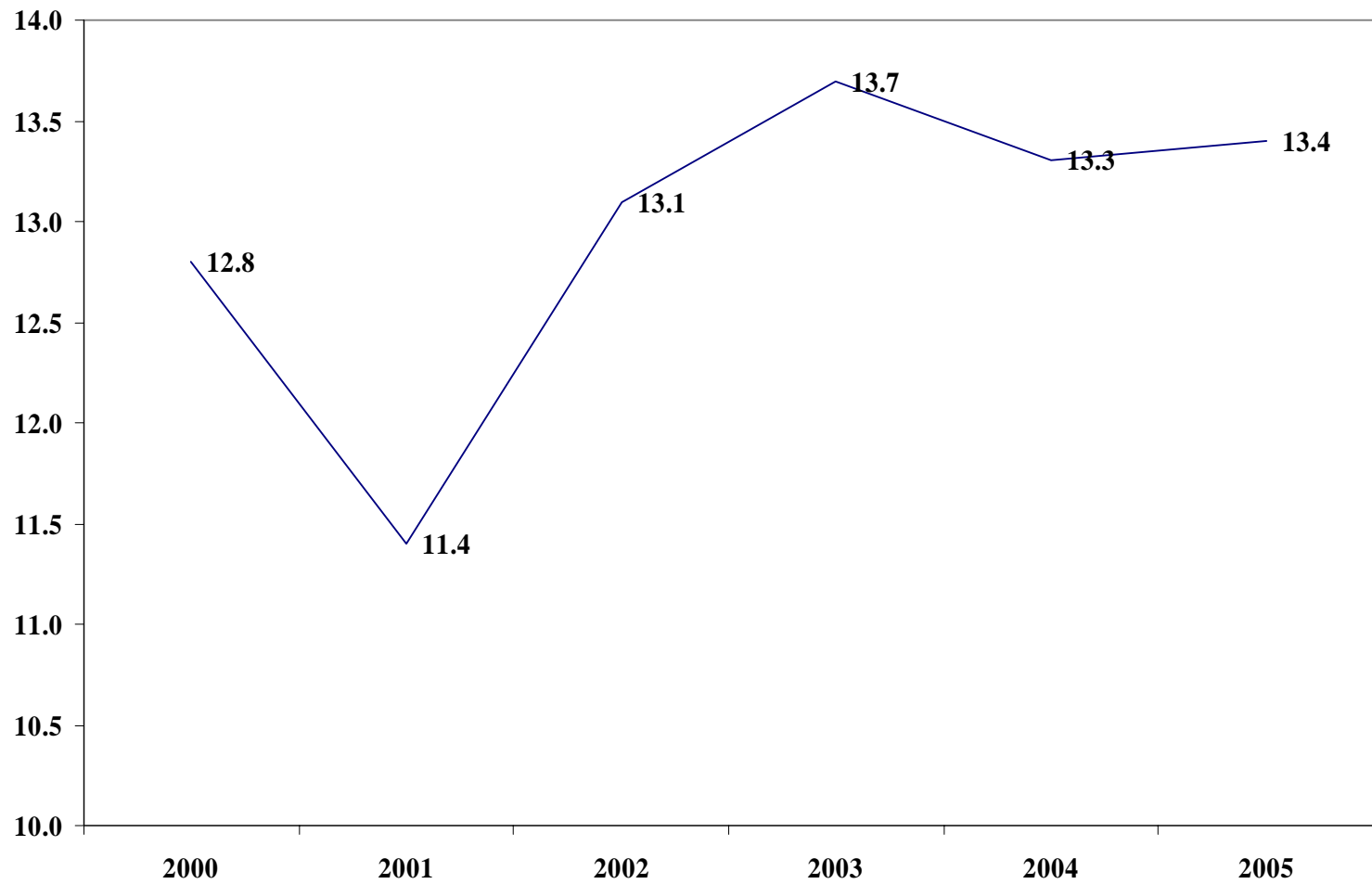


## R&D Intensity of Biopharmaceutical-Related Industries Compared to All Industries, U.S., 2004



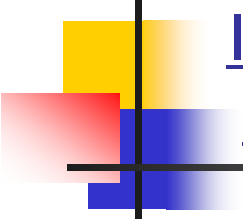


## R&D Intensity of PhRMA Member Companies Operating in Massachusetts, 2000-2005 (In %)



The Gender, Age and Race-Ethnic Characteristics of  
Employed Resident Workers in Biopharmaceutical-  
Related Industries and All Industries of  
Massachusetts, 2003-2005 Averages (in Percent)

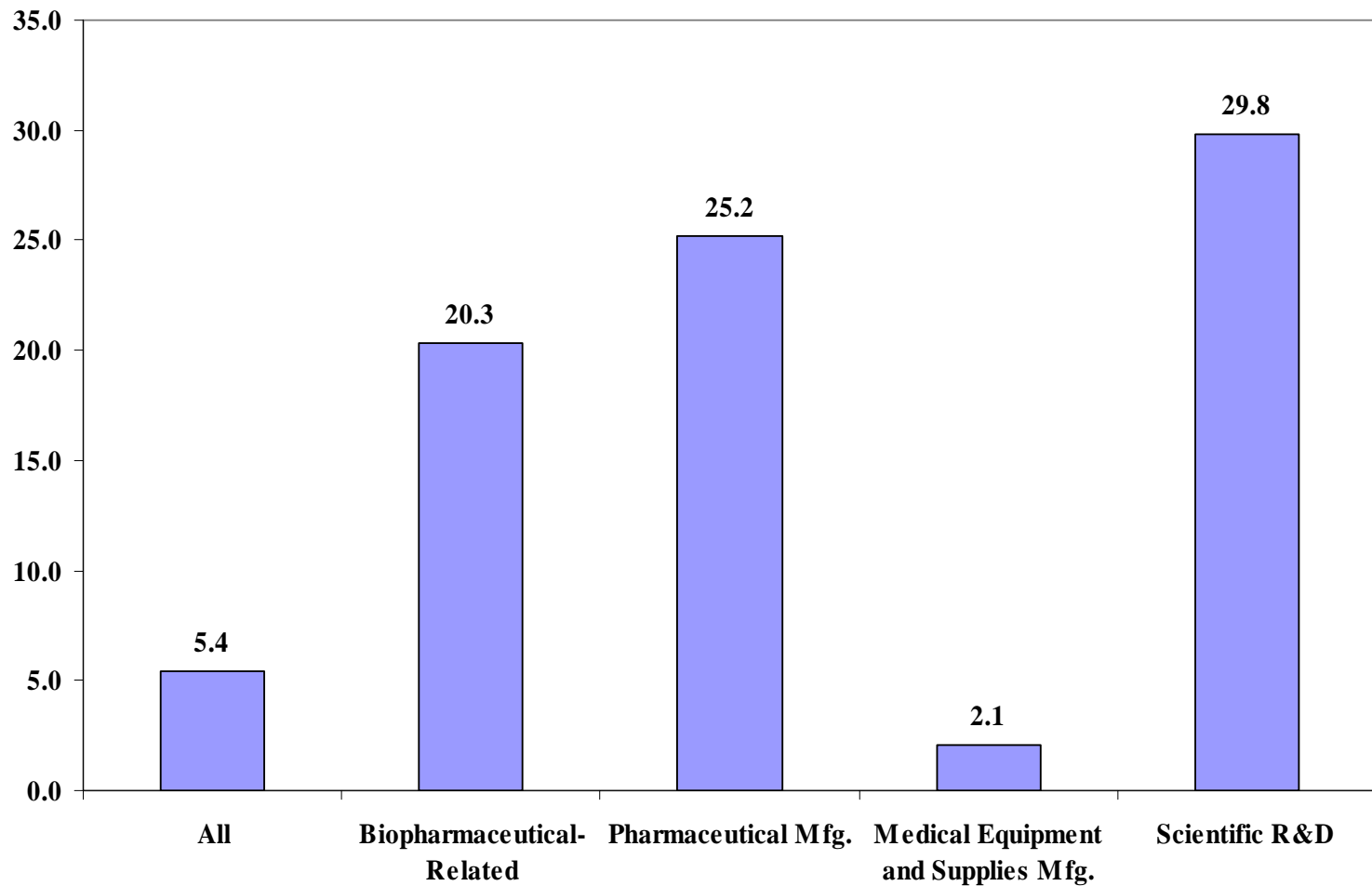
Characteristic	(A) All Industries	(B) All Biopharmaceutical	(C) Pharmaceutical and Medicine Mfg.	(D) Medical Instruments and Supplies Mfg.	(E) Scientific Research and Development
<b>Gender</b>					
• Men	52.3	55.2	50.9	52.8	59.2
• Women	47.7	44.8	49.1	47.2	40.8
<b>Age</b>					
• 16-19	3.5	.8	.5	1.4	.6
• 20-24	8.0	4.6	5.3	2.7	5.6
• 25-34	21.8	27.6	32.5	22.4	28.5
• 35-44	25.8	30.1	34.1	27.3	29.8
• 45-54	23.7	24.0	22.1	30.0	20.9
• 55-64	13.3	11.1	5.4	14.3	12.0
• 65+	3.8	1.9	.2	2.0	2.7
<b>Race-Ethnic Group</b>					
• Asian	4.6	11.3	13.2	11.5	10.1
• Black	5.0	4.9	7.5	6.3	2.5
• Hispanic	6.1	3.6	1.2	7.5	2.2
• Other	1.5	1.8	3.2	2.7	.5
• White	82.6	78.5	74.9	72.1	84.6

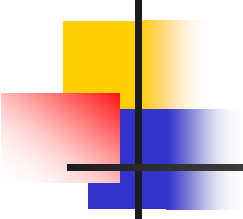


Percentage Distribution of the Employed (16+) in All Industries and Biopharmaceutical-Related Industries in Massachusetts by Educational Attainment, 2003-2005

	(A)	(B)	(C)
Educational Attainment	All Industries	Biopharmaceutical-Related Industries	Biopharmaceutical/All
Less than 12 or 12, no diploma/GED	8.5	2.8	.33
H.S. diploma/GED	25.3	15.0	.60
13-15 years	25.9	17.8	.67
Bachelor's degree	23.5	30.3	1.29
Master's or higher degree	16.8	34.0	2.03

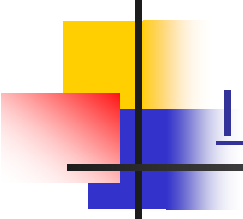
Percent of the Employed (16+) in All Industries of  
Massachusetts and Biopharmaceutical-Related  
Industries with a Professional or Ph.D. Degree, 2005





## A Comparison of the Occupational Distribution of Employment in Biopharmaceutical-Related Industries and All Industries in Massachusetts, 2003 (in %)

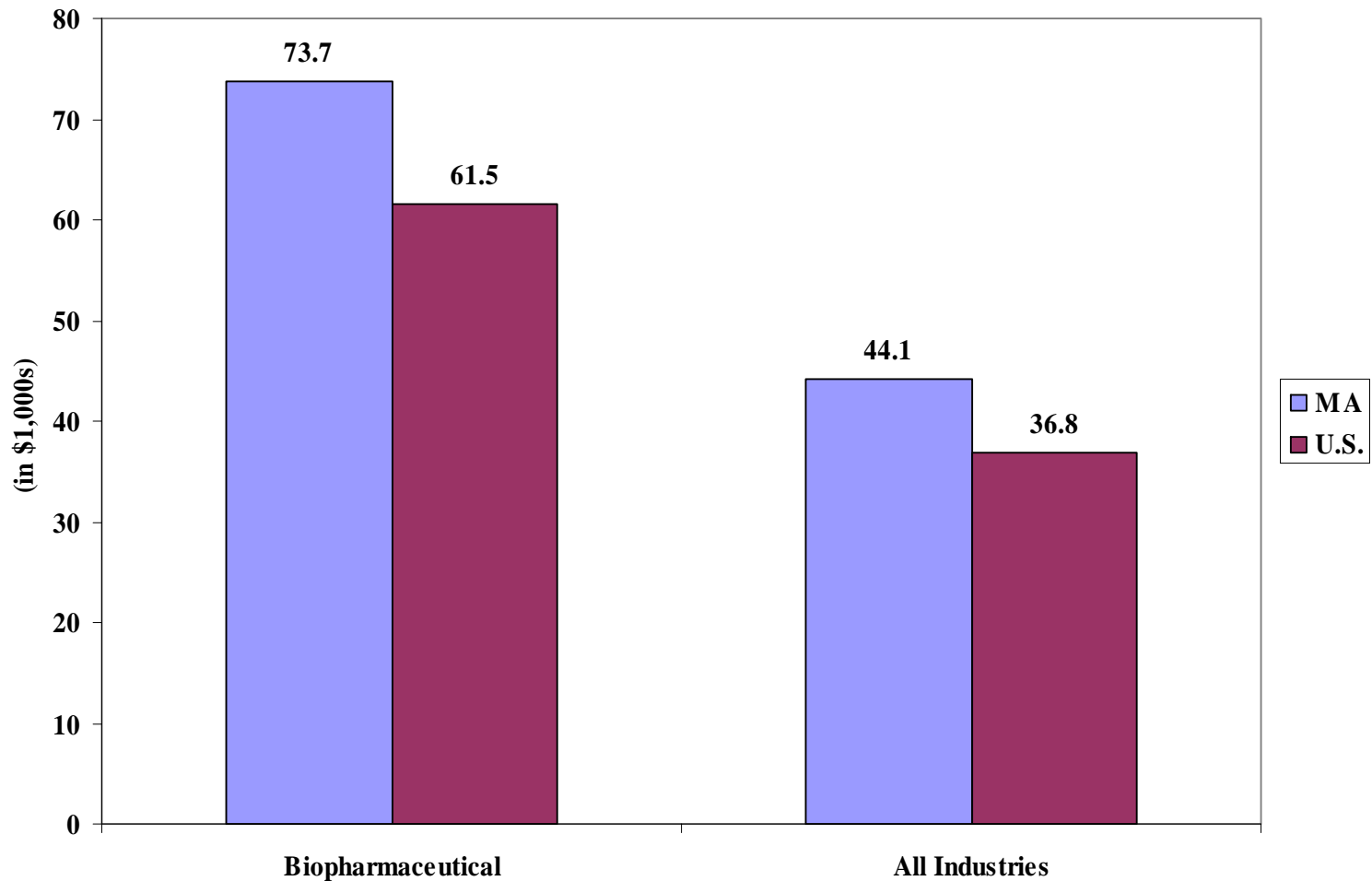
Occupational Group	(A) All Industries	(B) Biopharmaceutical- Related Industries
All Workers (in 1000s)	3,187	55.7
Management, Professional and Technical Occupations (in %)	34.3	56.7
Service, Sales and Office Occupations (in %)	47.1	22.9
Construction, Maintenance, Repair, Production Occupations (in %)	18.6	18.2



Median Annual Earnings of Employed Persons (16+)  
in Biopharmaceutical-Related Industries and All  
Industries of Massachusetts and the U.S.; 2004-2005

	(A)	(B)
Industry	Massachusetts	U.S.
Biopharmaceutical-Related Industries	\$56,000	\$46,000
Pharmaceutical and medicine manufacturing	60,000	55,000
Medical equipment and supplies manufacturing	40,000	36,000
Scientific research and development	66,000	50,000
All Industries	32,000	26,000
Biopharmaceutical-Related/All Industries	1.75*	1.77*

Comparisons of Mean Annual Earnings of the Employed  
in Biopharmaceutical Industries and All Industries,  
Massachusetts and the U.S., 2004-2005 (in \$1,000s)





Estimated Independent Impacts of Being Employed in a  
Biopharmaceutical-Related Industry in Massachusetts on the  
Expected Annual Earnings of Selected Groups of  
Full-Time, Year-Round Workers in 2005

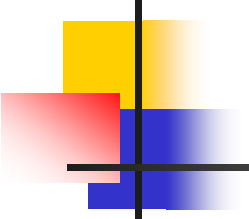
Group of Workers	Percentage Point Effect
All	23%
Medical equipment mfg.	16%
Pharmaceutical mfg.	35%
Scientific R&D	22%
Men	21%
Women	26%
Workers with 1-15 years of schooling	18%
Workers with Bachelor's or higher degree	22%



## Why Median and Mean Earnings of Workers in State Biopharmaceutical-Related Industries are Well Above Average?

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- Higher shares of the employed in biopharmaceutical-related industries work full-time, year-round
- The employed in biopharmaceutical industries are more highly educated, with well above average shares of workers with bachelor or higher degrees
- An above average share of biopharmaceutical workers are employed in professional, managerial, technical, and high level sales positions
- There are earnings premiums paid to workers in these industries relative to their peers in other industries after controlling for educational/work experience, demographic differences



## A Listing of the Cash Transfer, Non-Cash Transfer, and Personal Tax Items Used in Conducting the Fiscal Impact Analysis

<b>Total Costs to Government</b>		<b>Total Benefits to Government</b>
<b>Cash Transfers</b>	<b>Non-Cash Transfers</b>	<b>Tax Receipts</b>
Unemployment benefits	Market value of food stamps	Federal income tax payment <sup>(1)</sup>
Worker's compensation	Market value of Medicare insurance	State income tax payment <sup>(1)</sup>
Social Security retirement benefits payments	Market value of Medicaid benefits	Federal retirement payroll deductions
Supplemental Social Income for the disabled and aged	Family market value of housing subsidies	Social Security retirement payroll taxes
Public assistance income	Energy assistance payments	
Veteran's payments		
Survivor's income benefits		
Earned Income Tax Credits		
Other disability incomes		



Net Annual Fiscal Contributions of Workers (16+)  
in Biopharmaceutical-Related and All Industries of  
Massachusetts, 2004 and 2005 Averages

	(A)	(B)	(C)
Fiscal Measure	Biopharmaceutical- Related	All Industries	Biopharmaceutical Minus All Industries
(a) Taxes Paid	\$21,019	\$11,340	\$9,679
(b) Transfers Received	\$862	\$1,404	-\$542
(c) Net fiscal contribution (a – b)	+\$20,157	+\$9,936	+\$10,221

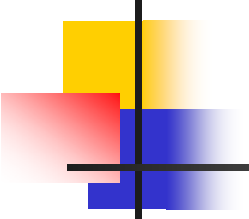


Estimated Expected Annual Values of Property Tax  
Payments by Employed Homeowners in  
Massachusetts by Major Industry of Employers, 2005

Variable	(A) Biopharmaceutical- Related	(B) All Industries	(C) Biopharmaceutical Minus All Industries
Homeownership Rate	73.6%	66.6%	+7 percentage points
Median Value of Property	\$3,563	\$3,026	\$547
Tax of Home Owners Expected Value of Annual Property Tax Payments	\$2,622	\$2,015	\$607

## Job Vacancy Levels and Vacancy Rates for Selected Biopharmaceutical-Intensive Occupations in Massachusetts, 2006 II

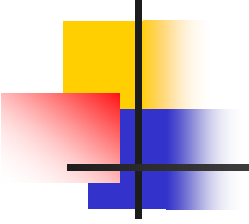
	(A)	(B)	(C)	(D)
	Estimated Vacancies	Vacancy Rate (in %)	Unemployed	V/U Ratio
<b>All Occupations</b>	<b>86,296</b>	<b>3.0</b>	<b>157,041</b>	<b>.55</b>
Medical Scientists, excluding epidemiologists	574	12.0	83	
Biochemists and Biophysicists	157	10.3	0	
Chemists	222	7.8	189	
Marketing and Sales Managers	457	6.6	596	
Industrial Engineers	392	6.2	106	
Computer Software Engineers, Applications	1,197	5.6	957	
Biomedical Engineers	55	4.1	0	
Computer Systems Analysts	575	3.5	719	
Sales Reps, Wholesale & Manufacturing, Technical & Scientific	235	1.3	68	
Biological Technicians	37	1.0	0	
Chemical Technicians	16	0.8	0	
Total, Above 12 Occupations	4,339		2,718	1.60



## Prescription Drugs/Medical Advances, Gains in Life Expectancy, and Their Economic Value Per Person and to the Nation

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- Newer drugs and medical advances have contributed in an important manner to gains in life expectancy in the U.S. and other countries over the past 30 years (Lichtenberg; Murphy and Topel/Rosenberg)
- Murphy and Topel (University of Chicago) have estimated that cumulative gains in life expectancy between 1970 and 2000 have been worth \$1.2 million per person in the U.S. and added \$3.2 trillion annually to the national wealth. These gains are not included in official GDP estimate

- 
- 
- Replacement of older drugs by new drugs results in reductions in mortality, morbidity, and total medical expenditure. Between \$4 and \$8 in medical saving reductions per \$1 increase in newer drug costs (Litchtenberg)
  - Increases in life expectancy increase the willingness of people to pay for further health improvements by increasing the value and quality of remaining life; health investments including new drugs are complementary not substitutes