Index of the Massachusetts Innovation Economy 2002

Prepared by:

Massachusetts Technology Collaborative
Westborough, Massachusetts

The Massachusetts Technology Collaborative (MTC) is an independent economic development agency chartered by the Commonwealth to serve as a catalyst for growing the state's innovation economy. MTC brings together leaders from industry, academia, and government to advance technology-based solutions that lead to economic growth and a cleaner environment in Massachusetts. We work with cutting-edge companies to create new jobs and stimulate economic activity in communities throughout the Commonwealth.

Technology-driven innovation fuels our economy. MTC is uniquely positioned to provide solutions to the difficult challenges presented by the Governor and State Legislature. By forming dynamic partnerships with key stakeholders, the agency serves as a catalyst for growing the innovation economy.

What is the Index *and the Massachusetts Innovation Economy?*

This is a report on the Massachusetts economy. Like most such reports, it uses statistics to illustrate how the state economy performs, and compares its performance to that of similar state economies throughout the United States. These states are referred to as the Leading Technology States (LTS), and they include: California, Colorado, Connecticut, Minnesota, New Jersey, and New York.

But unlike most economic studies, the *Index* does not report on the entire economy of Massachusetts. The *Index* does not cover all the industries active in the state, or all the jobs in the state. Instead, the *Index* focuses on nine broad industry groups—or "clusters"—that are significant in Massachusetts, and thirty statistical indicators that inform about the state of innovation in Massachusetts.

Why Does the Index *Do This?*

The *Index* is based upon the premise that innovation is a critical factor in the growth of the state's economy.

The nine industry clusters featured in this report represent industries that are heavily concentrated in Massachusetts. The jobs within these nine clusters represent a high proportion of all the jobs in the Massachusetts economy, compared to jobs within similar clusters in other states, and in the U.S. economy as a whole. Their dominance within the state's economy is a reflection of their competitiveness, either in the past or in today's economy.

The *Index* focuses on the nine key industry clusters to better understand how the state's climate for innovation influences the growth of these clusters, and to help gain important insights into the entire Massachusetts economy.

Why is Innovation Important?

Innovation is one of the most important factors behind economic growth in today's global economy. With the United States competing against several countries with lower costs, innovation may be the most important factor in generating future economic growth.

Economists now estimate that fifty percent or more of all the growth in the U.S. economy since World War II has been the result of new technology. Some economists estimate that as much as two-thirds of U.S. economic growth during the 1990s was due to the introduction of new technologies, particularly information technologies (IT).

Many tend to think that innovation and technology are the same thing, but businesses innovate all the time, with and without new technology. Boston's financial services industry has steadily grown for decades, thanks in part to the creation of the mutual fund—not a technology, but an innovative way of purchasing and holding stocks on behalf of investors.

Economists now speak of innovation as the result of a series of interrelated processes that range from basic scientific research to methods of finance and business strategy. Increasingly they speak of these processes as part of a national innovation system. According to the RAND Corporation, "the system . . . has emerged as one of our most important national assets, as important a source for growth today and in the future as have been . . . the nation's natural resources in the past."*

Why Does Innovation Matter to Massachusetts?

If innovation is extremely important to the U.S. economy, it is critically important to the Massachusetts economy.

For 150 years or more in Massachusetts, new industries with new technologies have supplanted older, shrinking industries with older technologies. Recently, the state's Internet and data communications hardware and software companies picked up the economic slack left by the decline of minicomputer and defense electronics firms during the late 1980s.

Innovation not only creates new products, it also creates new industries, which in turn creates new jobs in Massachusetts. Innovation creates a competitive edge for Massachusetts firms, which increasingly compete with companies all over the world. Just as important, innovation fosters productivity—increased economic output from each person working in Massachusetts. In effect, higher productivity cuts the cost of doing business: an important result, because the state's costs of doing business have been historically high relative to the rest of the U.S. Sustained productivity creates the conditions for increased wages and other employee compensations.

Harvard Business School Professor Michael Porter recently summed up the process this way in a report for business and government leaders in San Diego: "The central economic goal . . . should be to attain and sustain a high and rising standard of living for . . . citizens. The ability to earn a high and rising standard of living depends on increasing productivity which in turn depends on innovation. The central challenge then in enhancing prosperity is to create the conditions for sustained innovation output."**

For a complete description of the data and analysis utilized in the *Index*, see page 56.

*New Foundations for Growth: The U.S. Innovation System Today and Tomorrow
An Executive Summary, Steven W. Popper and Caroline S. Wagner, 2001.

**San Diego: Clusters of Innovation Initiative
Professor Michael E. Porter, Harvard University, Council on Competitiveness, Monitor Group, ontheFRONTIER, 2001.

How the Index Works

The Framework for Innovation

The *Index* measures progress of three key components of the Massachusetts Innovation Economy. It is based on a dynamic conceptual framework that links resources to economic results through the process of innovation. The framework measures Massachusetts progress in leveraging its resources through innovation to create higher levels of economic performance. In a vital cycle, high economic performance supports ongoing investment in the key resources required to sustain the Innovation Economy.

The Massachusetts Innovation Economy has three interrelated and interactive components:

Results: Outcomes for people and business—job growth, rising average wages, and export sales

Innovation Processes: Dynamic interactions that translate resources into results—idea generation, commercialization, entrepreneurship, and business innovation

Resources: Critical public and private inputs to the Innovation Economy—human, technology, and investment resources, plus infrastructure.

The format of this document reflects the relationship among these components. The *Index* begins by presenting the economic results of the Massachusetts Innovation Economy and follows by tracking key factors of the state's innovation processes. It concludes by documenting trends in a number of resources that fuel the Massachusetts Innovation Economy.

Selecting Indicators

Indicators are quantitative measures that tell us how well we are doing: getting better, worse, or staying the same.

A rigorous set of criteria was applied to all potential indicators. All of the selected indicators:

- Are derived from objective and reliable data sources
- Have statistics measurable on an on-going basis
- Are bellwethers that reflect the fundamentals of economic vitality
- Can be understood and accepted by the community
- Measure conditions in which there is an active public interest.

Benchmark Comparisons: Leading Technology States

MTC believes that Massachusetts should be able to track the Innovation Economy over time. Monitoring the Innovation Economy is crucial for regularly assessing its strength and resilience.

At the same time, benchmark comparisons provide an important context for understanding how Massachusetts is doing in a relative sense. Some of the indicators compare Massachusetts with the national average or with a composite measure of six competitive Leading Technology States (LTS). The six LTS chosen for comparison throughout the 2002 *Index* are California, Colorado, Connecticut, Minnesota, New Jersey, and New York. Appendix B describes the methodology for selecting the LTS.

Nine Key Industry Clusters

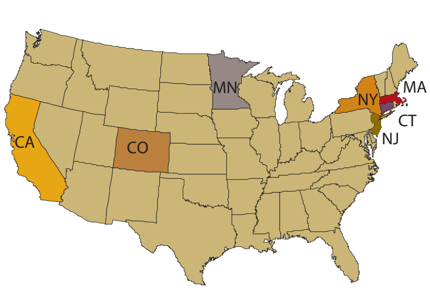
It is important to monitor the impact of innovation through those key industry clusters that are critical to the state's economy. The *Index* identifies nine industry clusters that are significant to the state and are linked to the Innovation Economy. These clusters range from the long-established, such as Postsecondary Education and Defense industries, to Software & Communications Services (which includes telecommunications) and Innovation Services (which includes engineering services and management consulting services). Appendix C provides a detailed definition for each of these clusters.

Together, these nine clusters account for 25% of non-government *employment* in Massachusetts and 39% of total private sector *payroll*. Government employment includes federal, state and local workers, postal workers, and education workers at the state and local level. Public sector payroll includes all government employees, armed forces and civilian employees.

At $69,011, the average wage paid by the nine key industry clusters is 32% higher than that of the rest of the Massachusetts economy ($47,191).

Leading Technology States

Massachusetts
and
California
Colorado
Connecticut
Minnesota
New Jersey
New York



Nine Key Industry Clusters

Computers & Communcations Hardware	Defense	Diversified Industrial Support	Financial Services	Healthcare Technology	Innovation Services	Postsecondary Education	Software & Communcations Services	Textiles & Apparel

Contents

Contents

Index Highlights

The Massachusetts Innovation Economy had a difficult year in 2001, and 2002 continues to be a struggle for the state to recover from a recessionary economy, stock market fluctuations, unsettling world events, corporate scandals, and local government budget constraints.

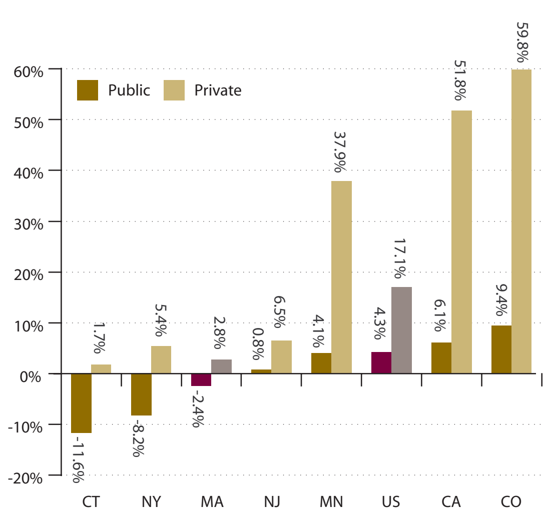
For the first time since the inaugural *Index* was released in 1997, most of the cyclical indicators point to either weakening or unchanged performance in the Massachusetts and U.S. economies. The extent of current economic weakness can be seen in a summary of several statistics comparing the first and second quarters for the past three years.

	MA Q1 and Q2 2002	MA Q1 and Q2 2001	MA Q1 and Q2 2000	U.S. Q1 and Q2 2002	U.S. Q1 and Q2 2001	U.S. Q1 and Q2 2000
Consumer Confidence	102.7	101.3	135.5	104.8	114.6	140.7
IPOs	1	2	24	25	38	267
Unemployment Rate	4.5%	3.8%	2.9%	5.8%	4.5%	4.0%
Venture Capital *(billions)*	$1.4	$2.2	$5.6	$11.9	$18.6	$50.3

Although Massachusetts is not alone in experiencing this economic slowdown, some of the *Index* indicators show the state has experienced more difficulties than the other LTS and the U.S. The table below highlights some areas in the Innovation Economy where the Commonwealth has been losing ground when compared to the LTS average and the U.S.

	MA	US	LTS Average
Average annual growth rate of NASDAQ companies' market value, 1997-2002	9.0%	14.0%	10.8%
Percent change in value of manufacturing exports, 2000 to 2001	-13.3%	-3.7%	0.5%
Average annual population growth rate, 1991-2001	0.6%	1.2%	1.1%
Percent change in total enrollments, public degree granting institutions, 1990-1999	-2.4%	4.3%	2.1%
Percent change in total enrollments, private degree granting institutions, 1990-1999	2.8%	17.1%	18.9%
Average 4 year tuition at private colleges, 2000	$20,098	$14,690	$16,185
Median price of single-family home, 2001	$252,000	$175,000	$225,650

Percent change in total enrollment, public and private degree granting institutions, Massachusetts, other LTS, and US, 1990-1999



Source: National Center for Education Statistics

The direction of the arrows reflects the performance of the Massachusetts Innovation Economy in the 2002 *Index*:

- ▲ Denotes a strength
- ◆ Indicates mixed progress
- ▼ Denotes a sign of weakness.

While the state and national economies are currently weakened, they will, of course, recover at some point. Beyond cyclical issues, however, the 2002 *Index* points to several long-term, chronic issues specific to Massachusetts that could negatively impact the foundation on which the state's Innovation Economy depends. These include:

College and University Enrollment Trends
This indicator is important because students often choose to reside and work in the region where they received their degree.

▼ From 1990 to 1999, Massachusetts enrollments in public institutions decreased 2.4%, one of only three LTS to experience a decline in public university enrollments.

▼ Massachusetts enrollments in private higher education increased 2.8% during the same period, but private institution enrollments in other states increased significantly, such as Colorado (59.8%) and California (51.8%).

Migration

A labor force expansion can help to sustain the economic growth of a region, as employers have a larger pool of workers from which to hire.

▼ Domestic out-migration increased from 8,656 to 20,751 from 1998-1999 to 2000-2001.

◆ International in-migration increased over one-third in Massachusetts from 1999-2000 to 2000-2001 (14,939 to 20,697). The state has relied on international in-migration to offset those who leave the state.

Housing

▼ From 1997 to 2001, the median home price in Massachusetts increased 40.1%, compared to the LTS (34.4%) and U.S. (25.0%) averages.

▼ The median home price in Massachusetts increased 12.0%, ($226,000 to $252,000) from 2000 to 2001.

Strengths in the Massachusetts Innovation Economy

Although there are areas for concern, the 2002 *Index* does report some good news for the Massachusetts Innovation Economy:

▲ Massachusetts labor force has one of the highest concentrations of scientists and engineers (0.91%) in the U.S.

▲ The state continues to receive high levels of federal research and development (R&D) investment at its academic and not-for-profit research institutions on both a per capita ($348 per 1,000 people) and absolute basis ($4.1 billion) in 2000.

▲ Corporate R&D spending at Massachusetts companies increased 25.1% from 2000 to 2001.

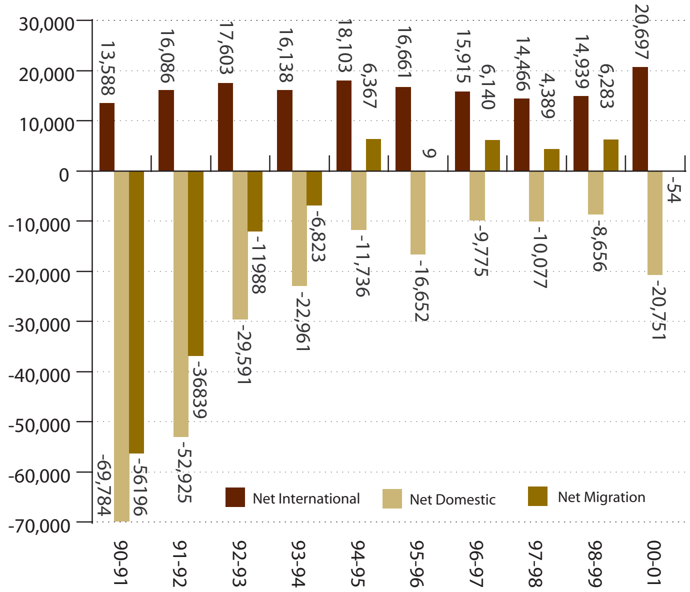
To put the current economic slowdown into perspective, one could look at the last time Massachusetts experienced a significant economic downturn, which was in the early 1990s. During this recession, Massachusetts suffered one of the worst contraction periods in its economic history. The state lost approximately 1% of its total population to domestic out-migration (-69,784), had an unemployment rate of 9.1%, and less than 1 in 4 high-tech CEOs ranked Massachusetts as a good place to create and operate a high-tech business.

Massachusetts	1991	1996	2001
New business incorporations	15,174	17,367	21,151
High tech CEO rating of state as favorable for business	23%	83%	90%
Fast growth firms	41*	93	86
Unemployment rate	9.1%	4.3%	3.7%
Consumer confidence	61.6*	93.5	98.8
Domestic out-migration from MA	-69,784	-16,652	-20,751
Median price of homes ($2001 inflation-adjusted)	$169,773	$172,698	$252,000

** 1992 earliest data available*

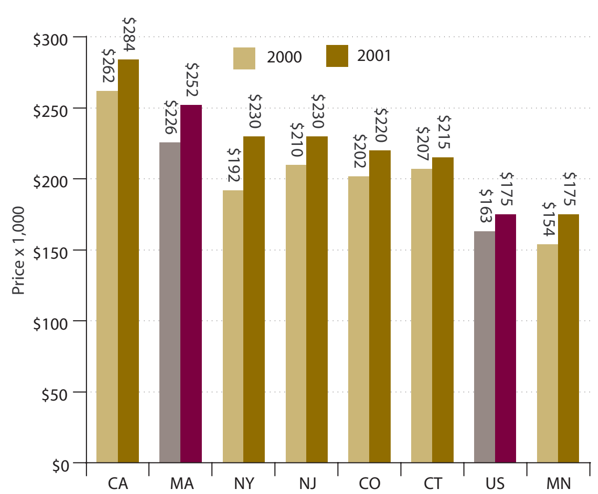
This year's *Index* demonstrates that the Massachusetts Innovation Economy is not immune from the inevitable slowdowns that occur in the U.S. and world economies. The Innovation Economy will go through cycles of strength, struggle, and recovery. *Index* indicators that are vulnerable to economic cycles, such as venture capital, consumer confidence, and the stock markets, will eventually rebound. For the immediate future, however, Massachusetts needs to address its long-term, structural issues, such as housing costs and domestic out-migration, in order to be well-positioned for the turn around in the U.S. and world economies.

International in-migration and domestic out-migration, Massachusetts, 1990-2001



Source: U.S. Census Bureau

Median price of single-family homes, Massachusetts, other LTS, and US, 2000 and 2001



Source: Federal Housing Finance Board

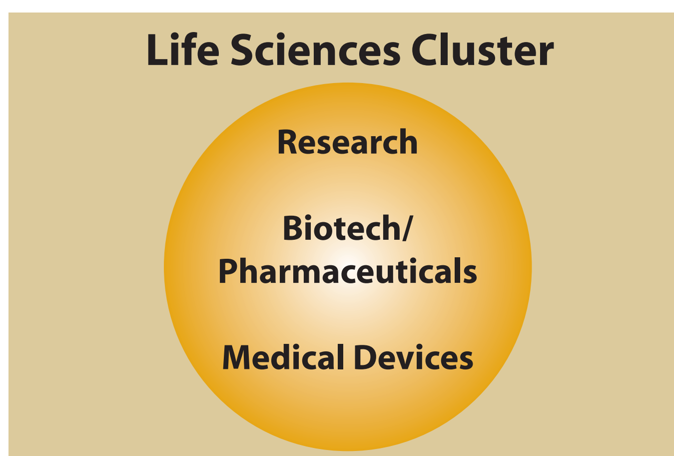
The Life Sciences Cluster in Greater Boston

Throughout its history, Greater Boston (which includes Worcester County and several counties in Eastern Massachusetts) has been recognized as a world center for developing innovative healthcare technology delivery and conducting breakthrough research. Greater Boston's doctors were the first to use ether as an anesthetic in the U.S. in 1846, and developed the world's first nutrition-filled baby formula in 1919. In the post-World War II era, Greater Boston's medical professionals performed the first successful kidney transplant in 1954, and spearheaded the international effort to map and sequence the human genome, known as the Human Genome Project, in the 1990s. This rich medical history has resulted in Greater Boston being a destination for both patients seeking the latest medical treatments and healthcare practitioners seeking to expand their knowledge of the latest innovations in healthcare delivery and research.

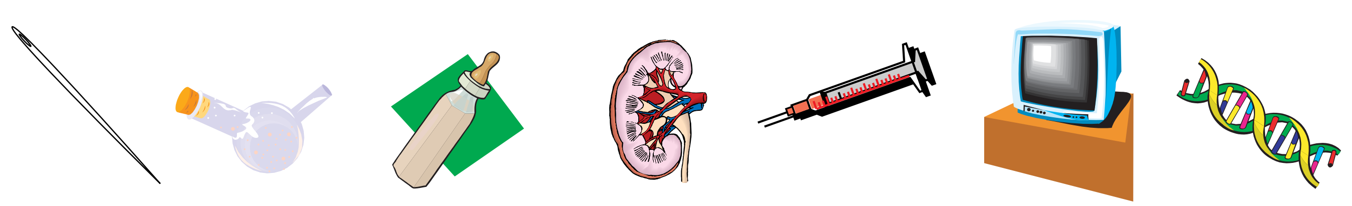
One of the positive impacts of this reputation as a world center for innovative healthcare delivery and breakthrough research has been the emergence of a concentration of companies that are focused on developing new products and processes in the biotechnology, pharmaceutical, medical device, and other health-related industries which are producing new products and generating thousands of jobs.

The growth of this cluster of firms in Greater Boston is fueled by their interaction with the region's hospitals and medical practitioners, and by the scientific research conducted by researchers working in teaching hospitals, research institutions, and universities. Revolutionary advances in medicine and science are taking place here that are transforming the healthcare industry, led by discoveries in genomics (the study of genes and their structure), proteomics (the study of the protein building-blocks of genetic material), nanotechnology (the mechanics of structures that operate at the molecular level) and bioinformatics (the application of Information Technology (IT) and computer science to decipher complex biological processes).

The growth of the Life Sciences cluster portends new opportunities for the region that Harvard University president Lawrence Summers has likened to a "biomedical Silicon Valley." The economic payoff of Greater Boston's Life Sciences cluster will depend upon how well it functions amidst growing competition from other regions, states, and countries. It is a prospect that is being aggressively pursued through major campaigns to attract research and development (R&D) dollars, talent, and new companies. Michigan and Pennsylvania have each pledged millions of dollars from tobacco industry settlements (in Michigan's case, $1 billion) to develop life sciences projects and attract companies and talent to their state. Outside the U.S., Singapore's government has pledged $2 billion for its life sciences ventures, and it has also signed a free trade agreement with Japan in which both governments have committed themselves to encouraging science and technology projects.



Massachusetts Life Sciences Breakthroughs



1721	1846	1919	1954	1957	1968	1990s
Inoculation of Smallpox	Use of Ether as an Anesthetic	Infant Formula	First Successful Human Kidney Transplant	Synthesis of Natural Penicillin	Closed-Circuit TV for Surgical Procedures	Sequencing the Human Genome

Special Analysis
The Life Sciences Cluster

For this Special Analysis, MTC examined how Greater Boston compared to five other leading life sciences regions in the U.S. The analysis explores how the Life Sciences cluster in Greater Boston fares in terms of employment and wages, innovative and entrepreneurial activities, and human and capital resources. It then addresses opportunities and challenges facing the Life Sciences cluster in Greater Boston.

The economic regions used, as defined by the U.S. Census Bureau, are:

Boston, MA-NH (NECMA)

New York - Northern New Jersey - Long Island, NY-NJ-CT-PA (CMSA)

Los Angeles - Riverside - Orange County, CA (CMSA)

Raleigh - Durham - Chapel Hill, NC (MSA)

San Diego, CA (MSA)

San Francisco - Oakland - San Jose, CA (CMSA)

For definitions of the regions, and all data sources for the Special Analysis, please see Appendix A.

Region	Total population, 2000 (000's) (Percent change in population, 1990-2000)	Total National NIH R&D funding in life sciences, 2001 (000's)	Total venture capital investments in life sciences, 2001 (000's)	Total number of life sciences related patents, 2000	Total number of life sciences related IPOs, 1997-2001	Total employment, life sciences cluster, 2001	Percent of total life sciences employment in biotechnology, 2001	Percent of total life sciences employment in research organizations (non-academic), 2001	Percent of total life sciences employment in medical devices, 2001
Boston MA NH (NECMA)	5,819 (6.7%)	$1,623,000	$835,402	848	11	47,370	24%	28%	48%
Los Angeles, Riverside Orange County, CA (CMSA)	16,374 (12.7%)	$709,000	$304,125	594	5	59,900	36%	16%	48%
New York, Northern New Jersey, Long Island, NY NJ-CT-PA (CMSA)	21,200 (8.3%)	$1,601,000	$567,880	311	6	175,510	67%	19%	14%
Raleigh-Durham Chapel Hill, NC (MSA)	1,188 (38.4%)	$484,000	$217,233	134	3	10,630	42%	54%	4%
San Diego CA (MSA)	2,814 (12.6%)	$724,000	$798,284	396	12	35,380	30%	49%	21%
San Francisco Oakland, San Jose CA (CMSA)	7,039 (12.1%)	$870,000	$1,355,768	1,284	31	71,210	17%	46%	37%

Life Sciences Results:

The Life Sciences cluster generates highly-skilled jobs and good wages for a region. For this analysis, the following industry sectors comprise the Life Sciences cluster:

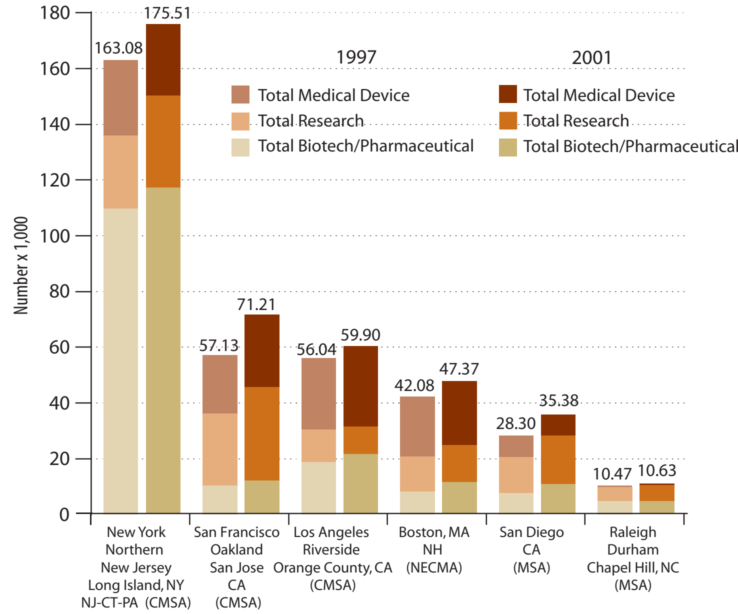
- biotechnology & pharmaceuticals
- medical devices
- research organizations (non-academic)

In 2001, Greater Boston had 47,370 people employed in the Life Sciences cluster, placing it fourth behind New York, San Francisco, and Los Angeles. In Greater Boston, 48% of Life Sciences cluster employment was in medical devices, 28% in research organizations (non-academic), and 24% in biotechnology & pharmaceuticals in 2001. The New York region employed the highest number of people in the Life Sciences cluster at 175,510, a reflection of its long-standing strength in the production of pharmaceuticals. Raleigh-Durham had the smallest Life Sciences cluster employment at 10,630.

From 1997 to 2001, Life Sciences cluster employment in Greater Boston has increased 12.6% (5,290 new jobs), which was the third largest percent increase in jobs among the regions. San Diego had the largest percent increase in Life Sciences cluster employment (7,080 new jobs, a 25.0% increase), followed closely by San Francisco at 24.6% (14,080 new jobs) for the same period.

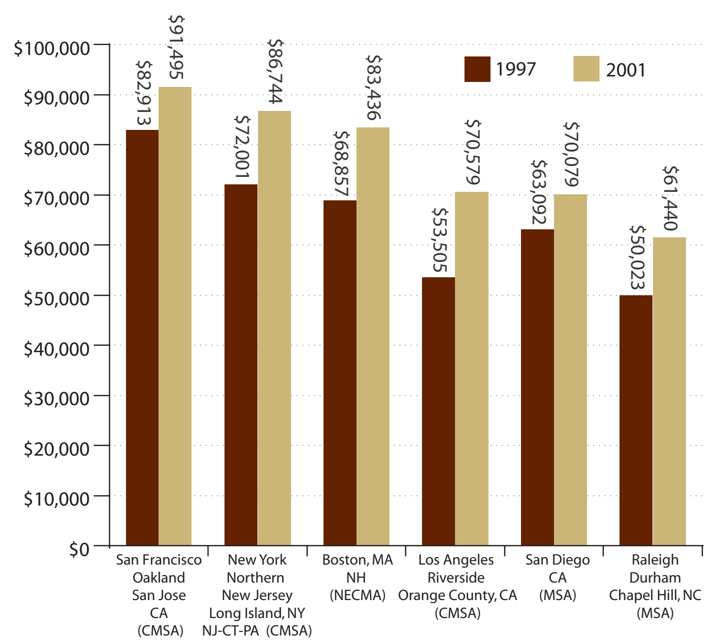
The technical sophistication and demand for the Life Sciences cluster's innovative products enables it to pay relatively high wages to its workers. In 2001, the average wage in the Life Sciences cluster in Greater Boston was $83,436, which was the third highest when compared to the other regions, and was 46% higher than that of the all-industry pay in Greater Boston ($45,191). San Francisco's Life Sciences cluster had the highest average wage at $91,495, followed by the New York region at $86,744. From 1997 to 2001, the average pay in Greater Boston's Life Sciences cluster increased at an average annual rate of 3.9%, which was the third highest rate when compared to the other regions. Los Angeles had the highest average annual percent increase in Life Sciences cluster wages at 5.7%, followed by Raleigh-Durham at 4.2% for the same period.

Total employment in selected life sciences related industries, Greater Boston and other regions, 1997 and 2001



Source: Economy.com

Average wage in the life sciences cluster, Greater Boston and other regions, 1997 and 2001 ($2001 inflation-adjusted)



Source: Economy.com

Life Sciences Innovation Processes:

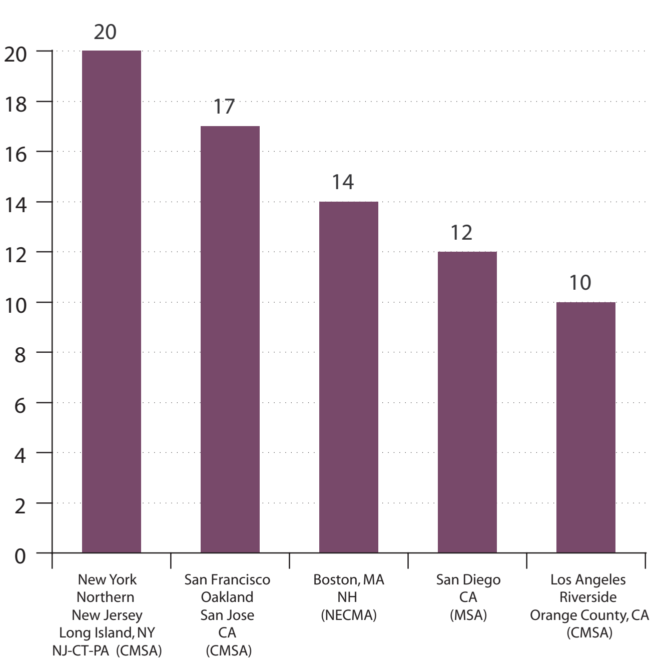
The dramatic increase of knowledge is driving innovation in the Life Sciences cluster. These indicators capture the process of turning that knowledge into commercial products and new enterprises that will drive future growth in the Life Sciences cluster.

Patents are particularly important to the Life Sciences cluster because of the high level of investment necessary to bring drugs and medical devices to market. In 2000, Greater Boston registered 848 life sciences related patents (which includes patents in biotechnology and medical devices), second only to San Francisco (1,284) among the other regions. From 1995 to 2000, Greater Boston's life sciences patent activity grew at an average annual rate of 18.7%, which was a slower growth rate than San Francisco (23.2%), Raleigh-Durham (19.1%), and San Diego (19.0%) for the same period. In 2000, 1 in 5 Life Sciences related patents in the U.S. were registered in Greater Boston and the five other regions.

Today's Life Sciences cluster has high levels of entrepreneurial activity. For start-up firms, early-stage research funding is critical for survival. In 2001, Greater Boston received approximately $66.4 million in National Institutes of Health (NIH) Small Business Innovation Research (SBIR) grants, the highest among the regions, and more than double that of its next closest competitor, San Francisco, which had approximately $31.4 million for the same year. From 1997 to 2001, Greater Boston's NIH-SBIR funding has increased at an average annual rate of 17.9%. Among the regions, San Diego (35.5%) and Los Angeles (19.4%) had the highest average annual percent increases in life sciences related NIH-SBIR funding for the same period. This growth in NIH-SBIR funding is indicative of strong levels of entrepreneurial activity in each region.

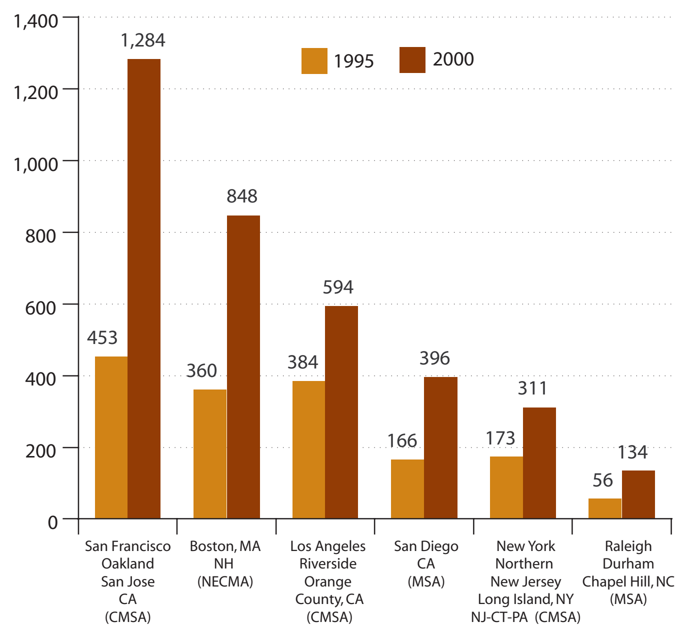
The U.S. Food and Drug Administration's (FDA) Center for Drug Evaluation and Research (CDER) approves all drugs to the U.S. market. Biotech drug approvals reflect innovation in health research and pharmaceutical manufacturing as well as strong connections to the biotechnology and healthcare technology industry sectors in the Life Sciences cluster. From 1997 to 2002, Greater Boston's firms had 14 biotech drugs approved by the FDA, which was the third highest compared to the other regions. The New York region was first with 20 biotech drug approvals, followed by the San Francisco region with 17 for the same period. The Los Angeles region had the smallest number of biotech drug approvals with 10. Raleigh-Durham had no biotech drug approvals for this period.

Total number of biotech drugs approved by the FDA, Greater Boston and other regions, 1997-2002



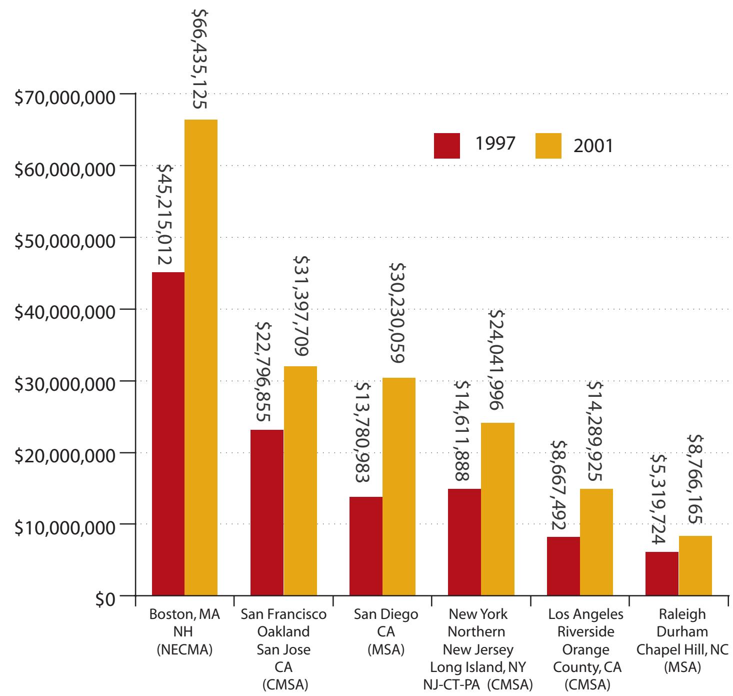
Source: U.S. Food and Drug Administration

Total number of life sciences related patents, Greater Boston and other regions, 1995 and 2000



Source: U.S. Patent and Trademark Office (USPTO)

Total value of National Institutes of Health (NIH) SBIR awards to Greater Boston and other regions' companies, 1997 and 2001



Source: National Institutes of Health, Office of Extramural Research

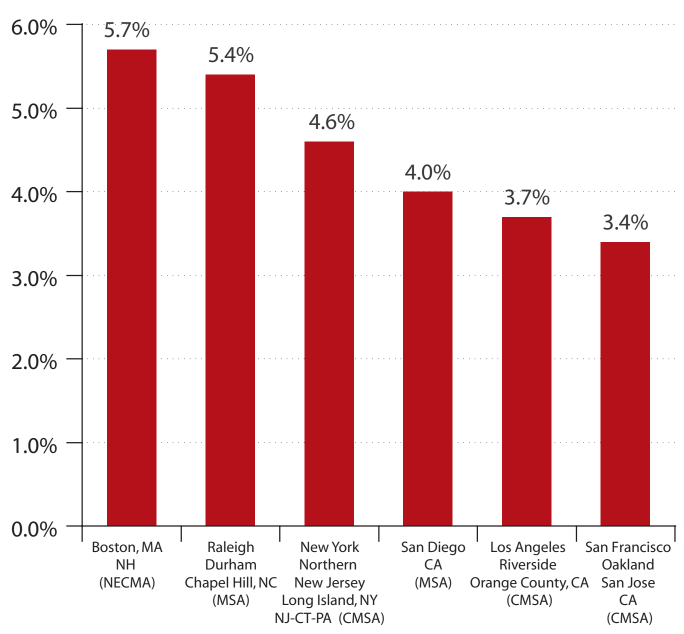
Life Sciences Resources:

Life Sciences cluster resources include academic and medical talent, and federal and private investments. These resources demonstrate a region's ability to create and foster an environment of collaboration and the exploration of new ideas and concepts, and these are important components in this dynamic cluster.

Regions that have a concentration of post-graduate degree programs have a competitive advantage both in research and in the creation of new medicines and technologies. The resulting pool of new life sciences and medical school graduates is an indicator of future workforce talent for the Life Sciences cluster. In 2000, Greater Boston's academic institutions granted 1,183 graduate degrees in life sciences, bioengineering & biomedical engineering, and medicine (MDs), which was the third highest absolute number when compared to the other regions. New York was first among the regions with 2,947 degrees granted in the selected advanced life sciences fields, followed by Los Angeles with 1,238. When looking at degrees in medicine (MD), Greater Boston granted a total of 566 medical degrees in 2000, which was second only to the New York region (1,593). On a per capita basis, Greater Boston's academic institutions granted 20 graduate life sciences, bioengineering & biomedical engineering, and medical (MD) degrees combined per 100,000 in the population, which was second only to Raleigh-Durham (52) when compared to the other regions.

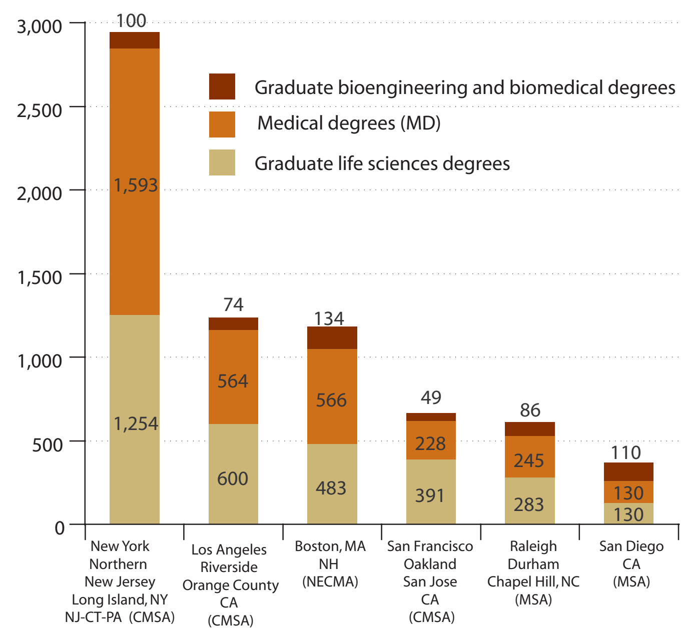
Academic and medical talent attracts capital and recognition to a region. Since 1901, the annual Nobel Prize in physiology and medicine has been awarded to those individuals that "have conferred the greatest benefit on mankind," and that "have made the most important discovery within the domain of physiology or medicine." (Source: The Nobel Foundation). From 1971 to 2002, Greater Boston had a total of 11 Nobel Prize winners in physiology and medicine

Healthcare practitioner and technical occupations as percentage of all occupations, Greater Boston and other regions, 2000



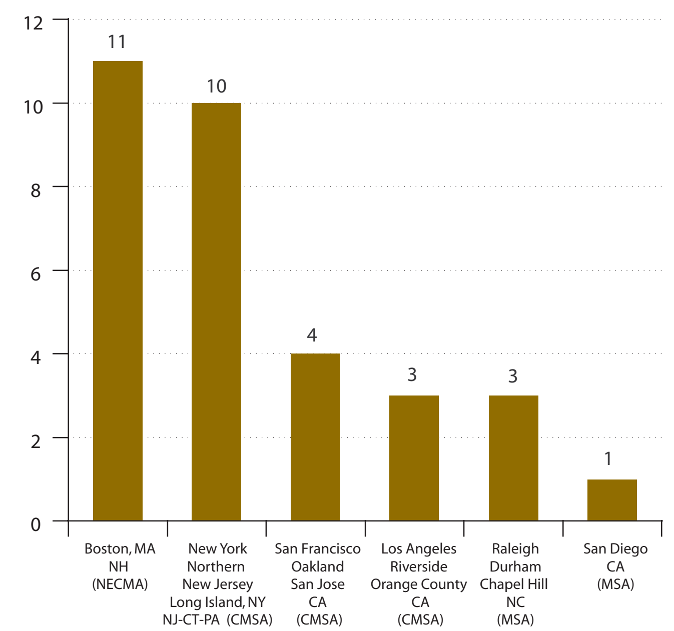
Source: Bureau of Labor Statistics

Total number of selected life sciences related degrees granted by Greater Boston institutions and other regions, 2000



Source: National Center for Education Statistics

Total number of Nobel Prize winners in Physiology and Medicine affiliated with institutions located in Greater Boston and other regions, 1971-2002



Source: Almaz

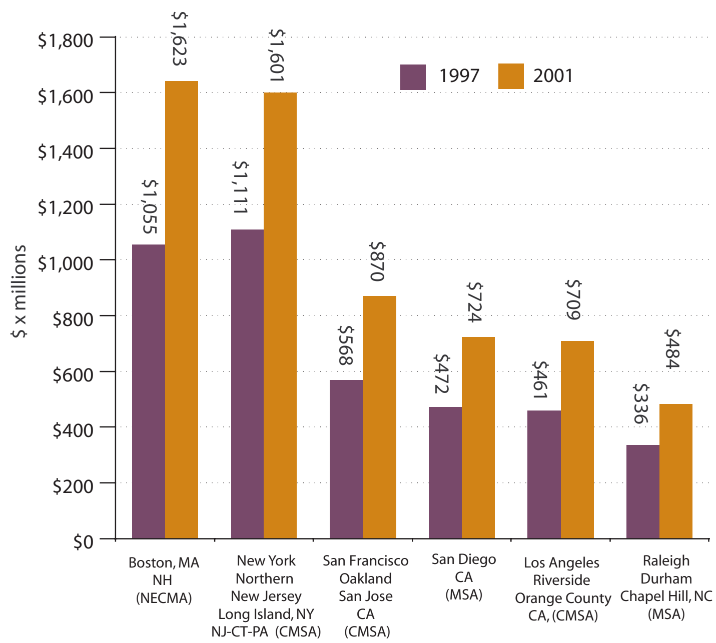
affiliated with their academic and research institutions, which was the highest number when compared to the other regions. The New York region was second, with 10 Nobel Prize winners affiliated with their academic and research institutions, followed by San Francisco with 4 Nobel Prize winners in physiology and medicine. In Greater Boston, Harvard Medical School and MIT comprised 63.6% of all Nobel Prize winner affiliations in physiology and medicine, while in the New York region, Rockefeller University comprised 57.1% of all Nobel Prize winner affiliations. Los Angeles and Raleigh-Durham each had 3 Nobel Prize winners affiliated with their academic and research institutions for the same time period.

Activities such as healthcare research, education, and treatment generate a wide range of healthcare and technical occupations for a region. Healthcare practitioner and healthcare occupations cover many categories, from physicians and nurses to laboratory technicians and occupational therapists. In 2000, healthcare practitioner and technical occupations comprised 5.7% of all occupations in Greater Boston, which was the highest percentage when compared to the other regions. Raleigh-Durham was second with 5.4% of its occupations in healthcare and technical work, followed by the New York region at 4.6%.

For life sciences research institutions and academic centers, federal spending is the primary source of funding. The National Institutes of Health (NIH) is the major funder of health-related research in the U.S. It is the largest source of federal funding for non-defense research, and it is an important driver of the biotechnology, medical device, and health services industries. In 2001, Greater Boston received $1.62 billion in NIH funding, which was the highest amount compared to the other regions, edging out New York at $1.60 billion. The San Francisco region was third at $870 million for the same year. From 1997 to 2001, NIH funding in Greater Boston had the highest total percent increase (54.3%) among the regions ($1.05 billion to $1.62 billion), closely followed by the Los Angeles region at 53.8% ($461 million to $709 million).

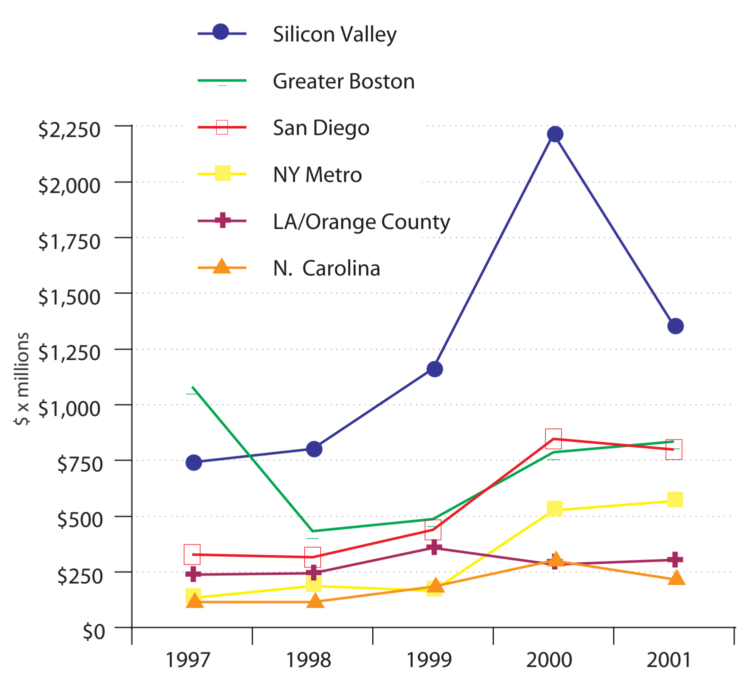
Venture capital is an important funding source for start-up firms in the Life Sciences cluster, since these firms need significant investments in order to conduct their research over the long term. The industry categories of life sciences-related venture capital investment categories include Biotechnology (which includes pharmaceuticals), Healthcare Services, and Medical Devices & Equipment. In 2001, Greater Boston attracted approximately $835 million in life sciences-related venture capital investments, which was the second highest total dollar amount when compared to the other regions. Silicon Valley was first in the U.S. in 2001, attracting over $1.3 billion in life sciences-related venture capital dollars. The drop experienced in Silicon Valley represents a decrease of 39% in life sciences-related venture capital financing from 2000 to 2001, which is due in large part to the overall drop in venture capital experienced in the U.S. for this period.

Total National Institutes of Health (NIH) research and development (R&D) funding in life sciences, Greater Boston, and other regions, 1997 and 2001



Source: National Institutes of Health, Office of Extramural Research

Total venture capital investments in life sciences-related industries, Greater Boston and other regions, 1997 and 2001



Source: PricewaterhouseCoopers LLP, Venture Economics, and National Venture Capital Association Money Tree Survey

"At IBM's headquarters, many believe their company will be a life-science company within three years . . . . Some of the world's largest companies . . . DuPont, Novartis, and Compaq . . . (have) declared that their future lies in life science, so many great minds are flocking to the centers leading the life sciences revolution . . . Boston/Cambridge, San Francisco/San Diego . . . ."

Source:
Juan Enriques, Director of the Life Sciences Project, Harvard Business School
As The Future Catches You, 2000

Challenges and Recommendations: The Life Sciences in Greater Boston — Not Just A Cluster, But A "Super Cluster"

As the data on the preceding pages demonstrates, Greater Boston is blessed with resources in life sciences research, development and commercialization that few other places in the U.S. or the world can match. This wealth of resources is bolstered by this region's outstanding biotech and medical device industries, large pool of life sciences-related venture capital funds, and sizable medical practitioner community. The chain of life sciences innovation in the region, measured from lab bench to bedside, can often be measured by a few steps—and when taken together, Greater Boston's life sciences firms, its researchers, and its financiers comprise a veritable Life Sciences "Super Cluster," a cluster of economic activity that positions Greater Boston and Massachusetts for growth in new markets in heretofore unrelated fields of science and technology.

As the Whitehead Institute in Cambridge helped lead the effort to decode the human genome, so now Greater Boston is serving as a center for the development of new tools that researchers are using to analyze genomic data for insights that will lead to the development of new and more effective drugs. Greater Boston, with its deep roots in computer science research and in the Information Technology (IT) industry, has rapidly become a center of this new industry. For example, the emerging field of bioinformatics applies advanced computational techniques and IT to data generated by genomic research to yield new targets for drug development. Nanotechnology promises to revolutionize medical treatment by creating drugs and devices that operate on a molecular scale. Greater Boston's historic strengths in materials research, computer science, and other fields have given the region an early lead in the race to claim leadership in emerging nanotechnology-related industries.

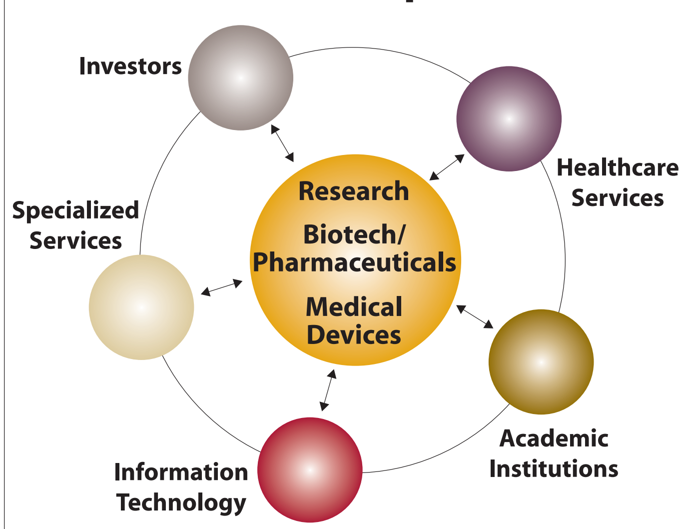
A number of researchers and firms within the Greater Boston Life Sciences "Super Cluster" are working to create new technologies for agriculture, industrial materials, and even bio-engineered computers and Information Technology. But most researchers and commercial firms within the Greater Boston Life Sciences "Super Cluster" are focused on healthcare, with the objective to create new treatments and therapies for U.S. and global healthcare markets. This represents an important economic opportunity for Massachusetts.

The long-term trends visible in the U.S. healthcare market could make the emerging life science industries major drivers of economic growth for Massachusetts in the years ahead.

Healthcare is a large and rapidly-expanding market in the United States. According to Piper Jaffray, healthcare spending in the U.S. exceeded 14 percent of GDP ($1.3 trillion) in 2000, and is expected to increase to 16 percent of GDP in five years. Expanding demand will be led by demography (e.g., growth in older population), rising incomes, advances in medical research, and increased utilization of new treatments and therapies; all indicate that the Life Sciences cluster will continue to provide economic growth for Greater Boston.

Current trends within the older and well-established healthcare industries will also help promote life sciences growth. For example, while Greater Boston is not a center of the traditional pharmaceutical industry, established pharmaceutical firms have shown increasing interest in establishing research operations in the region and the Commonwealth. Among the large pharmaceutical firms now operating research or manufacturing operations in Greater Boston are: Merck, Pfizer, Novartis (which will soon have its U.S. headquarters in Cambridge), Abbott Laboratories, Wyeth-Ayerst, and Serono Laboratories. Examples of established firms headquartered in the region include both biotechnology and medical device companies—Biogen, Boston Scientific, and Genzyme.

Life Sciences "Super Cluster"



The Life Sciences "Super Cluster" in Massachusetts and New Economic Growth—A Sure Bet?

Given the rich assets available within the Greater Boston Life Sciences "Super Cluster" and the enormous market potential for new healthcare technologies, is new economic growth for the region and Massachusetts a sure bet? Will the life sciences do for Massachusetts what defense did in the 1960s and 1970s, what minicomputers did in the 1980s, and what networking technologies and software did in the 1990s?

While the potential is vast, nothing is guaranteed in life—or the life sciences. The Life Sciences "Super Cluster" faces real challenges that must be surmounted if the promise of new growth is to become reality.

The challenges include the following:

The Uncertain Future of Healthcare Financing:

After a decade of relative stability, healthcare costs in the U.S. are once again increasing at double-digit rates. The return of healthcare cost inflation is also driving up the number of Americans without health insurance. According to the U.S. Census, over 41 million Americans are uninsured; an estimated 1.5 million lost insurance in 2001 alone. All this triggers intense pressure to contain healthcare costs. Over two-thirds of healthcare expenses in the U.S. are paid for by third-party insurers, including the federal government (Medicare and Medicaid) and private insurers. Insurers have long blamed the introduction of new technology for disproportionately inflating healthcare costs.

Most new drugs and medical devices require years to develop, to test and to secure approvals from the U.S. Food and Drug Administration (FDA). Investors in healthcare technology are extremely sensitive to forces that prolong the approval process, slow down the rate at which new products are accepted by users, or that reduce the reimbursements for new products paid by healthcare insurers and other payers. In the months ahead, life science industries may face higher hurdles to acceptance of new products, as healthcare payers increase their scrutiny of new products and procedures.

A U.S. healthcare provider's study attributes 50% of the rise in healthcare costs over the last 30 years to technology.

Source:
Blue Cross Blue Shield
Association of the U.S.

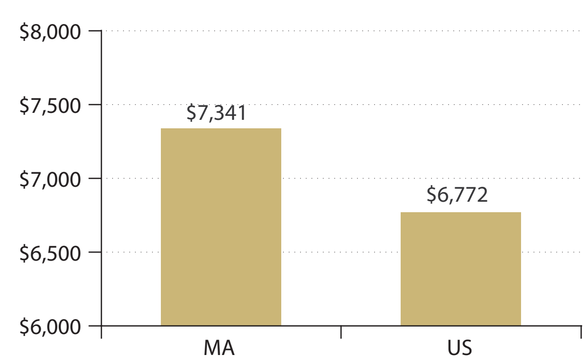
RECOMMENDATION:

GREATER BOSTON AND MASSACHUSETTS BIOTECH, MEDICAL AND TECHNOLOGY LEADERS SHOULD WORK WITH STATE AND FEDERAL GOVERNMENT OFFICIALS TO DEVELOP POLICIES THAT WILL ESTABLISH THE COMMONWEALTH AS A NATIONAL MODEL FOR THE ADOPTION OF COST-EFFECTIVE TECHNOLOGY IN THE HEALTHCARE SYSTEM.

Life Sciences Innovation vs. Healthcare Costs

While Massachusetts is a world-class center of medical and healthcare technology innovation, it is also one of the most expensive healthcare markets in the U.S.

Average total family premium per enrolled employee at private sector firms that offer health insurance, 2000



Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey

Special Analysis
The Life Sciences Cluster

Volatile Investment Climate:

Resistance from healthcare payers may slow down growth in the Life Sciences "Super Cluster" in the future, but the bear market from the end of 2000 through 2002 is taking a toll on growth in the cluster now.

Life sciences industries are particularly vulnerable in a poor investment climate, especially biotechnology firms, which must carry out research over several years, 'burning' cash on the way to formulation of new products that can be tested, licensed and sold for profit. Firms in the Life Sciences "Super Cluster" are heavily dependent upon venture capital finance, and venture capitalists are heavily motivated to invest because of the prospect of making profit through Initial Public Offerings (IPOs). At the time of publication, the U.S. IPO market is virtually closed (see Indicator #15 on page 37). As a result, life sciences firms face heavy pressure to conserve cash and stretch their resources as much as possible. Even in good, bull market periods, young life sciences firms frequently merge, are acquired, or establish strategic alliances with one another. As the Massachusetts Life Sciences "Super Cluster" grows, there will continue to be constant change and volatility among firms within it.

Recommendation:

The Commonwealth should carefully consider new or expanded strategies to help life sciences firms overcome the 'capital crunch' that constrains them. Such strategies could include: creation of incubator and other support facilities, encourage joint purchasing (such as space, equipment) or other cost-reduction programs, and careful adoption of tax incentive programs tailored to the needs of life sciences firms.

The process of developing new medicines takes an average of 12 years and $800 million dollars.

Source:
Tufts Center for the
Study of Drug Development, 2001

Competition:

While Massachusetts has a rich mix of assets in its Life Sciences "Super Cluster", other states are not standing still. Michigan and Ohio are among several states that have diverted substantial sums from their share of the national tobacco litigation settlement to new programs and new funds for the development of their own Life Sciences cluster.

Historically, Massachusetts state government has invested modestly in academic research or technology-related economic development. (A 1998 study by the Battelle Institute found that Massachusetts ranked 26th per capita in own-source revenue investment in science and technology-related economic development.) However, targeted investments in the life sciences have succeeded in the past. Examples include the Worcester Biotechnology Park and Massachusetts Biomedical Initiatives projects, organized by Worcester and its business community with state support.

Recommendation:

Massachusetts needs a credible strategy for 'technology-based economic development.' This strategy should include resumption of steady support for expansion of research programs within the University of Massachusetts (UMASS) system, and seek to leverage the rich resources available in the state's private universities and teaching hospitals to encourage accelerated development of new technologies and the creation of new firms.

41 states have started a Life Sciences initiative over the past several years. Thirty four (34) states have a statewide or regional group or organization focused on biosciences.

Source: Batelle and the Biotechnology Industry
Organization (BIO) Survey, 2002

Special Analysis
The Life Sciences Cluster

New Life Sciences Facilities Development:

The expansion of biomedical research facilities in Boston and Cambridge has long been a concern for both the institutions and their host communities. The region's university labs and teaching hospitals are usually situated in some of the most densely built-up neighborhoods in the state. By way of contrast, many competing regions throughout the U.S. are pursuing life sciences firms by offering viable land in university-related research parks or other green field development sites.

Seen in its entirety, the Greater Boston Life Sciences "Super Cluster" is not quite as Boston and Cambridge centric as some might think. The medical device industry has been dispersed beyond these two cities for decades. While biotechnology firms continue to cluster around Cambridge's Kendall Square, an increasing number of firms are finding their way both to Boston and to the suburbs. Early in 2002, the City of Fitchburg and MassDevelopment successfully brought a young biotechnology start-up to Fitchburg, kindling hopes that the biotechnology industry can be successfully transplanted to the state's older urban communities in the years to come.

Academic research and development in the life sciences must be centered at area universities and teaching hospitals, as a matter of course. The continuing ramp-up in life sciences research, fueled by both the National Institutes of Health (NIH) and industry sponsorship, will guarantee a need for some institutional expansion. To some extent, the cities view this expansion as directly competitive with the urgent need to preserve affordable housing. Successful management of these conflicts will be essential in the years ahead if the region is to nurture the Life Sciences "Super Cluster."

Recommendation:

Local government bears the primary responsibility for zoning and land use regulation in Massachusetts. Yet in light of the large economic stakes that the state has in the future development of the Life Sciences "Super Cluster", state government should adopt a pro-active strategy to assist in resolving issues relative to institutional expansion. State government agencies should also continue aggressive efforts to locate life sciences firms in historically under-served urban neighborhoods, and in older urban communities, so as to spread the wealth generated by the Greater Boston's Life Sciences "Super Cluster".

"With all the new large-scale build-to-suit lab buildings constructed over the past several years in East Cambridge, the biggest potential real estate challenge standing in the way of new (life sciences) expansion may be the lack of land to develop in the heavily demanded locations. East Cambridge and Boston's Longwood Medical Area are simply running out of room."

Source: Spaulding & Slye Colliers

Special Analysis
The Life Sciences Cluster

Workforce:

The most critical workforce issues facing Greater Boston and the Commonwealth are long-term and stem from the fact that low population growth yields a slowly growing workforce. Based on several population and workforce studies, older workers constitute the most rapidly-growing cohort of workers available to firms. Skill shortages—real and perceived—are magnified by this slow rate of growth.

Nevertheless, Greater Boston and Massachusetts sorely need to manage its education and workforce development programs so as to achieve two ends. First, it must take action to assure the life science industries that an adequate supply of workers are available in the future, lest the state lose opportunities to other regions that have more rapidly-growing populations (e.g., Raleigh-Durham and the California regions). Second, it must take action to capture the spectrum of job opportunities that will be created by growth in all the life science industries in the U.S., lest residents lose out on these new opportunities.

Recommendation:

Greater Boston and the Commonwealth need to continue to support and promote student interest in science, technology and mathematics. These fields are fundamental to the growth of a workforce in the state that can support the entire Innovation Economy, including the life science industries. The state also needs to create and support innovative approaches to filling the emerging need for skilled, technical workers in the Life Sciences "Super Cluster." The recently announced University of Massachusetts Life Sciences Initiative, which will expand life sciences graduate programs available at all five UMASS campuses, is a promising example.

As of September 2002, 18.4% of all Monster.com job postings in Greater Boston were in biotechnology, pharmaceuticals, healthcare practitioners and technicians, and science occupations.

Source: Monster.com

Going Forward:

Greater Boston and Massachusetts are well-positioned to enjoy new economic growth created by life sciences industries. Massachusetts researchers and firms are at the forefront of the cutting-edge innovation that will meet the growing demand for that most basic of human needs—health and well-being.

But it would be a mistake to assume that the Greater Boston Life Sciences "Super Cluster" will pull the region out of its current difficulties all by itself. New and emerging life sciences industries worldwide face a number of difficult hurdles to growth and profitability. The timetable for new growth in the Greater Boston "Super Cluster" will be dictated by several factors beyond the Commonwealth's control, such as the return of investor confidence in the stock market, and the resolution of basic health policy issues at the national level.

For all that, Massachusetts needs to seize this historic opportunity and ensure that it maintains the most hospitable atmosphere it can for life sciences industry growth within the state. Persistent effort to improve and expand the state's workforce, intelligent use of incentives for facility construction and the growth of firms, and a supportive atmosphere for research and development should all be part of a smart strategy to maintain the Commonwealth's competitiveness in the life sciences, and sustain the state's leadership in an increasingly intense, global competition for life sciences industries.

Results Indicators

Results Indicators

The important outcome of the Massachusetts Innovation Economy is its impact on the residents of Massachusetts by creating good jobs, rising wages, and a high standard of living. In this section we look at how jobs and wages changed in the Innovation Economy and nine key clusters in 2001. We also look at several measures of the Innovation Economy's resilience, to look for weaknesses or signs of trouble that may test the state's competitiveness in the months and years ahead.

Indicator 1

Industry Clusters Near zero job growth in key industry clusters and all industries combined from 2000 to 2001; more than half of Massachusetts key industry clusters experience decrease in total employment during the same time period

Why Is It Significant?

The nine key industry clusters constitute 25 percent of all non-government jobs in Massachusetts. Each cluster has a higher concentration within the Massachusetts economy than similar clusters on average elsewhere in the U.S. Such high concentration is a reflection of current or past competitive advantage that helped the cluster grow in Massachusetts.

How Does Massachusetts Perform?

Total employment in the nine key industry clusters grew less than one percent—0.8%—from 2000 to 2001, to approximately 733,000 people. The increase in total jobs statewide was 0.3%, compared to a 2.8% increase in total jobs in the state from the previous year (1999 to 2000). The Financial Services cluster remained the largest employer among the nine key industry clusters in 2001 with 145,889 people, and Defense remained the smallest at 26,446.

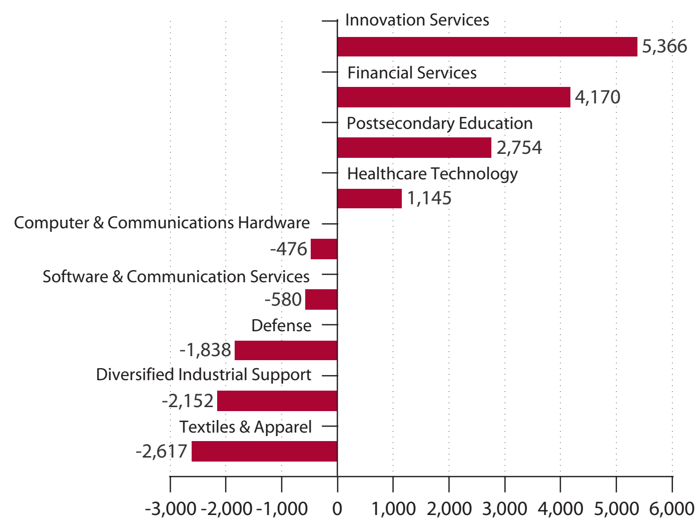
The state's clusters that are closely linked to the Telecommunications and Information Technology (IT) industries experienced significant changes in total employment from 2000 to 2001. The Massachusetts Software & Communications Services cluster shed 580 jobs from 2000 to 2001 (a decrease of 0.5%), compared to adding over 10,000 new jobs from 1999 to 2000. Among the Leading Technology States (LTS), all but Minnesota and Massachusetts experienced an increase in Software & Communications Services cluster employment. The Massachusetts Computer and Communications Hardware cluster lost 476 jobs from 2000 to 2001 (a decrease of 0.6%); the LTS average (1.7%) and U.S. (3.5%) also experienced decreases during the same time period. The Defense and Textiles and Apparel clusters in Massachusetts continued to contract, shedding 1,838 and 2,617 jobs, respectively, from 2000 to 2001.

The state's Innovation Services cluster registered the largest increase in jobs (5,366 new jobs, a 5.3% increase) from 2000 to 2001, outpacing the LTS average (4.9%) in this cluster. The Massachusetts Financial Services cluster added 4,170 new jobs (a 2.9% increase), followed by Postsecondary Education (2,754 new jobs, a 2.4% increase), and Healthcare Technology (1,145 jobs, a 3.3% increase). For the first time in several years, the percent change in LTS average Postsecondary Education employment (4.5%) outpaced Massachusetts growth (2.4%) in the same cluster.

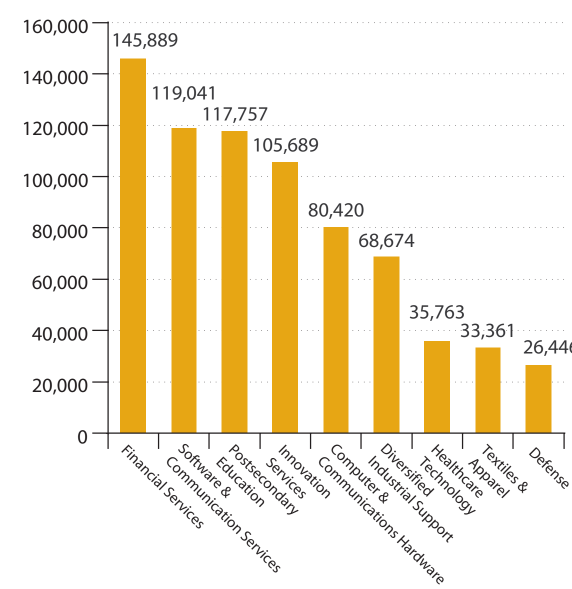
What Does this Trend Mean for Massachusetts?

Although the current economic downturn has been at various times characterized as a "tech wreck," of the 7,400 new jobs created between 2000 and 2001, more than three-quarters of these came from the nine key industry clusters in the state's Innovation Economy. The Diversified Industrial Support, Financial Services, and Healthcare Technology clusters each had the highest annual growth rates (or lowest job loss rate) among the LTS and significantly outperformed the U.S. as a whole. The Defense cluster continues to show evidence of significant restructuring as jobs continue to be shed from the LTS. The Textiles and Apparel cluster continues to contract both nationally and locally, as it has since the publication of the first *Index*. Perhaps most problematic is the performance of the Software and Communications Services cluster, historically the highest growth sector of the Innovation Economy. Massachusetts was one of two states among the LTS that actually lost jobs during the 2000-2001 period. Even more significant, employment in this cluster grew by over 5% for the U.S. as a whole during this period, almost twice the rate of that of the LTS average. It is important that the state be aware of the needs of all of its key industries, and that Massachusetts does not lose any competitive edge in the Innovation Economy.

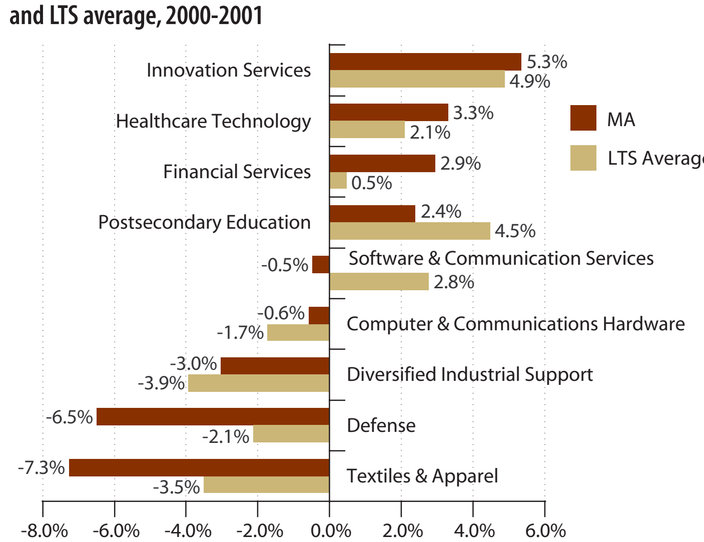
Net employment change, nine key industry clusters, Massachusetts, 2000-2001



Total employment, nine key industry clusters, Massachusetts, 2001



Percent change in cluster employment for Massachusetts and LTS average, 2000-2001



Source of all data for this indicator: Economy.com

Indicator 2

Employment Diversification

Although Massachusetts continues to have a diverse cluster portfolio, several key industry clusters' growth rates fell below the state growth rate

Why Is It Significant?

Specialized industry clusters create a competitive advantage for Massachusetts by bringing together the accumulated expertise of companies, research institutions, investors and other supporting organizations in a constant process of innovation. The Innovation Economy is sustained by a diverse base of clusters, making the state economy less vulnerable to failure in any one cluster.

How Does Massachusetts Perform?

The industry clusters that are most concentrated in Massachusetts relative to the nation are Postsecondary Education (2.9 times as concentrated), Textiles & Apparel (2.5 times), and Computers & Communications Hardware and Defense (each at 2.4 times).

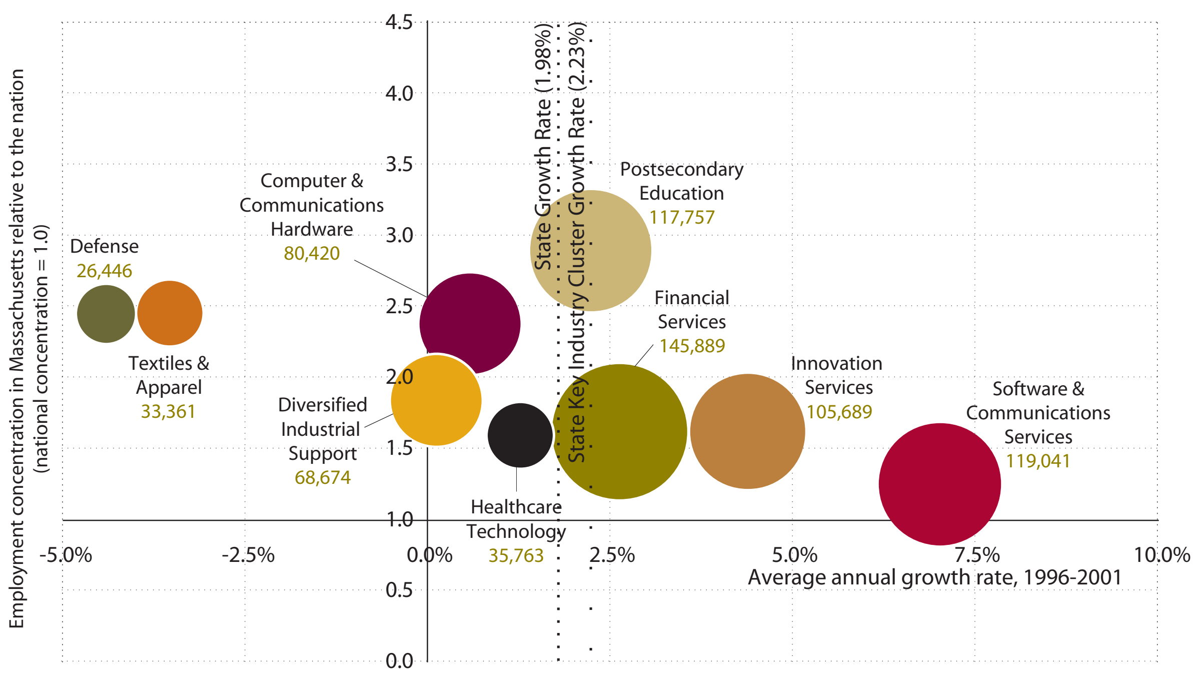
Of the nine key clusters, Financial Services is the largest employer, with 19.9% of total cluster employment. The Software & Communications Services, Postsecondary Education, and Innovation Services clusters have 16.2%, 16.1%, and 14.4% of total cluster employment, respectively. The Defense cluster has the smallest at 3.6%. (The size of each circle on the chart reflects the relative size of employment in Massachusetts in 2001.) Between 1996 and 2001, the average annual growth rate for Software and Communications Services (7.0%) was more than three times the state's overall growth rate (1.9%). The following key industry clusters had a smaller average annual growth rate from 1996 to 2001 than the overall Massachusetts growth rate: Defense, Textiles & Apparel, Diversified Industrial Support, Computers & Communications Hardware, and Healthcare Technology.

What Does this Trend Mean for Massachusetts?

From 2000 to 2001, several of the nine key industry clusters in Massachusetts either experienced a decrease in total employment growth, or a slowdown in its average annual growth over the long term. The two clusters with the highest employment growth in the past year—Innovation Services and Financial Services—are unlikely to be able to sustain that growth if the general economy does not rebound. The Defense cluster has been contracting for several years in the state; however, prospects for this cluster could change with government funding for homeland security. The Financial Services and Software & Communications Services clusters are the two largest employers of the nine key industry clusters; these two sectors are also currently vulnerable due to stock market volatility and decreases in Information Technology (IT) spending. Overcapacity in the telecommunications market has depressed demand in major segments of the Computer and Communications Hardware cluster.

Although today's Innovation Economy is much more diversified than it was a decade ago, strong linkages exist between several of the key industry clusters, such that weakness in one sector can lead to declining performance in others. Furthermore, despite the continued shift from a manufacturing to a service-based economy, the performance of the Massachusetts Innovation Economy remains heavily grounded in capital investment cycles. The current recession shows that even the presence of diverse clusters cannot fully cushion Massachusetts from the impact of cut-backs and slowdowns that have hit several clusters simultaneously, but as in past economic cycles, it is the excitement created by new products that create new value propositions and business opportunities in the marketplace that are likely to lead the economy out of recession.

Portfolio of nine key industry clusters by employment concentration and growth, Massachusetts, 1996-2001



Note: Numeral below name of industry cluster is 2001 total employment
Source: Economy.com

Indicator 3

Average Pay in Key Industry Clusters

Average annual wages in many of Massachusetts key industry clusters decline from 2000 to 2001

Why Is It Significant?

Growth in average pay per worker, adjusted for inflation, is a measure of job quality and a key element of standard of living. It can reflect rising levels of education and productivity. It can also result from employers increasing wages to attract and retain workers in short supply. Key industry clusters generate wealth through national, and international sales of their innovative products, processes and services. The strong demand for their innovative offerings enables these cluster firms to pay higher wages to their workers.

How Does Massachusetts Perform?

Workers in the knowledge-intensive service clusters continue to earn the top wages. The Financial Services cluster had the highest average pay, at $90,059 per year in 2001, a 1.2% increase from 2000. Software & Communications Services ranked second in 2001 (it was first in 2000) at $89,082 per year, closely followed by Innovation Services at $88,624. For the first time in over ten years, the percent change in annual wages (inflation-adjusted) for the nine key clusters as a whole experienced a decrease of 2.1% between 2000 and 2001; average wages for all industries in Massachusetts had a decrease of 1.2% during the same period.

Compared to the other LTS, Massachusetts has higher average wages in all but three industry clusters: Financial Services, Computers & Communications Hardware, and Defense. In 2001, the salary gap between Massachusetts and its competitors narrowed in Software & Communications Services. It widened, however, in Financial Services, where average pay per worker in Massachusetts was 20.9% lower than the average for the LTS. The LTS average pay in Financial Services increased 3.7% from 2000 to 2001, which was the highest percent increase among the six LTS average growth rate in all key industry clusters.

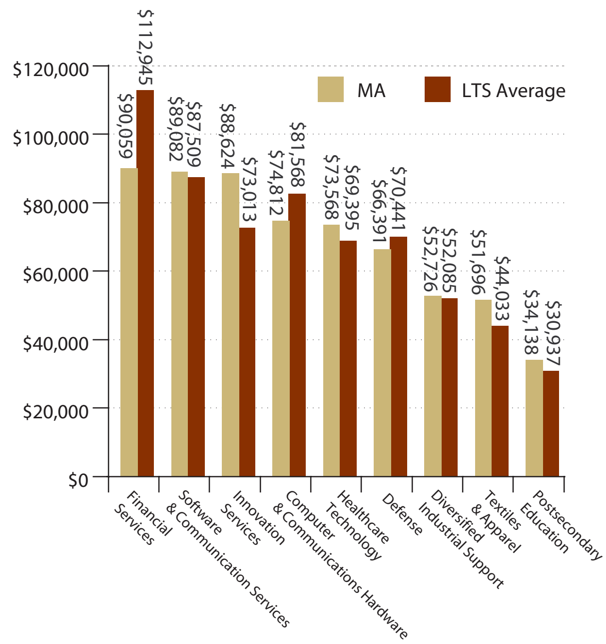
The average pay in eight of the state's nine key clusters (all but Postsecondary Education) is higher than the average annual pay per worker of $47,191 in all industries in the state and the LTS average of $44,929.

What Does this Trend Mean for Massachusetts?

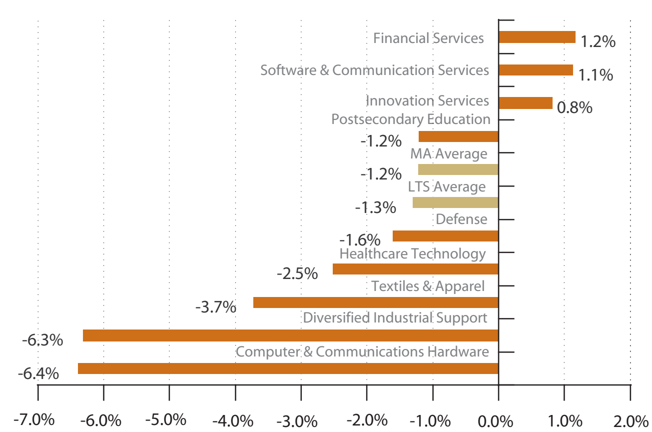
Average pay in the key clusters as a whole remains high relative to the all industries wage in Massachusetts; this points to good jobs in the key industry clusters that drive wealth creation in the state. Over time, most of the key clusters have consistently produced higher wages than the state average. And the average pay in all industries in Massachusetts is in line with average pay in the LTS, which is good news for the state.

From 2000 to 2001, several Massachusetts key industry clusters experienced a decline in percent growth in wages, as did the LTS and Massachusetts all industries average. These declines in pay may be in reaction to the national recession. It is too early to believe that the average wage growth rate in the key clusters will continue to lag the state's average wage growth rate. In the months ahead, it will be important to look for signs of growth—in both jobs and in wages—in the key clusters, since the nine key clusters have comprised one-fourth of all employment in the state over the past decade, and have paid higher than average wages when compared to all industries in the Massachusetts economy.

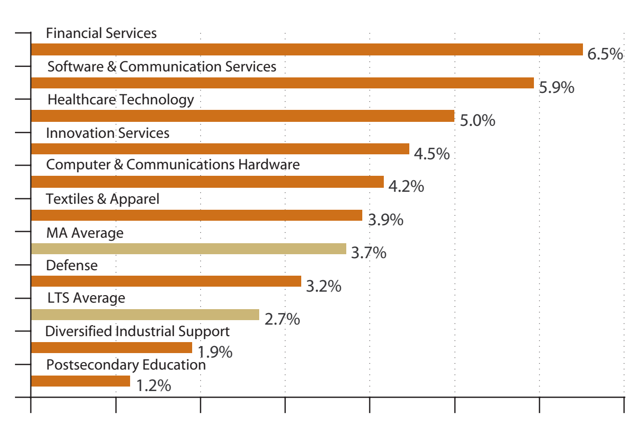
Average pay per worker, nine key industry clusters, Massachusetts and LTS average, 2001



Cluster industry wage growth rate, Massachusetts and LTS average, 2000-2001 (inflation-adjusted)



Cluster industry average annual wage growth rate, Massachusetts and LTS average,1996-2001 (inflation-adjusted)



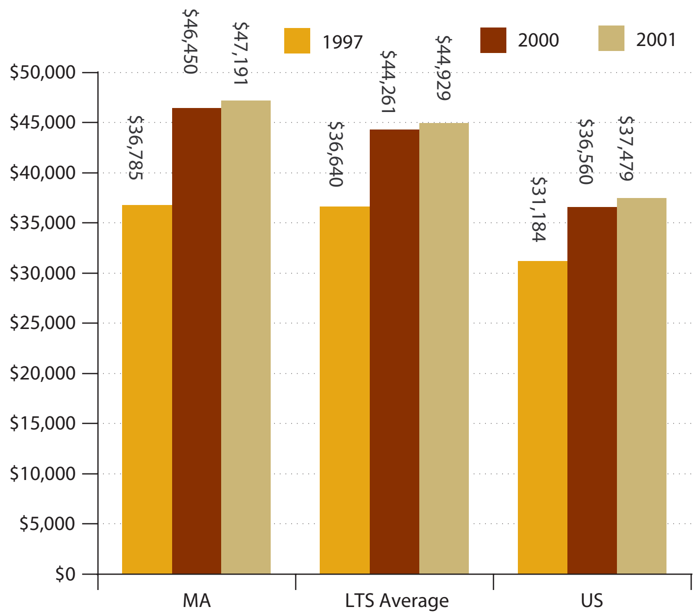
Source of all data for this indicator: Economy.com

Indicator 4

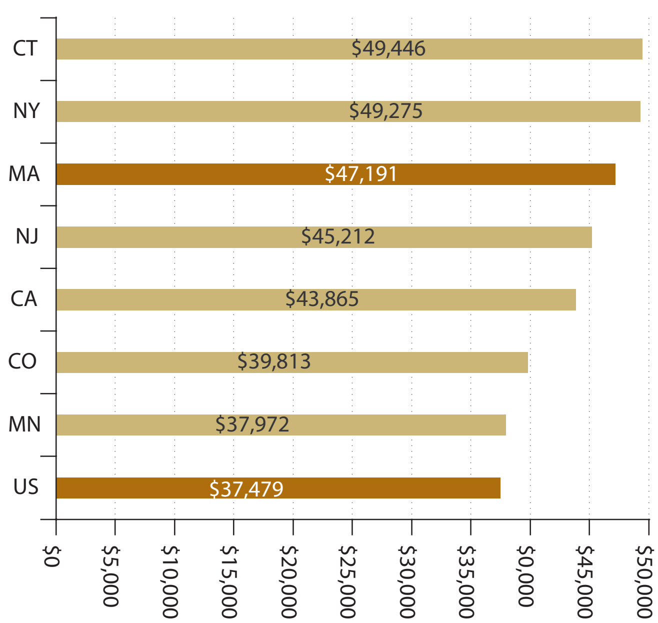
Pay per Worker in All Industries

Average pay in Massachusetts remains higher than the LTS and national average

Average annual pay per worker, Massachusetts, LTS average, and US, 1997, 2000, and 2001 (inflation-adjusted)



Average annual pay per worker, Massachusetts, other LTS, and US, 2001 (inflation-adjusted)



Source of all data for this indicator: Economy.com

Why Is It Significant?

Growth in pay per worker, adjusted for inflation, is a measure of job quality and a key determinant of standard of living. It can also result from employers increasing wages to attract and retain workers in short supply.

How Does Massachusetts Perform?

In 2001, the average annual pay in Massachusetts was $47,191, which was higher than the LTS average pay per worker of $44,929, and the U.S. average of $37,479. From 1997 to 2001, average annual pay per worker has increased 5.1% in inflation-adjusted terms in Massachusetts, which was higher than the LTS (4.2%) and U.S. (3.7%) averages. From 2000 to 2001, average pay per worker in Massachusetts increased 1.6%, which was slightly higher than the LTS average of 1.5%, and lower than the U.S. average of 2.5%.

Of the six other LTS, Massachusetts average pay per worker in 2001 was third to Connecticut ($49,446) and New York ($49,275).

What Does this Trend Mean for Massachusetts?

Massachusetts average pay per worker in all industries was higher than the six LTS and U.S. averages in 2001. The comparatively high level of average pay is consistent with the state's high level of workforce educational attainment, which affords Massachusetts firms access to a highly skilled pool of employees. While Massachusetts companies can attract top talent, they must pay for it. The state should continue to train all levels of the workforce to ensure demand alone does not push up the costs of doing business in the Commonwealth.

Indicator 5

Median Household Income

Massachusetts median household income increases, while LTS and US experience a decrease in median household income

Why Is It Significant?

Successful economies create opportunities for households to increase incomes. The U.S. Census Bureau tracks money income data for all people 15 years and older on an annual basis. It includes income before deductions for taxes and other expenses; it does not include lump-sum payments or capital gains. This indicator compares change in median household income in Massachusetts, in the LTS as a whole, and in the U.S.

How Does Massachusetts Perform?

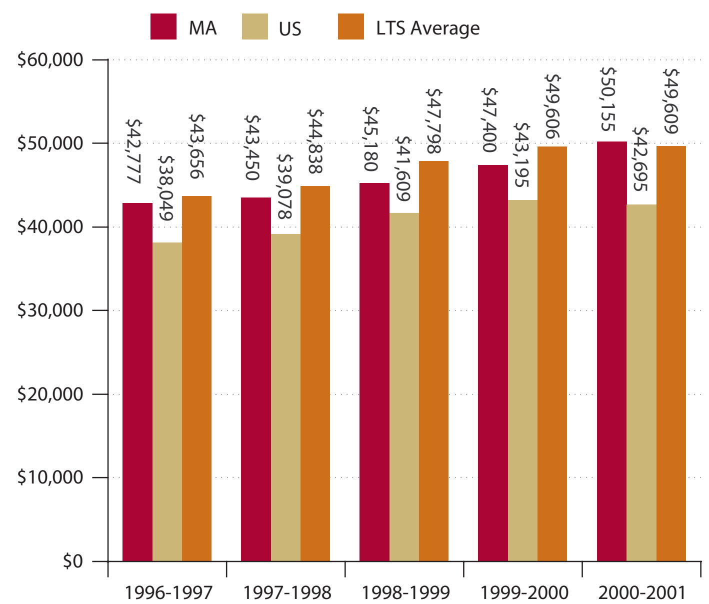
From 2000 to 2001, Massachusetts median household income was $50,155, which was higher than the LTS average ($49,609) and the U.S. average ($42,695). Based on comparisons of two-year average medians (1999-2000 and 2000-2001), Massachusetts median household income increased 5.8%, which was the highest compared to the LTS average (0.01%), and outpaced the U.S., which experienced a decrease of 1.2% for the same period. Massachusetts was one of only three states (Arizona and Pennsylvania, neither are LTS) to experience an increase in median household income for this period.

What Does this Trend Mean for Massachusetts?

Massachusetts experienced a significant increase in median household income from 1999-2000 to 2000-2001, which shows that incomes are rising to keep pace with rising costs of living. Slow population growth, relatively low unemployment rates, and fewer graduates from local colleges and universities may also be contributing to rising incomes, as employers must pay higher than average wages in order to attract and retain the skilled workforce they need to grow.

Economists have carefully watched for signs that a persistent, slow rate of growth in the state's labor force is acting to drive pay and household incomes up over time. Offsetting this, however, is evidence that the distribution of income in Massachusetts has widened over time. A study by Northeastern University found that only the lowest and highest income residents of Massachusetts saw an increase in real income between 1989 and 1999. Given that the highest incomes often flow to those with the highest skills and educational attainment, the prescription for Massachusetts and its Innovation Economy is the same whatever the diagnosis: the state has a long-term interest in improving educational levels in the labor force and enabling more workers to enter the ranks of the Innovation Economy.

Median household income, Massachusetts, LTS average, and US, 1996-2001 (2-year moving average)



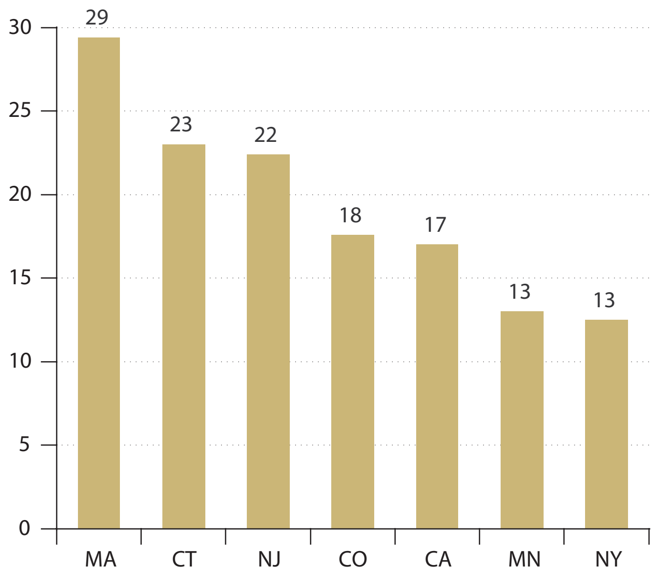
Source: U.S. Census Bureau

Indicator 6

Internet Job Postings

Labor force per capita job postings in Massachusetts highest among the LTS

Total number of Internet job postings per 10,000 in the labor force, Massachusetts and other LTS, September 2002



Source: Monster.com and Bureau of Labor Statistics

Why Is It Significant?

Monster.com is a career portal, serving 21 countries and the United States. Monster.com's main focus is job postings; as of September 2002, there were over 800,000 U.S. job postings on the Monster network. To measure job opportunities by state, the total number of job postings at Monster was divided by the total labor force population for a measure of how many vacant jobs there are by state on a per capita basis.

How Does Massachusetts Perform?

As of September 2002, Massachusetts had 29 job postings per 10,000 workers (as measured by the Monster.com Internet job postings site), which was the highest number of job postings on a per capita basis among the LTS. Connecticut was second with 23 job postings per 10,000 in the labor force, closely followed by New Jersey with 22. Minnesota and New York had the smallest numbers of job postings (each had 13).

In Massachusetts, the job categories that had the highest share of Monster.com job postings as of September 2002 included Healthcare Practitioner, Technician, and Other (10.1%), Accounting/Auditing (8.2%), Biotechnology/Pharmaceuticals (6.5%), Information Technology (IT) (5.6%), and Engineering (5.4%).

What Does This Trend Mean for Massachusetts?

Relative to the LTS, Massachusetts had the highest number of job listings on a per capita basis. Despite the economic slowdown, the Massachusetts Innovation Economy continues to have more job opportunities in comparison to the other LTS. The statistics also reinforce the widely-held view that life sciences industries are one of the major economic drivers in the Massachusetts economy. It is important that Massachusetts continue to find ways to attract and retain workers, and develop more education and training programs so that all of its citizens can succeed in the Innovation Economy.

Indicator 7

Perception of Business Climate and Consumer Confidence Index

State's favorable business climate rating by high-tech business leaders experiences another decrease in 2002; state and US Consumer Confidence Indices remain low relative to previous years

Why Is It Significant?

Confidence of business executives in a region reflects not only current conditions but also influences future prospects. Positive or negative perceptions of a state affect investment patterns. The perception by high-technology business leaders of how Massachusetts rates as a place in which to create, operate, or expand businesses is an indicator of the overall climate for innovation and technology-based industry in the state.

Consumer confidence is a leading indicator for the financial markets. The U.S. Consumer Confidence Index measures the level of confidence individuals have in the performance of the economy. The quarterly Massachusetts Consumer Confidence Index is modeled on the U.S. Conference Board Index. Consumer confidence correlates with business and job prospects, incomes, and inflation. The growth of help wanted advertisements and rising stock prices are examples of occurrences that can contribute to boosting consumer confidence.

How Does Massachusetts Perform?

Although most local CEOs continue to rank the state favorably as a place to conduct business, the trend is downward. Although 84% of the executives responding to the Massachusetts High Technology Council annual survey in 2002 rated the Massachusetts business climate as "good" or "outstanding," this rating is a decline from 90% a year earlier and from the peak of 96% in 1999.

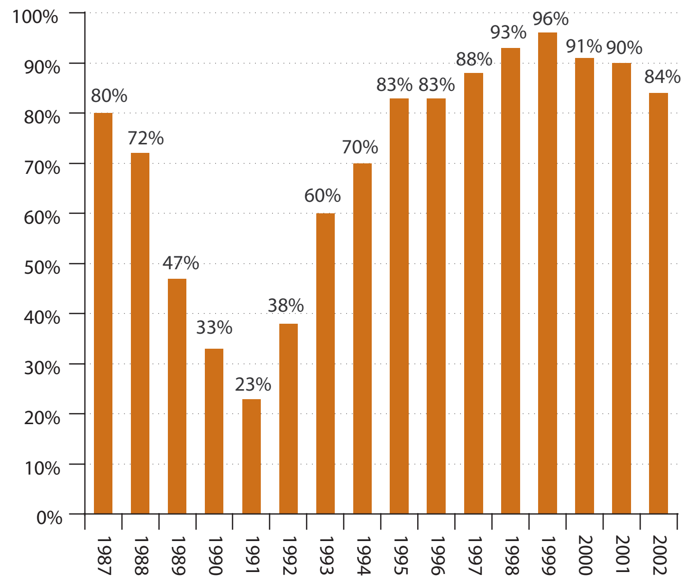
As of September 2002, the Massachusetts Consumer Confidence Index stood at 96.5, representing a 2.3% decrease in consumer confidence in the state from 98.8 in 2001. The average U.S. Consumer Confidence Index as of September 2002 was 101.5, compared to 114.5 a year ago for the same month. From 1992 to 2000, the Massachusetts and U.S. Consumer Confidence Indices had experienced a steady increase, with the U.S. reaching a twenty-year high of 144.7 in the summer of 2000.

What Does this Trend Mean for Massachusetts?

Massachusetts CEOs continue to rank Massachusetts as a favorable place to conduct business in 2002, although there has been a continuing downward trend since 1999. The Massachusetts High Technology Council reported that the "survey results show that despite the national recession and tech sector slowdown, Council members are still bullish about being in Massachusetts." U.S. executives shared similar views to Massachusetts CEOs—the U.S. Conference Board reported that as of the second quarter of 2002, "executives continue to rate current economic conditions favorably, but they are more cautious looking ahead."

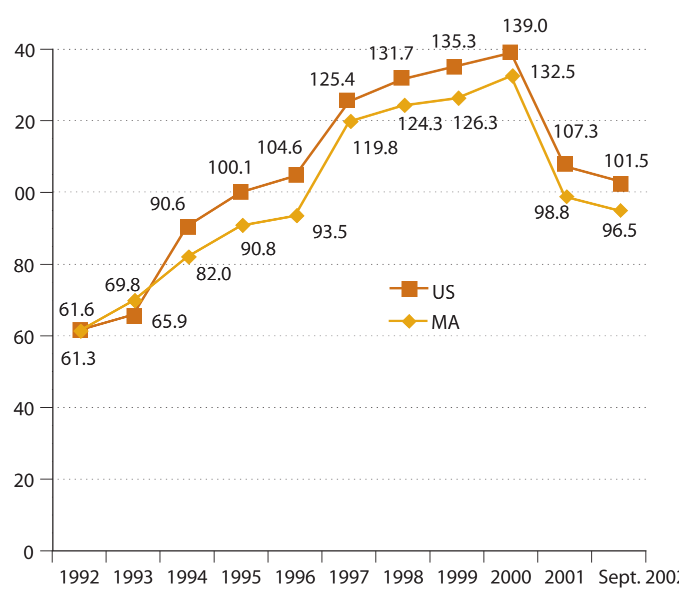
As of September 2002, consumer confidence in Massachusetts is lower than a year ago. Mass Insight and the New England Economic Project stated that "the economy is growing slowly in the U.S., but in Massachusetts, (the state) hasn't turned any corners. The recovery has not gained any traction [here]." Consumers' current assessment of economic conditions in both Massachusetts and the U.S. has paralleled the slowdown in the economy, aftermath of the terrorist attacks on September 11th, and the sluggish stock market. Weak consumer confidence can prolong the economic recovery in the state and in the U.S.

Percentage of high-tech CEOs rating Massachusetts "good" or "outstanding" as a place to create, operate, and expand high-tech businesses, 1987-2002



Source: Mass High Tech Council

Consumer Confidence Index, Massachusetts and US, 1992-September 2002



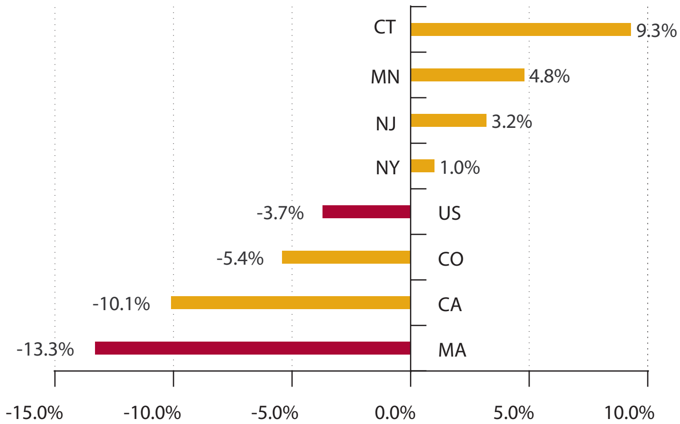
Source: The Conference Board (US); Mass Insight / New England Economic Project (NEEP) (Massachusetts)

INDICATOR 8

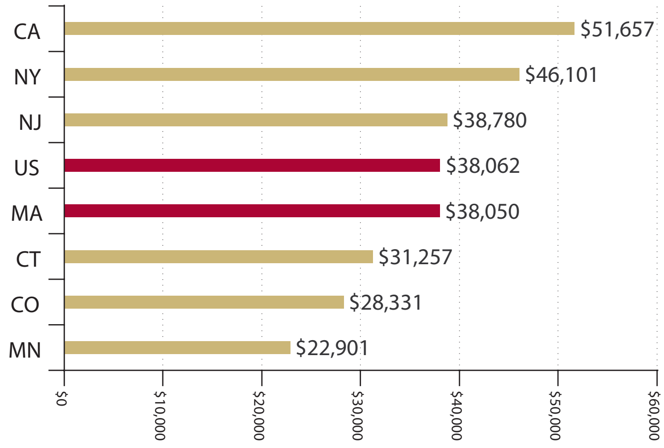
Manufacturing Exports

Massachusetts experiences largest percent decline in value of manufacturing exports of all LTS from 2000 to 2001; Massachusetts exports to Asia decrease in 2001

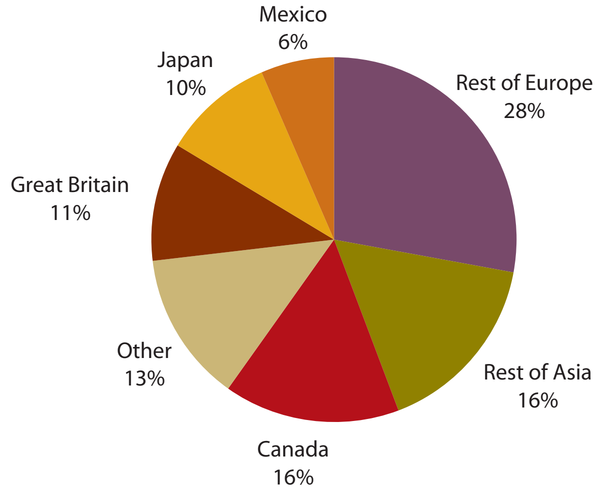
Percent change in value of manufacturing exports per employee, Massachusetts, other LTS, and US, 2000-2001



Value of manufacturing exports per employee, Massachusetts, other LTS, and US, 2001 (inflation-adjusted)



Destination of Massachusetts exports, 2001



Note: Portions may not sum to 100 % due to rounding

Source of all data for this indicator: MISER; Office of Trade and Economic Analysis; International Trade Administration, U.S. Department of Commerce; Bureau of Labor Statistics

Why Is It Significant?

Exports are an important indicator of global competitiveness. Serving growing global markets can bolster growth in employment, sales, and market share for innovation-based companies. Also, diversity of markets can protect a region from downturns in any single market. Creating high value exports are important in order to compete successfully in a global economy.

How Does Massachusetts Perform?

After several years of significant growth, Massachusetts and several of the other six LTS experienced decreases in the value of its manufacturing merchandise exports between 2000 and 2001. The value of Massachusetts exports decreased 13.3% during this period, which was the largest decrease among the LTS. California also experienced a double-digit decrease (10.1%) from 2000 to 2001. Connecticut ranked first among the LTS, experiencing a growth in its value of manufacturing exports per employee at 9.3%, outpacing the growth rate of Minnesota (4.8%) and New Jersey (3.2%) during this period.

Per employee, Massachusetts manufacturing exports ($38,050) placed the state fourth among the other LTS, and just below the national average ($38,062) in 2001. California ranked first among the LTS at $51,657, followed by New York at $46,101, and New Jersey at $38,780.

There was little change in the destination patterns for Massachusetts exports between 2000 and 2001. Canada (16%), Great Britain (11%), and Japan (10%) remained the state's largest trading partners in 2001. Major trading regions were Europe (excluding Great Britain) at 28%, and Asia (excluding Japan) at 16%. In 2000, 20% of Massachusetts exports went to Asia.

What Does this Trend Mean for Massachusetts?

In 2001, Massachusetts and several of the LTS experienced a decline in the value of their manufacturing exports. Reasons for this decline include the U.S. recession and world economic slump, which has led to cut-backs in overall spending for companies here and abroad. But Massachusetts had the largest decrease from 2000 to 2001, signaling falling demand for the state's manufactured products. Massachusetts concentration in the semiconductor market and in many forms of Information Technology (IT) spending, reductions in manufacturing employment, and unstable foreign markets are likely causes for the drop in the state's total value in manufacturing exports from 2000 to 2001. Massachusetts should aggressively promote trade and assist companies with business overseas, especially in tough economic times.

Innovation Process Indicators

Innovation Process Indicators

The innovation process includes idea generation, technology commercialization, and entrepreneurship, as well as innovation occurring in established businesses. A dynamic innovation process is an essential component of a competitive economy, because it translates ideas into high-value products and services. Positive results are created for both business and people. The innovation process has different stages, but a strong interrelationship among them is critical for success.

Indicator 9

Number of and Type of Patents Issued

Massachusetts regains lead in patents per capita compared to the LTS in 2001; state has second highest increase in total number of patents among the LTS from 2000 to 2001

Why Is It Significant?

Patents reflect the initial discovery and protection of innovative ideas. Strong patent activity often reflects significant conduct of commercially relevant research and development. The primary reason to secure patent protection is the potential relevance of an invention or discovery to a marketable product or process.

How Does Massachusetts Perform?

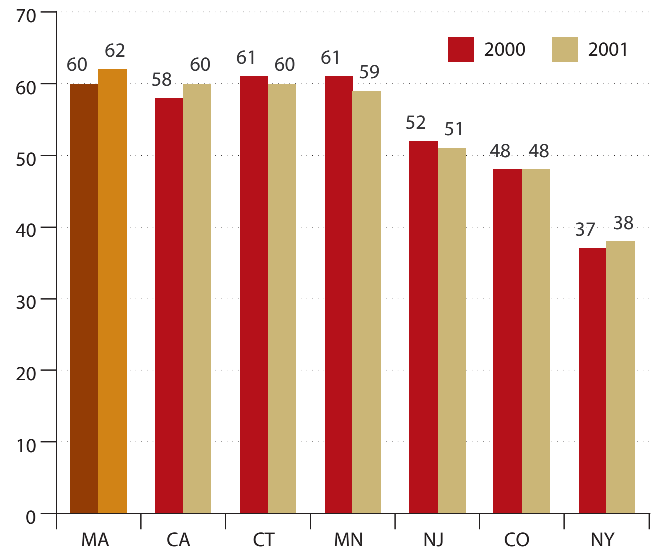
In 2001, Massachusetts innovators were granted 62 patents per 100,000 residents, placing the state first among the LTS in patents per capita. The absolute number of patents in Massachusetts has increased 3.4%, from 3,841 in 2000 to 3,972 in 2001. From 2000 to 2001, California (5.1%), Massachusetts, and New York (2.1%) led the LTS in terms of growth in total number of patents. From 1997 to 2001, Massachusetts has seen a 40.3% increase in patent activity, which placed the state third among the LTS. California led the LTS during this period with a 61.5% total increase in patent activity, followed by Colorado at 56.9%.

Patents in Massachusetts cross a wide range of sectors. From 1997 to 2001, Healthcare was the most active area, with 24% of all patents, as compared to 17% between 1992 and 1996. Miscellaneous Industry & Transportation and Aerospace was second with 19% of all patents from 1997 to 2001, followed by Computers (13%), and Chemicals (9%).

What Does this Trend Mean for Massachusetts?

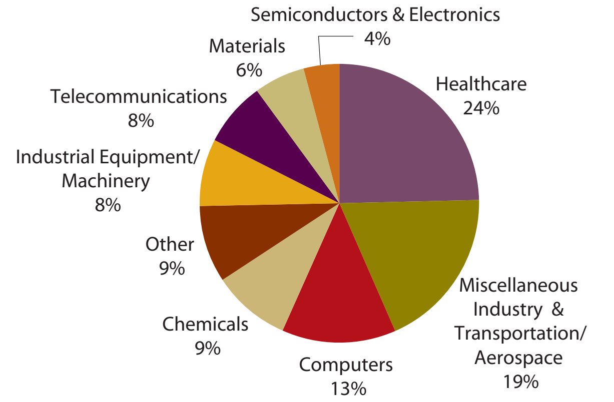
The level of patent activity and the diversity of the patent portfolio are good news for Massachusetts. Patents are an important factor in the growth of the Innovation Economy, for this shows continuing growth in inventions which form the basis of new commercial products and services. The state should work to encourage research and development activity in Massachusetts, and institutions should continue to explore ways to encourage more patent activity.

Number of patents issued to state residents, per capita, Massachusetts and other LTS, 2000 and 2001

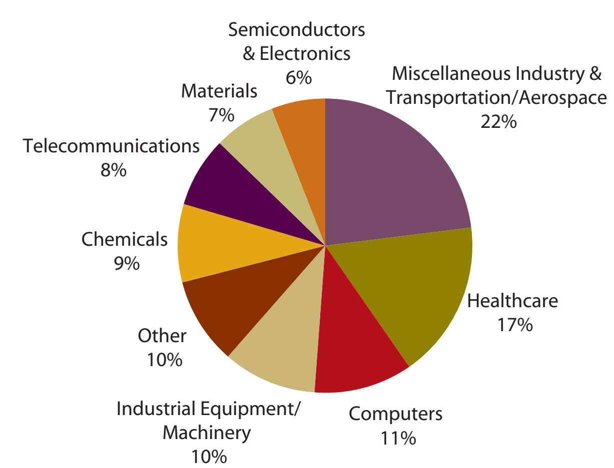


Source: U.S. Patent and Trademark Office, U.S. Census Bureau

Distribution of patents issued, Massachusetts, 1997-2001



Distribution of patents issued, Massachusetts, 1992-1996



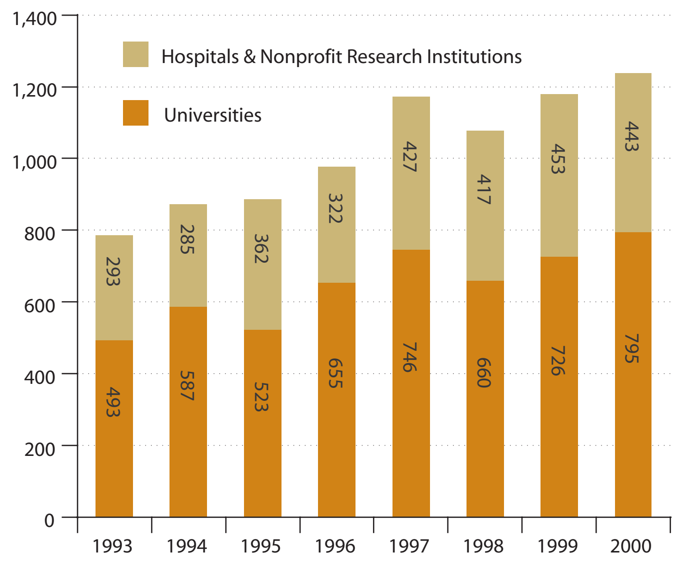
Note: Portions may not sum to 100 % due to rounding

Source of data for pie charts: CHI Research

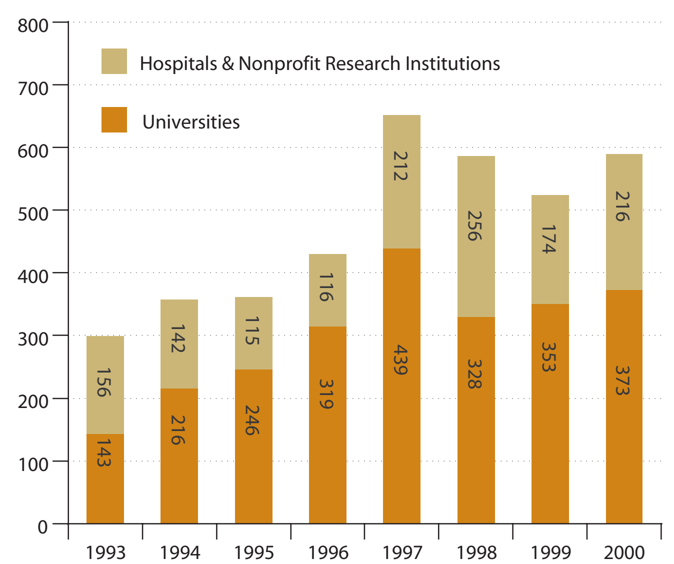
Innovation Process Indicators

Idea Generation

Number of invention disclosures received by major universities, hospitals, and nonprofit research institutions, Massachusetts, 1993-2000



Number of new patent applications filed each year by major universities, hospitals, and nonprofit research institutions, Massachusetts, 1993-2000



Source of all data for this indicator: Association of University Technology Managers and MIT Technology Licensing Office

Indicator 10

Invention Disclosures and Patent Applications

Invention disclosures and patent applications continue to increase in Massachusetts

Why Is It Significant?

Massachusetts universities, hospitals, and research institutions are important sources of innovative ideas. Individual inventors formally disclose innovations to their sponsoring institutions to initiate the complex process toward patent protection. The next major step following disclosure is formal patent application to the U.S. Patent and Trademark Office. The level of invention disclosures and formal patent applications reflect the initial registry of innovative ideas or inventions with commercial potential.

Research conducted by major universities, hospitals, and research institutions has a two-fold "spillover" effect in the state's economy. First, institutional research induces private research and investment to capitalize on innovations. The new companies, goods, and services created downstream then spur economic vitality.

How Does Massachusetts Perform?

The number of invention disclosures reported annually by Massachusetts academic and nonprofit institutions increased 5.0% from 1,179 in 1999 to 1,238 in 2000. Since 1991, over sixty percent of these invention disclosures originate at universities, and the remainder are based in hospitals and other nonprofit research institutions.

Of the hospitals and research institutions, Massachusetts General Hospital (MGH) accounted for the highest number of invention disclosures (33.9%) in 2000. Significant growth occurred at the Dana Farber Cancer Institute—19.1% between 1999 and 2000. Among the universities, the Massachusetts Institute of Technology (MIT) was responsible for just over half of all the inventions disclosed between 1999 and 2000. Boston University and Harvard University each showed strong growth in invention disclosures, increasing 23.2% and 22.0%, respectively, between 1999 and 2000.

Massachusetts universities, hospitals and research institutions filed 589 patent applications in 2000, an 11.8% increase from 1999 (527). Patent applications filed by hospitals and research institutions increased by 24.1% between 1999 and 2000, while patent applications by universities increased 5.7% during this period. The highest percent increases in patent applications among Massachusetts universities occurred at Boston University and the University of Massachusetts (all campuses), at 20.5% and 19.2%, respectively, from 1999 to 2000.

What Does this Trend Mean for Massachusetts?

The development and protection of intellectual property by Massachusetts leading institutions shows a healthy base for future products, technologies, and goods. Massachusetts continues to remain strong in inventions and patent applications in 2000, both at the state's universities and at hospitals and nonprofit research institutions. It is important that Massachusetts continues to support these innovative activities at all institutions.

Indicator 11

Technology Licenses and Royalties

Massachusetts universities, hospitals, and research institutions increase number of technology licenses, and technology license royalties experience sharp increase from 1999 to 2000

Why Is It Significant?

Technology licenses provide a vehicle for the transfer of intellectual property (e.g., patents, experimental findings) from universities, hospitals, and other research organizations to companies who will commercialize the technology. Royalties from these licenses reflect the perceived value and success of the intellectual property in the commercial marketplace.

Licensing revenues are affected by the disciplines in which the research is undertaken and by the degree to which university and other institutional research is focused on marketable products. The number of new technology licenses, and gross royalties derived, is an indicator of the success of technology transfer efforts by universities, hospitals, and research institutions. License revenues are typically returned in part to the research institutions and investigators' labs, where the monies go to support continuing research.

How Does Massachusetts Perform?

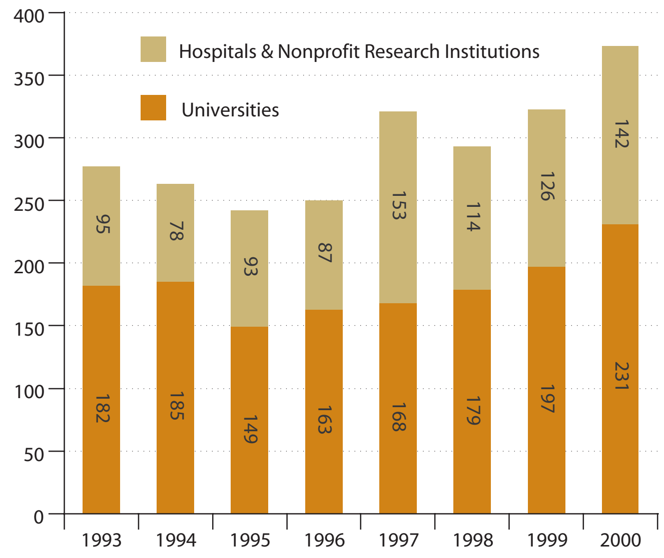
New technology licenses issued by major universities, hospitals, and research institutions in Massachusetts increased 15.5% from 323 in 1999 to 373 in 2000. The Massachusetts Institute of Technology (MIT) and Harvard University together generated 46.1% of all licenses in 2000 among major universities, hospitals, and research institutions.

Gross royalties received from institutional licensing in Massachusetts increased 74.4%, from $50.8 million in 1999 to $88.6 million in 2000. In 2000, the four institutions in Massachusetts receiving the highest amount of royalties were, in descending order: MIT, Harvard, Massachusetts General Hospital, and the University of Massachusetts (UMASS), all campuses. Boston University and the UMASS system each more than doubled their license income from 1999 to 2000.

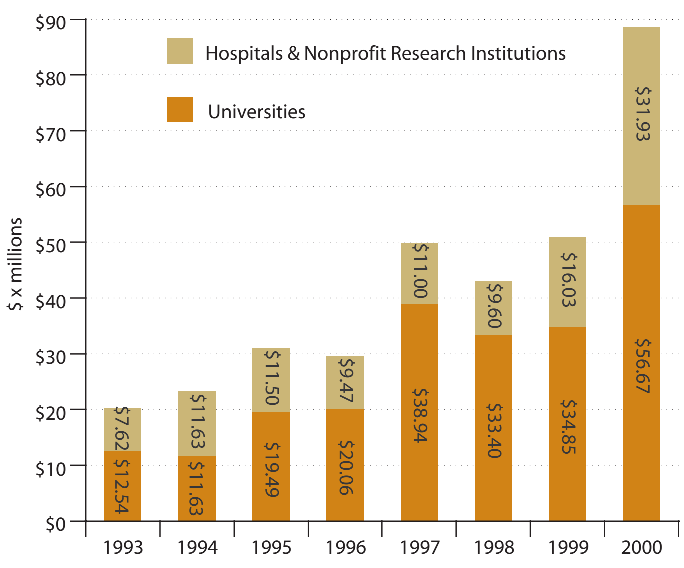
What Does this Trend Mean for Massachusetts?

The number of technology licenses and value of gross licensing income received by Massachusetts hospitals and universities is evidence of the commercial relevance of the state's basic research, and its continued strength in this area over time. This activity highlights the importance of universities in the innovation process—from the university powerhouses of Harvard University and MIT, to the growing role of Boston University and the University of Massachusetts system—as a large amount of licensing revenues are recycled back into additional research at the institution.

Number of technology licenses issued by major universities, hospitals, and nonprofit research institutions, Massachusetts, 1993-2000

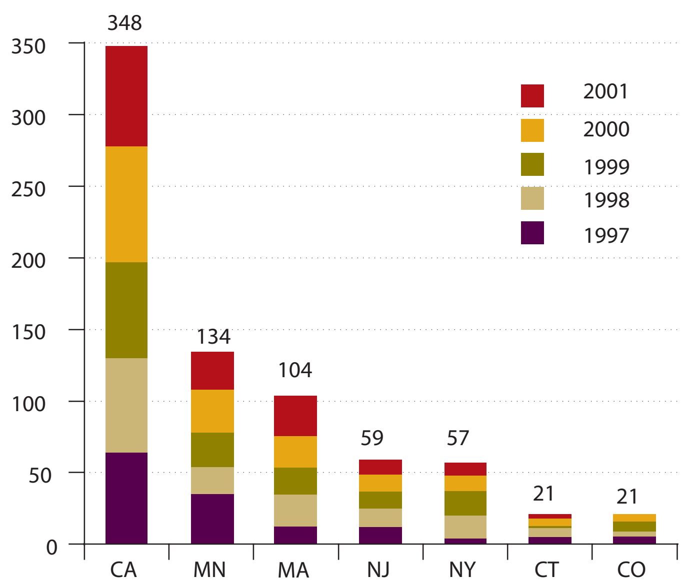


Value of gross licensing income received, Massachusetts, 1993-2000

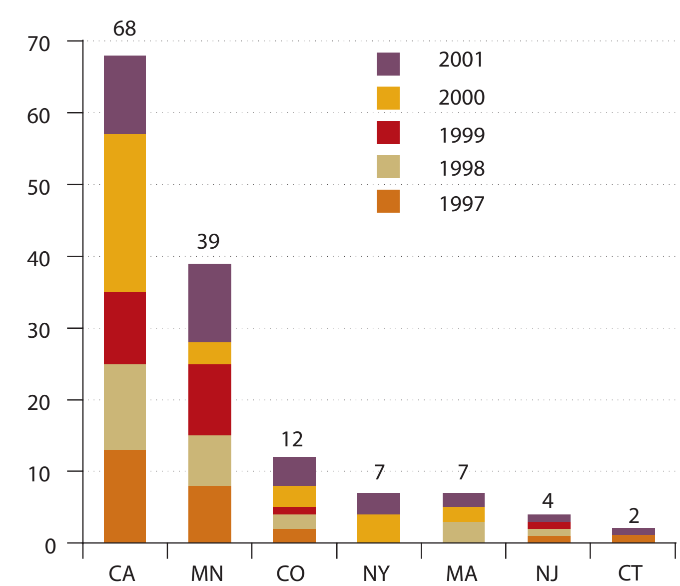


Source of all data for this indicator: Association of University Technology Managers

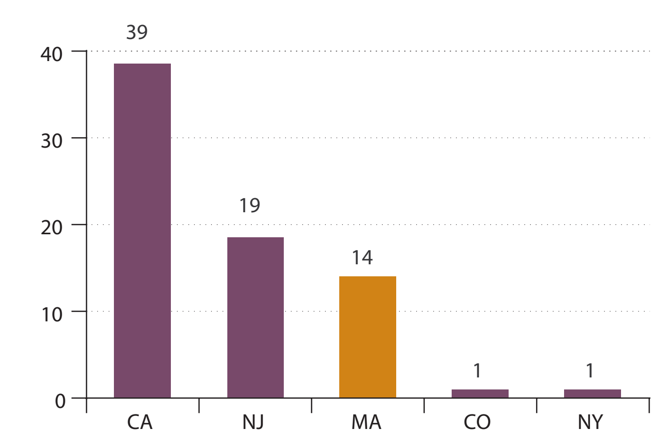
Total number of investigational medical devices (IDEs), Massachusetts and other LTS, 1997-2001



Total number of premarket approvals (PMAs), Massachusetts and other LTS, 1997-2001



Total number of biotech drugs approved by the FDA, Massachusetts and other LTS, 1997-2002



Source of all data for this indicator: U.S. Food and Drug Administration

Note: Number at top of bar represents total from 1997-2001

Indicator 12

FDA Approval of Medical Devices and Biotech Drugs

Medical device applications and biotech drug development activity strong in Massachusetts compared to LTS, although several states are gaining on Massachusetts in the premarket medical device arena

Why Is It Significant?

The U.S. Food and Drug Administration (FDA) approval process uses three application categories to classify medical devices: investigational device exemptions (IDEs), premarket approvals (PMAs), and 510(k)s for less sophisticated instruments or product improvements. Since the most complex, the highest-risk, and the newest technologies tend to be classified as either IDEs or PMAs, this indicator shows data for these two categories. Approval rates reflect innovation in medical device manufacturing and important linkages to the teaching hospitals, where many of these instruments undergo clinical investigation.

The FDA's Center for Drug Evaluation and Research (CDER) approves all drugs to the U.S. market. The new drug approval (NDA) process is comprehensive, involving clinical trials and an extensive review process. Biotech drug approvals reflect innovation in health research and pharmaceutical manufacturing as well as strong connections to the biotechnology and healthcare technology industry sectors.

How Does Massachusetts Perform?

Massachusetts consistently ranks among the top states in the nation for approval of IDEs. In 2001, Massachusetts had 28 IDEs, a 27.3% increase from the previous year (22). Among the LTS, California ranked first, with 70 IDEs, followed by Massachusetts, then Minnesota (26), for the same period. From 1997 to 2001, the total number of Massachusetts IDEs has doubled. In 2001, Massachusetts had 2 PMAs, placing the state fifth among the LTS. California and Minnesota led the LTS in total number of PMAs with 11 each, followed by Colorado with 4 PMAs in 2001.

From 1997 to 2002, Massachusetts companies received 14 biotech drug approvals, placing the state third among the LTS in biotech drug approval activity. Among the LTS, California ranked first with 39 biotech drug approvals, followed by New Jersey with 19. Colorado and New York each had 1 biotech drug approval for this period. Connecticut and Minnesota had no biotech drug approvals from 1997 to 2002.

What Does this Trend Mean for Massachusetts?

Massachusetts continues to be one of the leaders in the U.S. of new medical device and biotech drug applications and approvals. Massachusetts is especially strong in the IDE area for medical devices and in biotech drug approvals when compared to the LTS. But competitor states have had a higher number of PMAs, and several states are aggressively investing capital and resources into building a Life Sciences cluster, which includes biotechnology and medical device industries. The state needs to understand the federal approval processes and help the state's biotechnology and medical device firms to remain competitive in medical device and biotech drug evaluations and approvals. The state should continue to lobby Washington for timely reviews and approvals of medical devices and biotech drugs, advocate for favorable reimbursement policies, and encourage more investments in early-stage companies in the state.

Indicator 13

New Business Incorporations

New business incorporations increase in the state in 2001

Why Is It Significant?

The formation of new businesses is a key indicator of a robust economy. High numbers of new business starts typically indicate an economic environment capable of fostering risky and innovative ideas. Successful new companies provide new jobs, ideas, goods, and services for a region.

How Does Massachusetts Perform?

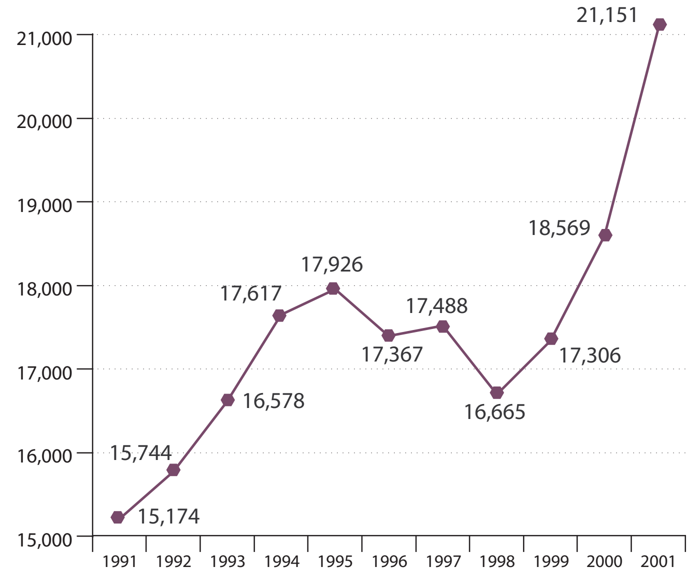
In 2001, there were 21,151 new business incorporations registered with the Massachusetts Secretary of State in 2001—a 13.9% increase from 2000 (18,569). 77% of the new business incorporations in 2001 were for-profit businesses; 16% were foreign (i.e., out-of-state); and 7% were not-for-profit businesses. The total number of for-profit new business incorporations in Massachusetts increased 28% from 2000-2001, the largest one-year increase recorded since 1991-1992.

As of July 2002, there have been 14,092 new business incorporations registered in Massachusetts.

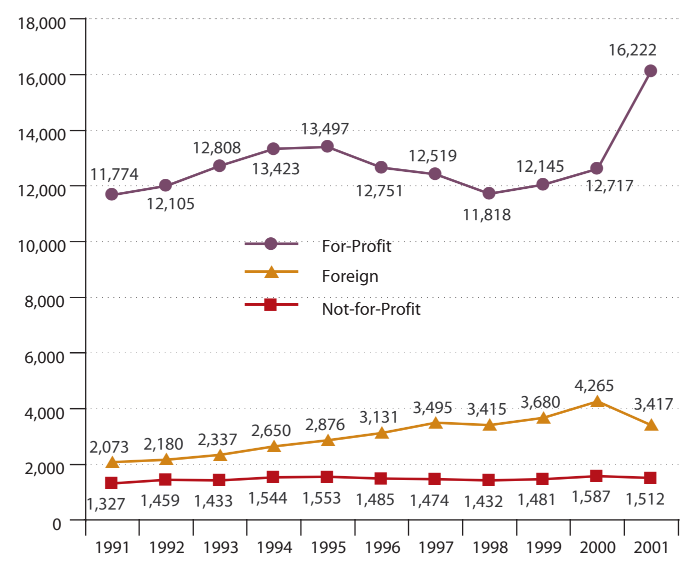
What Does this Trend Mean for Massachusetts?

Massachusetts experienced a large increase in new business incorporations from 2000 to 2001, consistent with the CEO survey (indicator 7) that the state is still a good place to conduct business. In times of economic downturn and job losses, it is not unusual to see an increase in new business starts. This trend needs to be monitored to see if these new businesses are viable and are potential seeds for tomorrow's Innovation Economy. New business incorporation activity is an indication that people are willing to take the risk and begin new ventures. This should bode well for the Innovation Economy. The state needs to continue to encourage entrepreneurship by its citizens and develop policies and an economic development infrastructure that support new business growth.

Number of new business incorporations, Massachusetts, 1991-2001



Number of new business incorporations by category, Massachusetts, 1991-2001



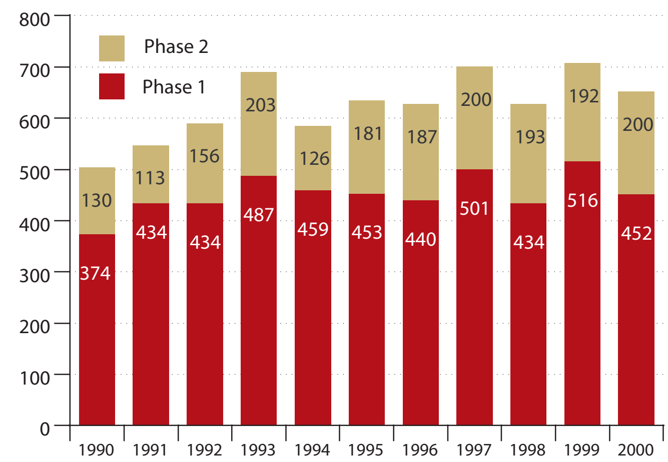
Source of all data for this indicator: Secretary of the Commonwealth

Indicator 14

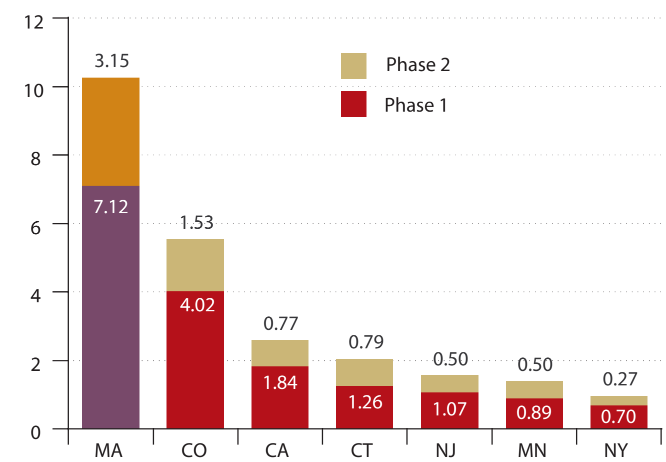
Small Business Innovation Research (SBIR) Awards

Although Small Business Innovation Research Awards decrease in number, total value increases in 2000

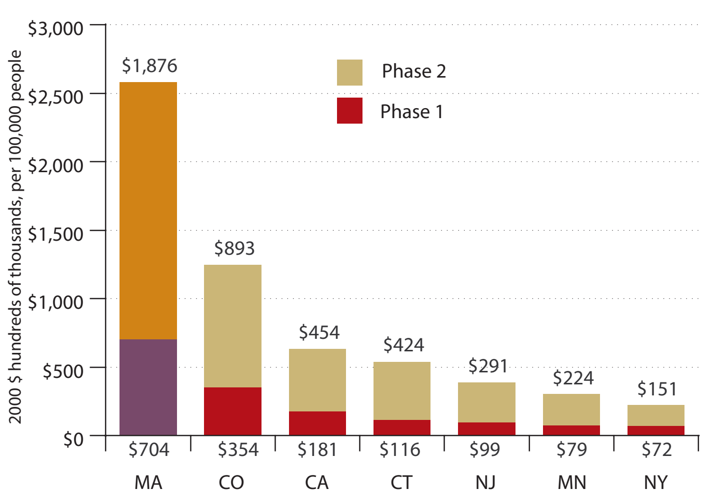
Number of SBIR awards to Massachusetts companies by phase, 1990-2000



Number of SBIR awards to Massachusetts and other LTS companies by phase, per 100,000 people, 2000



Value of SBIR awards to Massachusetts and other LTS companies by phase, per 100,000 people, 2000



Source of all data for this indicator: Small Business Administration

Why Is It Significant?

The Small Business Innovation Research (SBIR) Program provides competitive grants to entrepreneurs seeking to conduct "Phase I" proof-of-concept research on the technical merit and feasibility of their ideas, and "Phase II" prototype development to build on these findings. The federal SBIR program is reputed to be the world's largest seed capital fund for development of new products and processes, and often provides the initial revenue stream for start-up companies. In the U.S., companies that receive funding from Phase II of the SBIR program significantly outperform similar companies that do not receive such support. Participants in the SBIR program are often able to use the credibility and experimental data developed through their research to attract strategic partners and outside capital investment.

The U.S. Department of Defense funds the largest amount of SBIR dollars; other funding sources of the SBIR program include the National Institute of Health (NIH) and the National Science Foundation (NSF).

How Does Massachusetts Perform?

Since the inception of the program in 1983, Massachusetts has consistently ranked second behind California in total number of awards and dollar amounts received from the SBIR program. In 2000, Massachusetts received a total of 652 SBIR awards, a decrease of 7.9% from 1999 (708). While Phase I awards declined, there was an increase in Phase II development awards. On a per capita basis, Massachusetts had the highest award rate in the country in 2000. Massachusetts received two times the number of per capita awards of Colorado, its closest competitor among the LTS, and almost four times that of California in the same time period.

In 2000, the total dollar value of SBIR awards to Massachusetts companies was $164 million. Phase II awards are significantly larger in dollar value than Phase I awards. While representing 30.7% of all SBIR awards in Massachusetts in 2000, Phase II awards accounted for 72.7% of the total dollar value in the state.

What Does this Trend Mean for Massachusetts?

On a per capita basis, Massachusetts is the national leader in this activity in both value and total number of awards. In 2000, Massachusetts received 15.3% of all SBIR dollars awarded in the U.S. Massachusetts continues to perform well in attracting SBIR dollars over time, but the state should remain vigilant to maintain the lead, as other states aggressively pursue more awards.

Indicator 15

Initial Public Offerings (IPOs) and Mergers & Acquisitions (M&As)

IPO market drops in 2001 in Massachusetts and the US; total number of M&As decreases in Massachusetts and in most of the LTS in 2001

Why Is It Significant?

The number of initial public offerings (IPOs) is one indicator of future high-growth companies. "Going public" raises significant capital to invest and stimulate next-stage growth in a company. A successful IPO reflects confidence by investors that a company can generate increases in value, sustain growth, and produce satisfactory returns on investment. Mergers and acquisitions (M&As) are another important avenue to liquidity for entrepreneurs and investors in rapid-growing companies. Innovation-based niche companies may be attractive to other firms seeking to diversify, expand sales or market share, and create an integrated service model that can further develop technologies and products.

How Does Massachusetts Perform?

After strong IPO years in 1999 and 2000, Massachusetts had only 2 IPOs in 2001, a decrease of 94.3% from the previous year (35), and the second largest decrease when compared to the LTS. In 2001, Massachusetts was fifth among the LTS in total number of IPOs, with California leading in IPO activity with 24 IPOs, followed by New York with 7. The LTS as a whole and the U.S. each had a significant decrease, 78.9% and 78.2%, respectively, in total number of IPOs from 2000 to 2001. Colorado had the largest drop among the LTS; it had no IPOs in 2001, compared to 12 in 2000.

The Computer & Communications Hardware and Innovation Services industry clusters each had one IPO in Massachusetts in 2001—Mykrolis Corporation and Exact Sciences Corporation. Mykrolis Corporation was a spin-off from an established Massachusetts company, Millipore Corporation. For those LTS that had IPOs in 2001, the key industry clusters that had the highest IPO activity included: Software & Communications Services (California), Financial Services (Connecticut), Software & Communications Services (Minnesota), Computer & Communications Hardware (New Jersey), and Financial Services (New York).

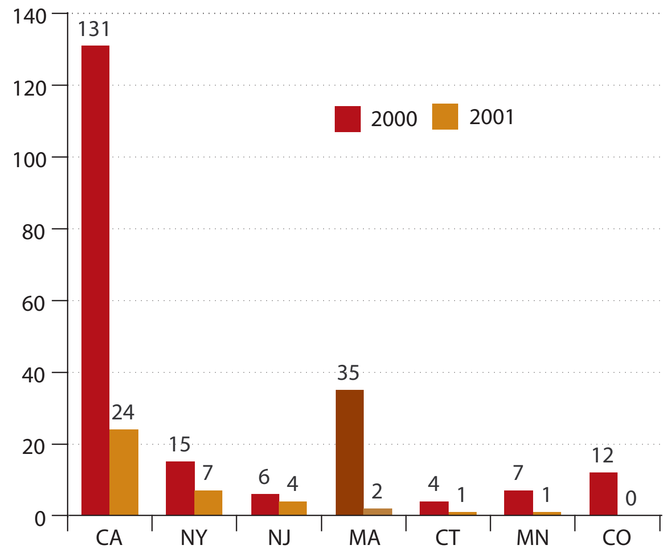
In 2001, Massachusetts had 309 M&As (representing the total number of acquired companies), a decrease of 21.6% from the previous year of 394 companies. Among the LTS, from 2000 to 2001, New Jersey had the largest decrease in M&A activity involving acquired companies, from 278 to 214 (a decrease of 23.0%), followed by Colorado (223 to 173, a decrease of 22.4%). Only Connecticut saw an increase in total number of M&As (8.5%) during the same period. The U.S. experienced a decrease of 16.2% in total number of M&A activity of acquired companies (7,938 to 6,652), which was the first decline in M&A activity in nine years.

What Does this Trend Mean for Massachusetts?

While the results for 2001 were not positive for Massachusetts on either an absolute or comparative basis, the numbers should be viewed in light of the overall collapse in the IPO market, especially for technology companies. Massachusetts also has a history of building smaller, more nimble companies, and many of these firms are either acquired or remain privately held. It is important to watch what happens when the IPO window nationwide opens again to see how Massachusetts companies fare in this arena. IPOs are a valuable asset to the Innovation Economy, and the state should encourage and support companies that want to go public.

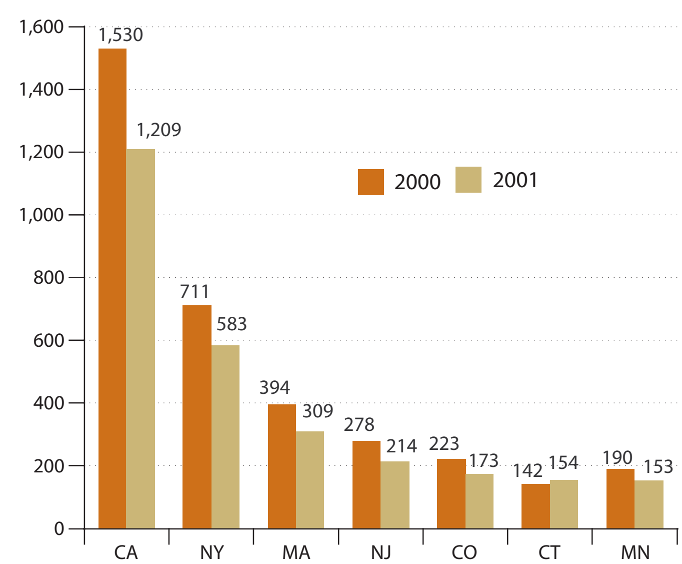
The decrease in M&A activity of acquired companies in Massachusetts and most of the LTS reflected the economic slowdown experienced during 2001. Since 1997, Massachusetts has had the third highest number of companies acquired in M&A deals when compared to the LTS. It will be important to monitor this aspect of the state's economy so that competitive advantage and high-tech growth are not in danger of being weakened or hindered through deals that could result in companies either being dismantled or moved to another state or country.

Total number of initial public offerings (IPOs), Massachusetts and other LTS, 2000 and 2001



Source: IPO.com

Total number of mergers and acquisitions (M&As) activity of acquired companies located in Massachusetts and other LTS, 2000 and 2001



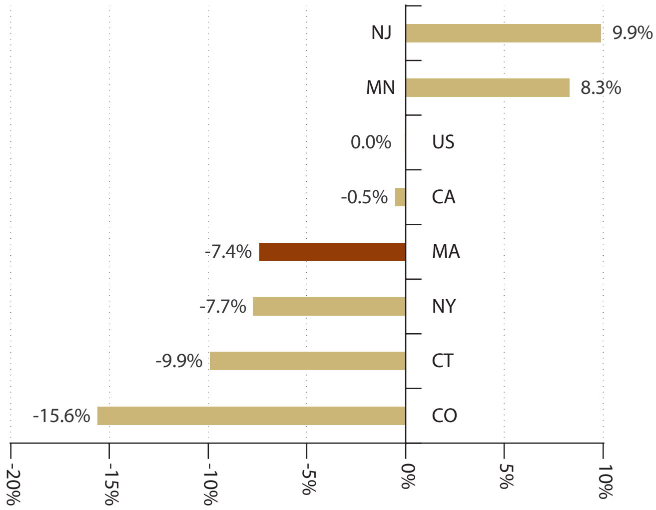
Source: Mergerstat

Indicator 16

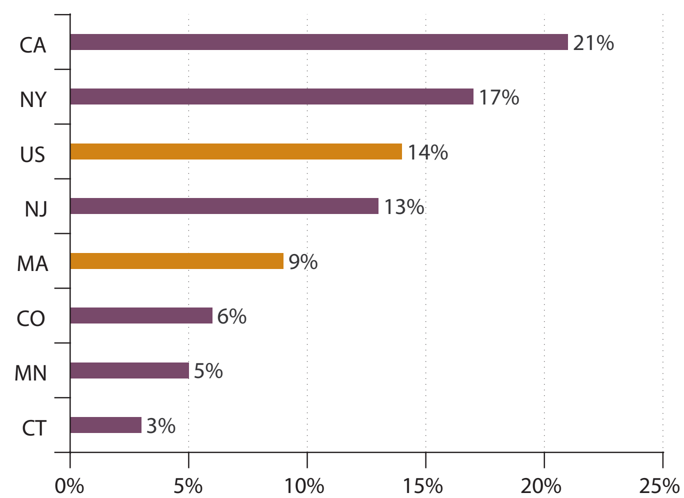
NASDAQ Firms' Market Value

Market volatility affects annual growth rate of NASDAQ firms in Massachusetts and the LTS

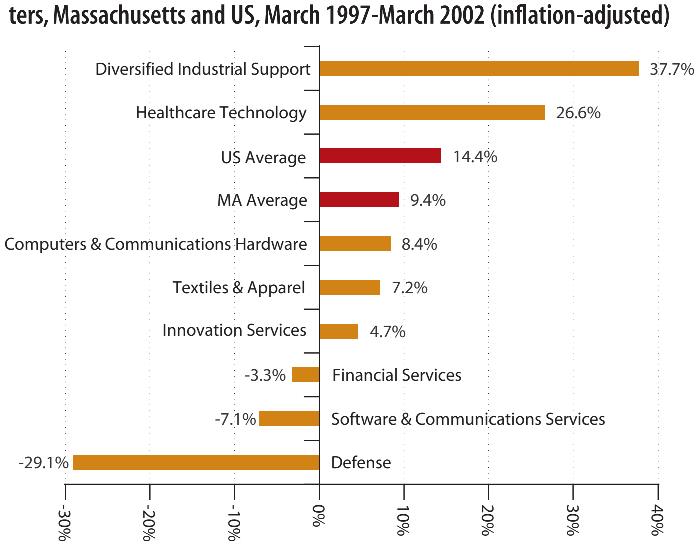
Average annual growth rate of total market capitalization for Massachusetts, other LTS, and US, March 2001-March 2002



Average annual growth rate of total market capitalization for Massachusetts, other LTS, and US, March 1997-March 2002 (inflation-adjusted)



Average annual growth rate of NASDAQ companies' market value by clusters, Massachusetts and US, March 1997-March 2002 (inflation-adjusted)



Source of all data for this indicator: Standard & Poor's

Why Is It Significant?

The National Association of Securities Dealers' stock exchange, NASDAQ, is known for its innovative, emerging growth companies. Forty percent of its listed companies are small, with market capitalization of less than $100 million. NASDAQ is home to some of the nation's fastest growing technology-based companies. A strong stock price enables a NASDAQ company to raise capital more efficiently and to use its stock as currency in acquisitions. A strong stock price also reflects favorable operating and financial results for the company.

How Does Massachusetts Perform?

The market value of Massachusetts-based NASDAQ companies grew from $59 billion in March 1997 to $93 billion in March 2002, inflation-adjusted. Massachusetts annualized growth rate of 9% lagged the 14% annualized growth rate of all NASDAQ firms in the U.S., and placed the state behind California (21%), the top ranked LTS.

From March 2001 to March 2002, Massachusetts-based NASDAQ companies experienced a decrease of 7.4% in total market value. Among the LTS, Colorado-based NASDAQ companies had the largest loss in total market value, a decrease of 15.6%, during the same period, followed by Connecticut (9.9%) and New York (7.7%). Only two of the LTS had an increase in the total value of its NASDAQ companies—New Jersey (9.9%) and Minnesota (8.3%)—for this period.

The average annual growth in market value of Massachusetts NASDAQ companies between March 1997 and March 2002 was strongest in Diversified Industrial Support (37.7%), followed by Healthcare Technology (26.6%), and Computers & Communications Hardware (8.4%). The U.S. average annual growth rate of 14% from March 1997 to March 2002 outpaced Massachusetts as a whole (9%), and six of the state's nine key industry clusters' market growth rate during the same period.

What Does this Trend Mean for Massachusetts?

From March 2001 to March 2002, most of the LTS had a decrease in the total market value of its NASDAQ companies. The U.S. economic slowdown, the pullback in the financial markets, and the terrorist attacks on 9-11 have all contributed to the declines in total market capitalization for many firms, particularly those in the tech sector. The Innovation Economy by its very nature is expected to have swings, so it is important that Massachusetts continue to maintain its diversity in areas such as key industry cluster employment, patents, and venture capital investments. As with the IPO indicator, the state should encourage and support emerging growth and technology-based companies that are vital to the Innovation Economy.

Indicator 17
Number of Fast Growth "Gazelle" Companies

Total number of fast growth firms in Massachusetts declines again in 2001; firms in the Healthcare Technology cluster comprised over a quarter of all gazelle firms in the state

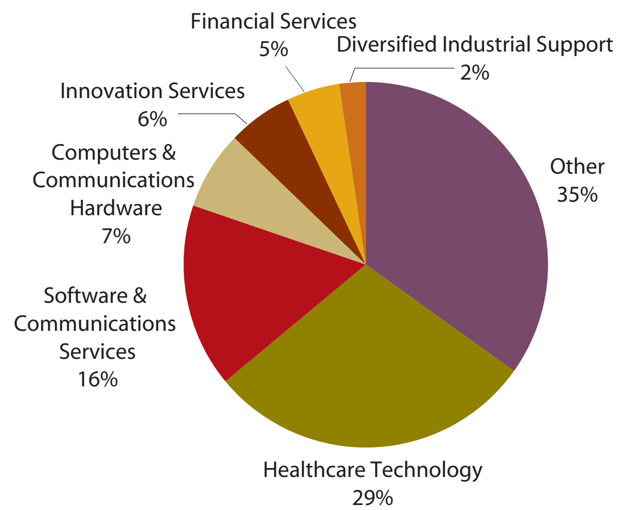
Why Is It Significant?
As the United States has made the transition to a knowledge-based economy, a new generation of fast-growing companies is emerging in the market. One benchmark of such growth is the number and distribution of "gazelles," i.e., publicly-traded companies that have grown in revenue at an average annual compound rate of 20% or more for the last four years. By generating accelerating increases in output and jobs, gazelles stimulate growth in the economy.

How Does Massachusetts Perform?
Massachusetts was home to 86 fast growth companies in 2001, a decrease of 14.0% from 2000 (100). The total number of fast growth firms in Massachusetts has been decreasing since 1999.

The Healthcare Technology (29%), Software & Communications Services (16%), and Computers & Communications Hardware (7%) clusters comprise over half of all gazelles in Massachusetts. Thirty-five percent of the gazelles fall into the "other" category, which spans retail, restaurants, and other diverse services and products.

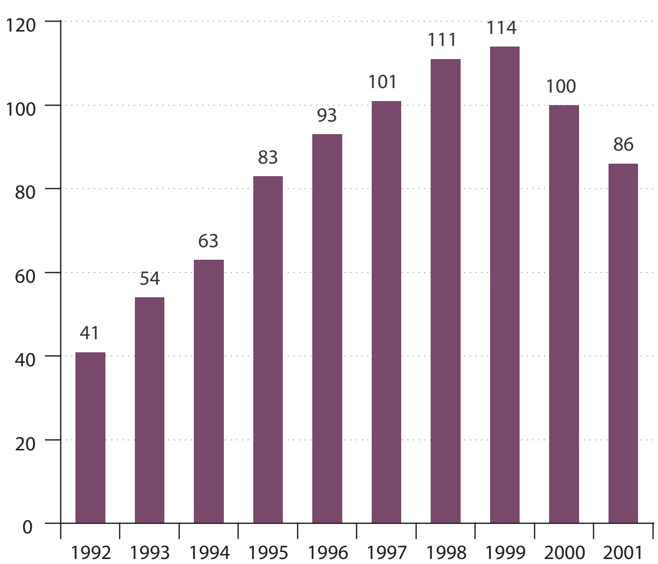
What Does this Trend Mean for Massachusetts?
The total number of fast growth companies in Massachusetts decreased in 2001, which marks the second straight year that the state experienced a drop in the number of gazelles. Since these fast growth firms are publicly-traded, market troubles over the past year most likely had a negative affect on the overall revenues of many of these firms. In addition, the decline in IPOs has meant fewer new companies have entered the public market. One bright spot is that the fast growth firms in the state's Healthcare Technology cluster have increased over the past two years, showing Massachusetts strength in the life sciences sector. Fast growth companies are a vital part of the Innovation Economy, and Massachusetts should support a business climate that encourages these companies to thrive in the state. Massachusetts still maintains diversity in gazelles, which is indicative of a climate that is supportive of this type of accelerated business activity in the economy.

Distribution of publicly-traded fast growth companies, Massachusetts, 2001



Note: Portions may not sum to 100 % due to rounding

Total number of publicly-traded fast growth companies, Massachusetts, 1992-2001



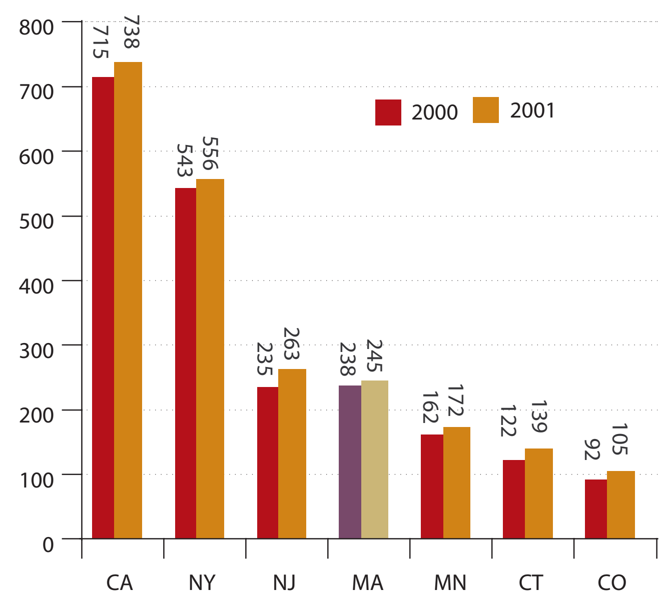
Source of all data for this indicator: Standard & Poor's

Indicator 18

Corporate Headquarters and "Technology Fast 500" Firms

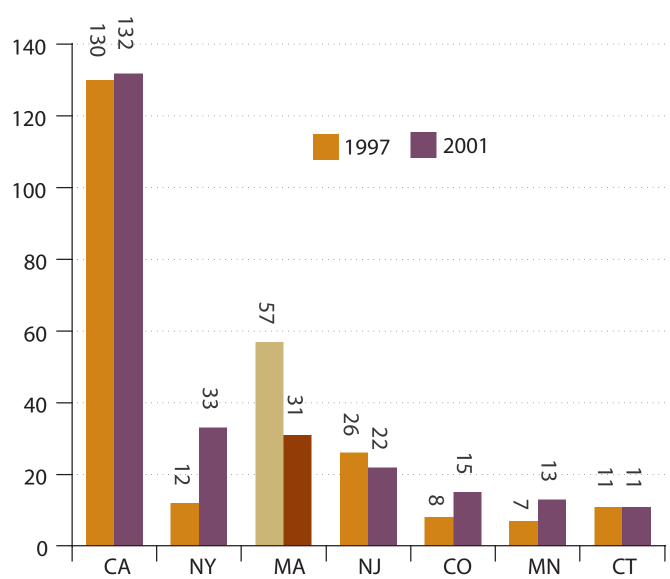
Although Massachusetts experiences largest decrease in total number of "Tech Fast 500" firms compared to LTS, total number of corporate headquarters increases in state from 2000 to 2001

Number of corporate headquarters located in Massachusetts and other LTS, corporations with more than 500 employees, 2000 and 2001



Source: Info USA

Total number of Technology Fast 500 companies located in Massachusetts and other LTS, 1997 and 2001



Source: Deloitte and Touche

Why Is It Significant?

Corporate headquarters are important "anchors" of industry clusters. They spawn and acquire new businesses, and corporations often keep their key strategists and development-related activities near their headquarters. Corporate headquarters tend to have greater community ties, including philanthropic support, than do branch offices.

The Technology Fast 500 list represents the fastest-growing public and private companies in the U.S. To be considered a Technology Fast 500 firm by Deloitte and Touche, a company must meet several criteria, including devoting a significant proportion of its revenues to research and development (R&D) spending in technology, be in business for at least five years, have operating revenues of at least one million dollars, and be headquartered in North America.

How Does Massachusetts Perform?

In 2001, Massachusetts was home to the corporate headquarters of 245 firms with 500 or more employees, a 2.9% increase from 2000 (238). All the LTS experienced an increase in total number of corporate headquarters from 2000 to 2001. California had the highest number of headquarters in 2001 with 738 (a 3.2% increase from 2000), followed by New York with 556 (a 2.4% increase from the previous year). Colorado had the smallest number of corporate headquarters with 105, but had the largest percent increase in total number from 2000 to 2001 (14.1%).

Massachusetts was home to 31 Technology Fast 500 firms in 2001, ahead of New Jersey (22), Colorado (15), Minnesota (13) and Connecticut (11). California was first among the LTS with 132 companies, followed by New York (33). Despite having the third highest number of Tech Fast 500 companies when compared to the LTS in 2001, Massachusetts had the largest decrease (45.6%) in total number of Tech Fast 500 firms over time from 1997 to 2001. New Jersey was the only other LTS to experience a decrease (15.4%). New York nearly tripled and Colorado and Minnesota each almost doubled their total number of Tech Fast 500 companies during the same time period. Over fifty percent of all Technology Fast 500 Firms in the U.S. are headquartered in Massachusetts and the six other LTS.

What Does this Trend Mean for Massachusetts?

The total number of corporate headquarters with 500 or more employees in Massachusetts increased from 2000 to 2001. With its highly-skilled, well-educated workforce, its large number of colleges and universities, and strong professional services base, Massachusetts is an attractive site for corporate headquarters, which are often the primary location for corporations' research, entrepreneurial, and philanthropic activities. However, the Tech Fast 500 data highlight a significant drop in the number of technology-based firms in the state over the past five years. In contrast, most LTS competitor states have experienced increases in their number of Tech Fast 500 firms. The decrease in total number of Fast 500 companies located in Massachusetts appears to be attributed to several factors. Many of the state's fastest-growing companies have been tied to the telecommunications sector, which has been particularly hard hit by the economic downturn. Other companies have been acquisition targets, but are Massachusetts companies creating and selling their technologies, or have these companies moving out of state? More research should be done to further explore what is happening to high-tech companies headquartered in Massachusetts.

Resource Indicators

Resource Indicators

Critical resources include available workforce, technology, investment, and infrastructure. These resources are essential for productivity growth and are the foundation of the Innovation Economy. Private investment decisions and public policies affect the level and nature of available resources.

INDICATOR 19

Population Growth Rate, Unemployment Rate, and University Enrollments

Massachusetts has relatively low population growth rate and a relatively low unemployment rate among the LTS; Massachusetts public higher education institutions enrollments experience decrease from 1990 to 1999; private institutions increase but well below the national average

Why Is It Significant?

State population growth rates represent changes in demographics through the process of births, deaths, aging, and movement from state-to-state or to other countries. Population trends affect the pool of workers available as well as the pool of potential students. The unemployment rate is an important measure for the Innovation Economy. It is indicative of a state's ability to employ its residents in the economy, and of its untapped pool of potential workers. The quality and choices of postsecondary education institutions are important to a region in attracting the talent and skills of people both in-state and out-of-state. Students often choose to reside and work in a region where they received their degree.

How Does Massachusetts Perform?

From 1991 to 2001, Massachusetts experienced an average annual population growth rate of 0.6%, which was the third lowest among the LTS (Connecticut was the lowest at 0.4%, followed by New York at 0.5%). The nation's population grew at 1.2% annually during the same period. Among the LTS, Colorado had the highest average annual population growth rate of the LTS at 2.8%, followed by California at 1.3%.

In 2001, the Massachusetts unemployment rate was at 3.7%—the second-lowest unemployment rate among the other LTS and below the national average of 4.8%. Connecticut had the lowest unemployment rate of 3.3% during the same period. California had the highest rate among the LTS with 5.3%. From 2000 to 2001, all of the LTS and the nation experienced a marked increase in its unemployment rate as the economy slumped. The unemployment rate has continued to rise. As of September 2002, Massachusetts unemployment rate had climbed to 5.2%, and the U.S. was at 5.6%.

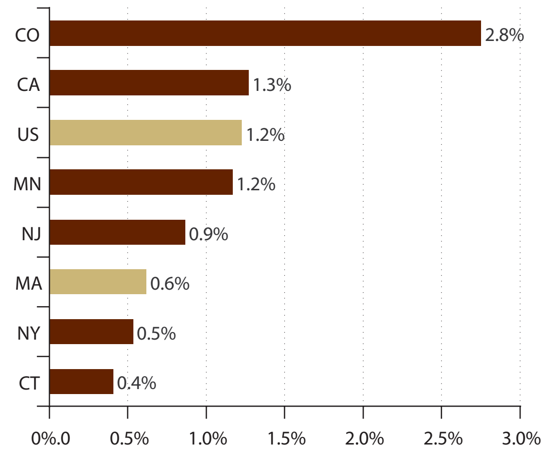
From 1990 to 1999, Massachusetts enrollments in public degree granting institutions had a decrease of 2.4%, one of 3 LTS to experience a decline (Connecticut and New York also declined at 11.6% and 8.2%, respectively). Among the LTS, Colorado had the highest increase at 9.4%, followed by California at 6.1%. The nation experienced a 4.3% increase during this period.

Private degree granting institutions enrollments in Massachusetts experienced a 2.8% increase from 1990 to 1999. The increase was, however, the second lowest percentage among the LTS. Only Connecticut was lower at 1.7%, and both Massachusetts and Connecticut were considerably below the national increase of 17.1%. Colorado and California experienced the largest increases in private institution enrollments during this period, growing at 59.8% and 51.8%, respectively. These two states have also lead the LTS in population growth rates over the past ten years.

What Does this Trend Mean for Massachusetts?

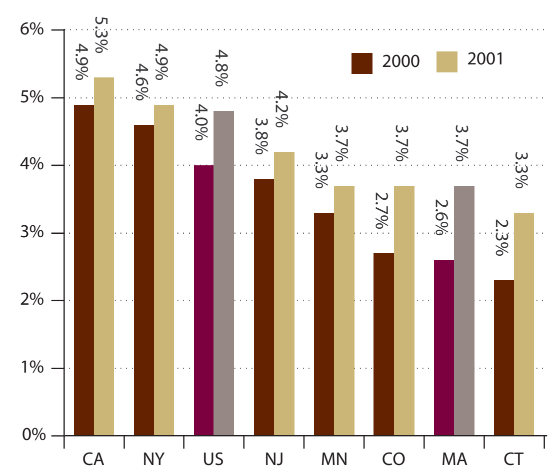
The Massachusetts population has been growing slowly for some time and is expected to do so for the foreseeable future. This trend has helped keep the unemployment rate relatively low, but has done so due to a smaller pool of workers, not job growth. This could hurt the state when the economic recovery occurs, especially if other states are not so constrained by a small labor pool. Also, since the majority of students in the state are Massachusetts residents, relatively slow population growth can be expected to have a negative impact on both public and private college and university enrollments overall in Massachusetts. If the state is to expand enrollments, it must encourage nontraditional students to attend college and/or actively recruit more students from other states.

Average annual population growth rate, Massachusetts, other LTS, and US, 1991-2001



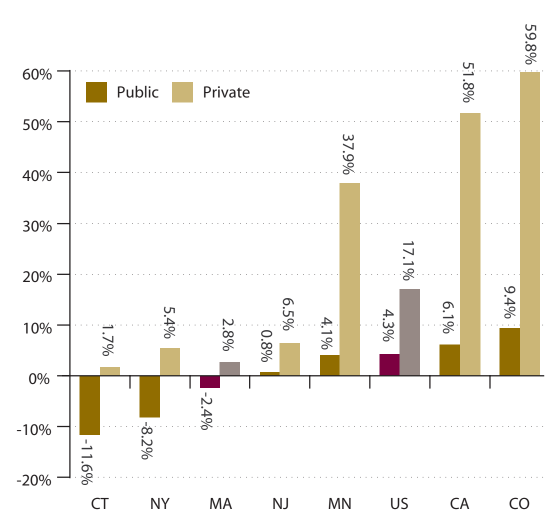
Source: U.S. Census Bureau

Unemployment rates, Massachusetts, other LTS, and US, 2000-2001



Source: Bureau of Labor Statistics

Percent change in total enrollment, public and private degree granting institutions, Massachusetts, other LTS, and US, 1990-1999



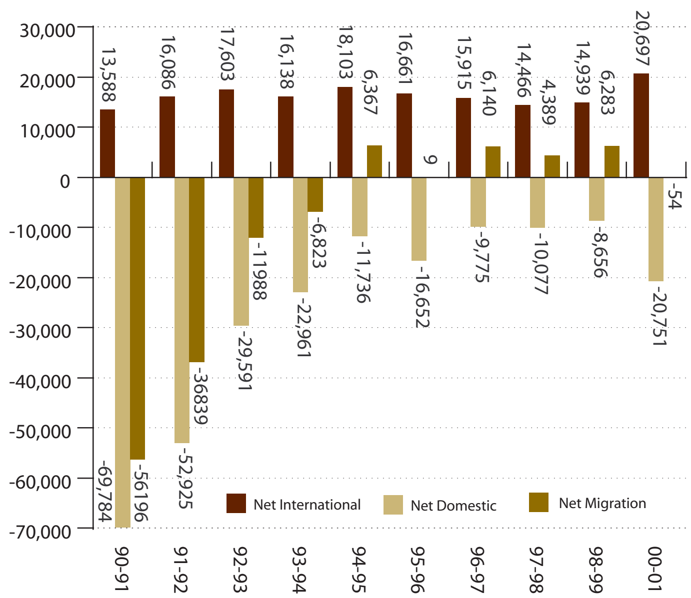
Source: National Center for Education Statistics

Indicator 20

Migration

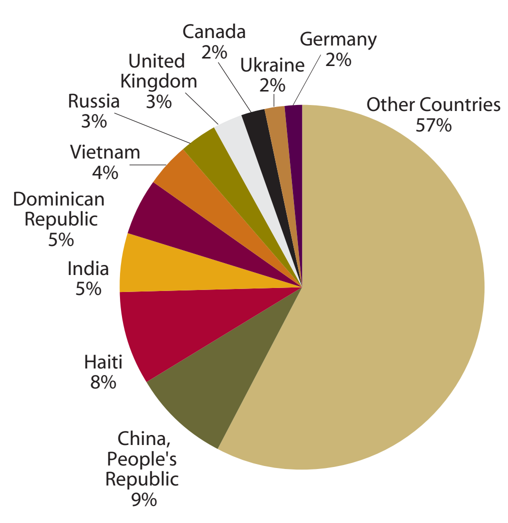
Massachusetts experiences a sharp increase in domestic out-migration in 2001; international in-migration continues to increase

International in-migration and domestic out-migration, Massachusetts, 1990-2001



Source: U.S. Census Bureau

Distribution of immigrants intending to reside in Massachusetts, 2000



Note: Portions may not sum to 100 % due to rounding
Source: Immigration and Naturalization Services

Why Is It Significant?

Labor force expansion can help to sustain the economic growth of a region as employers have a larger pool of workers from which to hire. Alternatively, labor shortfalls and high demands may constrain economic growth as employers experience staffing shortages, higher wages, or both. The immigrant population has been important to the Massachusetts Innovation Economy in providing an additional workforce pool for a state that is constrained by low population growth rates.

How Does Massachusetts Perform?

Each year from 1990 to 2001, Massachusetts has experienced domestic out-migration. In 2001, more than 20,000 moved from Massachusetts to other states, more than double the number in 2000 (8,656). Massachusetts international in-migration has offset some of the domestic out-migration from Massachusetts to other states. In 2001, just over 20,000 people moved into Massachusetts from other countries, an increase of 38.5% from the previous year (approximately 14,900 people).

In 2000, over 23,000 immigrants entering the U.S. indicated Massachusetts as their intended state of residence, which represented 2.8% of all immigrants coming to the U.S., and a 54.7% increase from the year before (15,180) for the state. Immigrants from The People's Republic of China had the highest percentage intending to reside in Massachusetts with 9%, followed by Haiti (8%), India and the Dominican Republic (each at 5%). In 2000, 25.6% of immigrants that came to the U.S. intended on residing in California, which was the highest among the LTS, followed by New York (12.5%).

What Does this Trend Mean for Massachusetts?

Out-migration from the state further constrains the available labor pool already affected by relatively slow population growth in Massachusetts. The results of a May 2002 University of Massachusetts Donahue Institute poll showed nearly one in three Massachusetts residents would seriously consider leaving the state if economic conditions worsened. And a recent study by MassINC indicated that significant numbers of those leaving the state are college-educated and relatively young workers. To remain a leader in the Innovation Economy, the state cannot afford to have large numbers of well-educated, highly-skilled workers exiting to other regions. Research and policies to help retain those key individuals should be explored.

International in-migration has helped Massachusetts offset the thousands who have left the state. Immigration has also been a huge contributor to the U.S. high-tech workforce; in 1999, 1 in 5 employed scientists and engineers with a PhD in the U.S. were non-U.S. citizens. Massachusetts companies are heavy users of the H1-B visa program to fill many jobs in the Innovation Economy, and are dependent on having a favorable federal policy that allows foreign talent to work in the state. There are also many immigrants with little or no education and limited skills who are in need of education and training. Further study of what factors impact both out-migration and immigration—availability of jobs, climate, costs of living trends (housing costs)—needs to be conducted. More work also needs to be done on finding ways to retain current state residents.

Indicator 21

Workforce Education

Massachusetts has lowest per capita state appropriations to operational expenses at public universities among the LTS; Massachusetts has highest average private college and university tuition among the LTS

Why Is It Significant?

The levels of higher education spending show a region's commitment to investments in all levels of public higher education, from four-year public universities to community and technical colleges. The educational attainment levels of the workforce are a fundamental indicator of how well a region can generate and support knowledge-based, innovation-driven economic growth. Education levels reflect labor force quality, which is important to prospective employers.

How Does Massachusetts Perform?

Over the past ten years, Massachusetts appropriations to public universities have increased over 70%, which is the highest percent increase when compared to the LTS during this period.

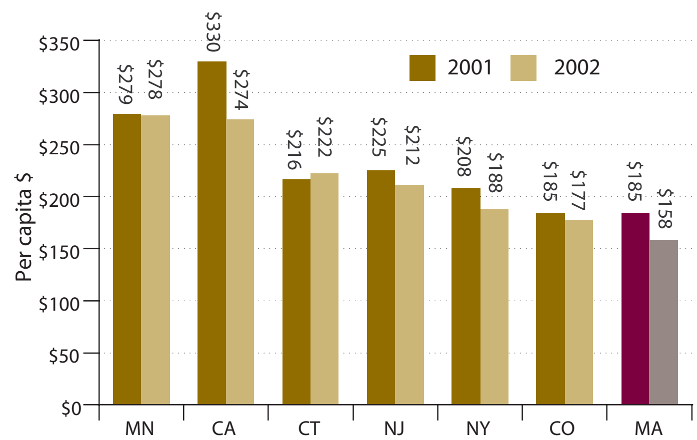
Massachusetts, however, ranked last among the LTS in FY2002, with appropriations of $158 per capita towards public higher education expenditures, a decrease of 14.6% from the previous fiscal year. Connecticut was the only LTS to have an increase (2.8%) in public university expenditures from FY2001 to FY2002. Minnesota ranked first among the LTS in FY2002 at $278, followed by California at $274.

In the 1999-2000 academic year, Massachusetts average tuition at private four-year institutions was $20,098, the highest tuition among the LTS and 26.9% above the national average ($14,690). Connecticut was second at $19,783, followed by New York at $16,596. From 1998-1999 to 1999-2000, Massachusetts average private tuition increased 5.1%, which was the third highest percent increase among the LTS. Colorado had the lowest average private tuition at $13,334. For public four-year institutions in the LTS, New Jersey had the highest in-state tuition at $5,255 from 1999 to 2000. Massachusetts was third at $4,105, while California had the lowest public institution tuition at $2,559. California (2.2%) and Minnesota (0.9%) were LTS that had percent decreases in average tuition costs at public four-year institutions from 1998-1999 to 1999-2000.

What Does this Trend Mean for Massachusetts?

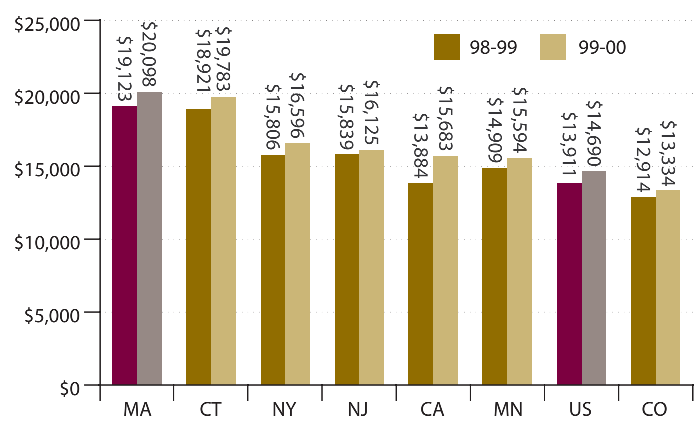
Massachusetts has a relatively large number of private college and university options for students (over 90 institutions). This, however, does not negate the importance of a strong, affordable public college and university system in the state. Well-educated workers are one of the state's competitive strengths, and the state should strive to help all individuals reach their full potential. A strong public sector should provide viable higher education alternatives to private schools, and help bolster the workforce for the Innovation Economy.

Appropriations of state/local tax funds for operational expenses of public higher education per capita, Massachusetts and other LTS, fiscal year 2001 and 2002



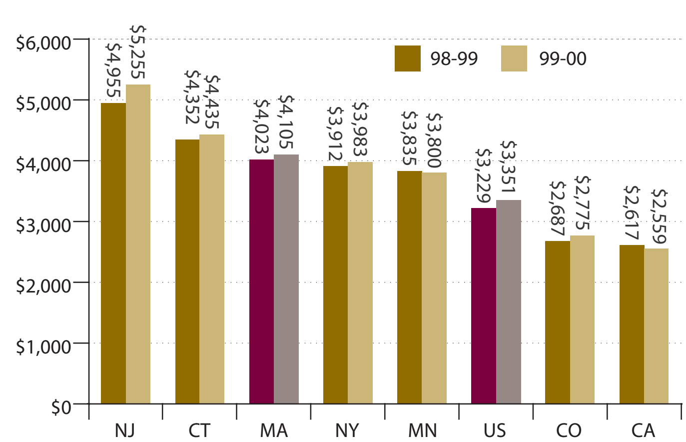
Source: Grapevine Center for Higher Education

Average four-year tuition at private colleges and universities, Massachusetts, other LTS, and US, 1998-1999 to 1999-2000



Source: U.S. Department of Education

Average four-year tuition at public colleges and universities, Massachusetts, other LTS, and US, 1998-1999 to 1999-2000



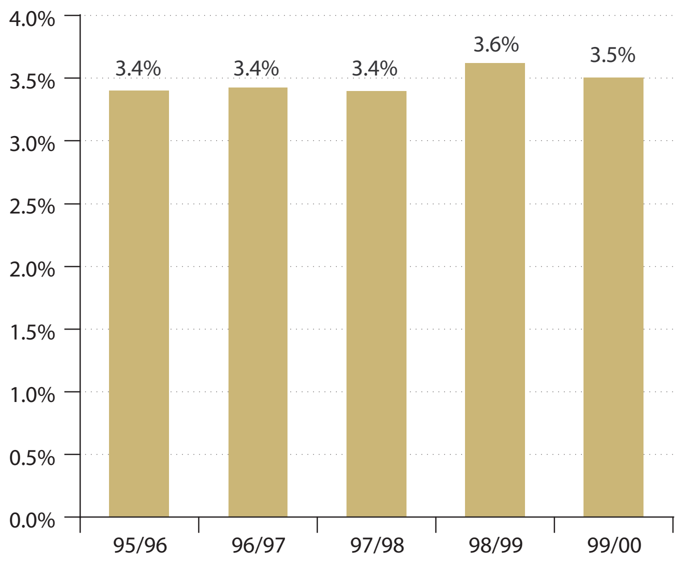
Source: U.S. Department of Education

Indicator 22

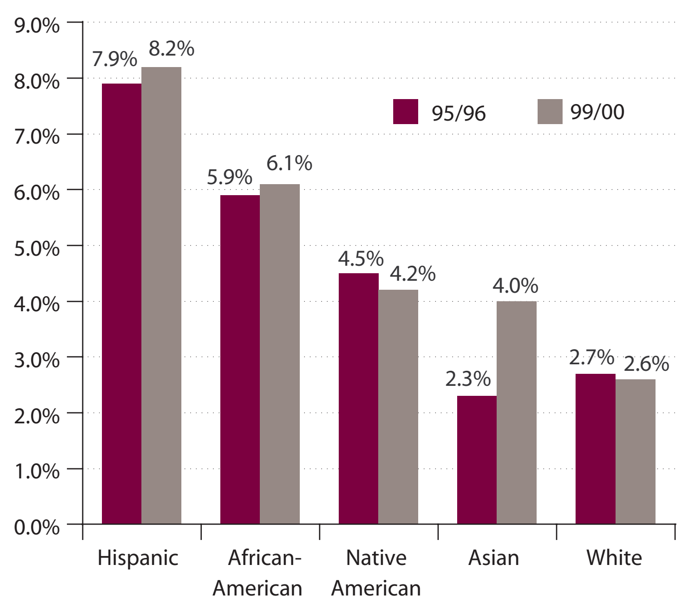
High School Dropout Rates

Although Massachusetts overall dropout rate decreases from 1999-2000, several ethnic groups experience increase in dropout rate

High school dropout rate, Massachusetts, 1995-1996 through 1999-2000



Percentage of students who dropped out of high school by race/ethnicity, Massachusetts, 1995-1996 and 1999-2000



Source of all data for this indicator: Massachusetts Department of Education

Why Is It Significant?

Almost all jobs require a minimum of a high-school degree. The high school dropout rate is a risk indicator that warns of lost potential and of children being left behind in the educational system. Focusing on decreasing the high school dropout rate is one way to further develop human resources, which is critical in Massachusetts because of slow labor force growth.

How Does Massachusetts Perform?

The annual dropout rate in Massachusetts was 3.5% for high school students from 1999-2000, a 2.8% decrease from 1998-1999. (The annual rate means that 3.5% of students enrolled in grades 9-12 in the state's public schools in the fall of 1999 did not return by October 1, 2000 for reasons other than transfer.)

Dropout rates vary across race and ethnicity. White students, at a 2.6% annual rate, were the least likely to dropout in Massachusetts from 1999-2000. Other racial and ethnic groups, however, are at significantly higher risk. The dropout rate for Hispanic students was at 8.2% and African-American students had a 6.1% dropout rate. Asian students experienced the highest increase, from 2.3% in 1995-1996 to 4.0% in 1999-2000, a 74% increase. Native American students experienced a decrease in its dropout rate for the same time period (4.5% to 4.2%).

What Does This Trend Mean for Massachusetts?

The state's ability to maintain a low and steady total high school dropout rate is commendable, but dropout rates for minority students in Massachusetts remain a critical issue. Massachusetts should continue to encourage all young people to obtain their high school degree, at a minimum. Because education is vital to economic and social mobility, the state should work in partnership with local educators, community groups, and businesses to foster programs that help all individuals graduate from high school and obtain the skill sets that they need to succeed in the Innovation Economy. It is also important for the state to focus attention on the diverse experiences of racial/ethnic groups, including the relatively high Hispanic and African-American dropout rate, and the rising Asian dropout rate.

Indicator 23

Engineering and Computer Science Degrees; Scientists and Engineers in the Labor Force

Massachusetts has highest percentage of scientists and engineers in its workforce compared to the LTS; state experiences slight increase in total number of engineering degrees granted in 2001; state sees increase in total number of computer science degrees granted from 1998 to 2000

Why Is It Significant?

Regions that are well-served by postsecondary engineering and computer science programs have a strong workforce advantage in the creation of new products and ideas. The potential pool of new engineers and computer scientists for technology-related industries is an important indicator of future workforce resources.

How Does Massachusetts Perform?

In 1999, 0.91% of Massachusetts total labor force was comprised of scientists and engineers, the highest percentage among the LTS, and double the national average (0.45%). Connecticut was second with 0.64%, followed by Colorado at 0.60%. The scientists and engineers number constitutes only those that hold a doctorate degree.

Massachusetts experienced a 0.4% increase in total number of engineering degrees awarded in 2001, from 4,512 in 2000 to 4,528 in 2001. The state's increase lagged the U.S. increase of 3.3%. At the undergraduate level, the number of degrees awarded by Massachusetts schools experienced a decrease of 2.2% from 2000 to 2001 (2,437 to 2,384). Nationally, undergraduate engineering degrees increased 2.5% during the same period. At the graduate level, the number of master's engineering degrees awarded by Massachusetts institutions increased 2.1% from 2000 to 2001, but was less than the national increase of 5.1%. The total number of engineering PhD degrees awarded in Massachusetts increased by 9.7%, outpacing the 3.6% increase experienced nationwide.

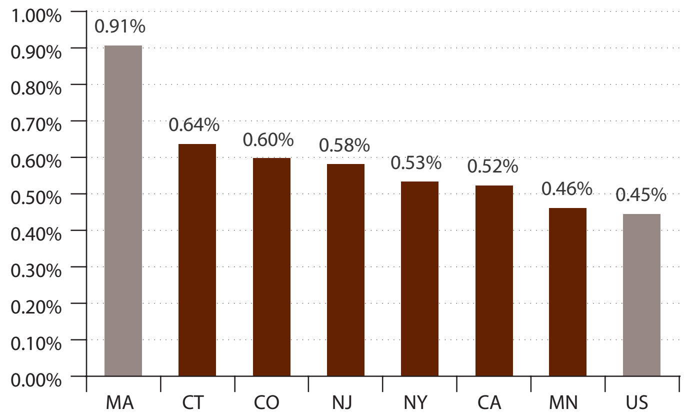
The total number of computer science degrees in Massachusetts increased by 34.1% from 1998 to 2000 (1,414 to 1,896). The total number of undergraduate degrees awarded by Massachusetts institutions increased 32.4% between 1998 and 2000. At the graduate level, there was a significant increase in the total number of master's degrees (44.2%) in 2000, compared to the previous year's increase of 15.6%. There was a sizeable decrease in the total number of doctorate degrees awarded in Massachusetts (29.5%) from 1998 to 2000.

What Does this Trend Mean for Massachusetts?

The fields of engineering and computer and information science play an important role in the growth of the Innovation Economy. Massachusetts experienced an increase in total number of computer and information science degrees granted from 1998 to 2000, which is a positive sign. Individuals with computer and information science skills are sought by many of the key industry clusters in the Innovation Economy. Although the total number of engineering degrees granted in Massachusetts experienced a small increase from 2000 to 2001, the number of bachelor's degrees awarded in the state decreased, while the U.S. total increased during the same period. Universities, state government, and the private sector should continue to support programs that encourage more young people to enter and complete these programs.

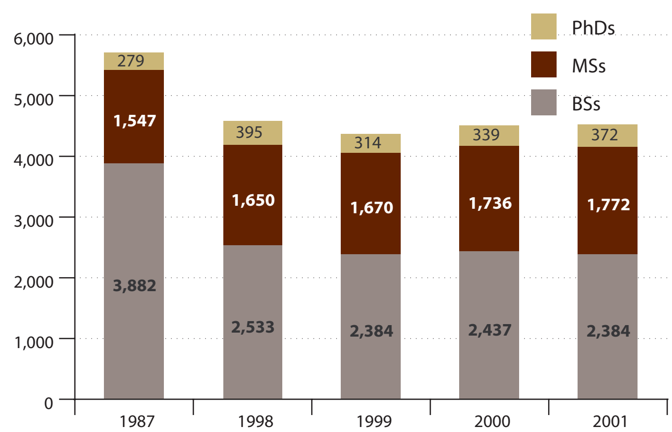
A labor force with a strong number of scientists and engineers in Massachusetts is good for the Innovation Economy. However, the decreases in the total number of doctorate degrees awarded in computer science and the total number of bachelor degrees awarded in engineering in Massachusetts are areas of concern if the state is to remain a leader.

Scientists and engineers as a percent of the total labor force, Massachusetts, other LTS, and US, 1999



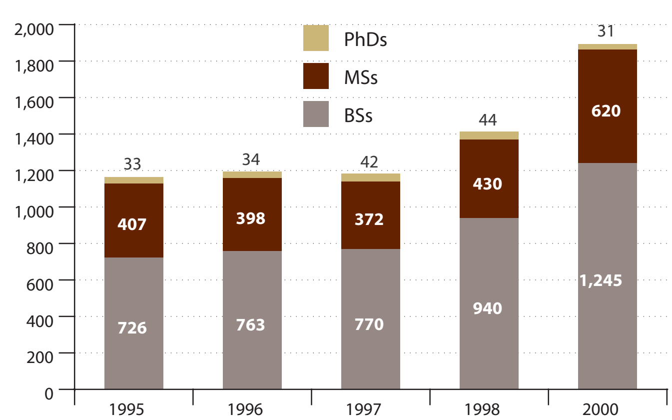
Source: National Science Foundation and Bureau of Labor and Statistics

Number of engineering degrees awarded by Massachusetts schools, by degree level, 1987, 1998-2001



Source: American Association of Engineering Societies

Number of computer and information science degrees awarded by Massachusetts schools, by degree level, 1995-1998, and 2000



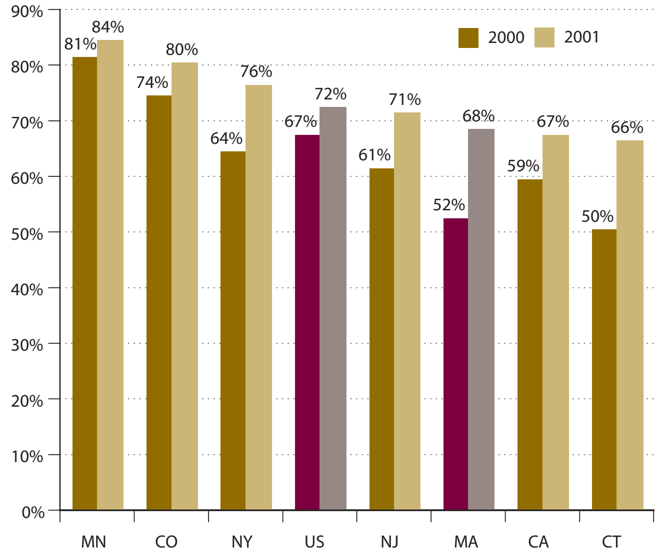
Source: National Science Foundation

Indicator 24

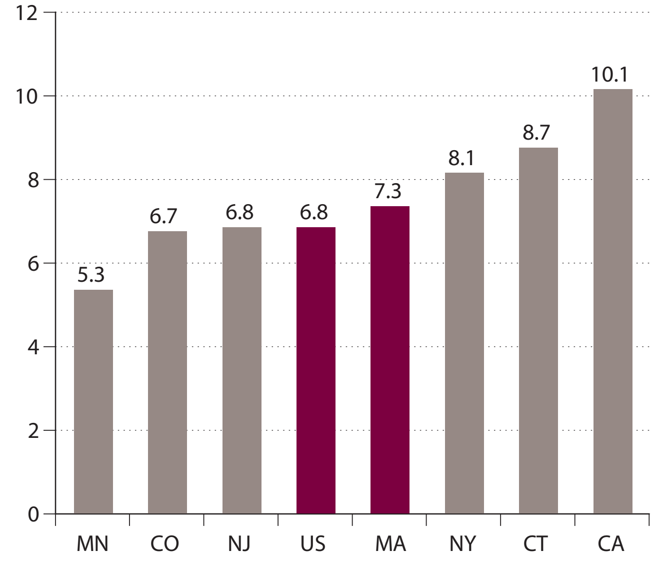
Computers in Education

Number of Massachusetts K-8th grade students per Internet connected computer was above the US average and several LTS in 2001; state makes gains in increasing high-speed connectivity to schools from 2000 to 2001

Percentage of schools that access the Internet through a high-speed connection (T1, T3, digital satellite, cable modem), Massachusetts, other LTS, and US, 2000 and 2001



Students per Internet-connected computer, Massachusetts, other LTS, and US, 2001



Source of all data for this indicator: Education Week

Why Is It Significant?

Access to computers and the Internet in classrooms allows children to develop computer skills at an early age. Students who work with computers will acquire important technical expertise and an understanding of the Innovation Economy, and be better prepared for higher education and jobs. The Internet is also a valuable tool in learning, for it provides immediate access to many kinds of information and data to the classroom. Schools that have 'broadband' access to the Internet (high-speed connection that allows large amounts of video and data to be transmitted in two directions) benefit from faster transmissions of information, thus allowing the Internet to become a more accessible tool for education.

How Does Massachusetts Perform?

In 2001, 68% of Massachusetts K-8th grade schools accessed the Internet through a high-speed connection (T1, T3, digital or cable modem), a significant increase from the previous year (52%). Nevertheless, Massachusetts had the third lowest percentage among the LTS in 2001. Minnesota ranked first with 84% of its schools accessing the Internet through a high-speed connection, followed by Colorado at 80%. Connecticut had 66% of its schools with Internet connectivity through a high-speed connection, which was the lowest percentage among the LTS.

A lower ratio of students to an Internet-connected computer makes hands-on, instructional learning and retrieval of information more accessible to students. In Massachusetts, there was one Internet-connected computer for every 7.3 students in 2001, which was higher than the U.S. average of one computer per 6.8 students. Among the LTS, Minnesota had the best ratio, with 5.3 students per Internet-connected computer, followed by Colorado and New Jersey at 6.7 and 6.8, respectively. California had the highest ratio among the LTS at 10.1 students per Internet-connected computer.

What Does this Trend Mean for Massachusetts?

Massachusetts should be a leader in this indicator. Although Massachusetts did show significant gains in providing high-speed Internet connections to schools, the state continues to lag most of the LTS in this area. There is a strong correlation between broadband access and using the Internet in the classroom for information-gathering and use in instruction. A lower student-to-computer ratio allows for more applied computer and learning experience by a student, and helps provide the student with the technical tools for the Innovation Economy. The state should strive to lower the student-to-computer ratio in K-12 schools. It should also encourage more industry-academic partnerships in the state to bolster more resources for educators and schools, such as additional computers, software, and IT training.

Indicator 25
Student Interest in Engineering and Science

Massachusetts students show increased interest in pursuing the fields of engineering, but in fields of science, Massachusetts rank drops compared to the LTS

Why Is It Important?

Postsecondary education is a minimum requirement for many jobs in innovative-based companies. The fields of engineering, science, and Information Technology (IT) are especially important to the growth of the Innovation Economy. Most colleges and universities require the Scholastic Aptitude Test (SAT) as part of the admissions requirement. The profile of intended majors of college-bound seniors who take the SAT is an important indicator of the interests that high school students have in those fields that are important to the Innovation Economy.

How Does Massachusetts Perform?

In 2001, of those Massachusetts high school students taking the SAT, 7% indicated an intention to major in engineering in college, compared to 6% in 1999. Among the LTS, only Massachusetts and California experienced an increase from 1999 to 2001. Minnesota and Colorado students ranked highest among the LTS, each with 11% of students intending to major in engineering. Minnesota and New York each experienced a small drop in percentage of students intending to major in engineering from 1999 to 2001. In 2001, 31% of all high school students in the U.S. intending to major in engineering were from Massachusetts and the six other LTS.

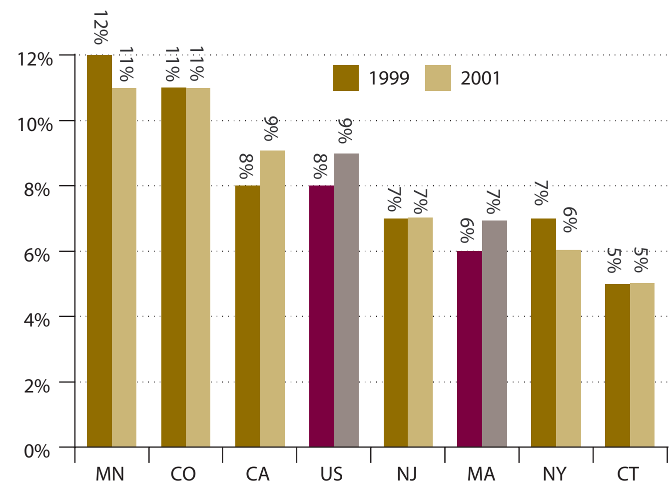
Massachusetts students interested in majoring in the sciences in college (which include: Biological Sciences, Computer or Information Science, Mathematics, and Physical Sciences) was at 13% in 2001, the same as in 1999. Most of the LTS experienced a one or two percentage point increase in students intending to major in the sciences. In 2001, 36% of all high school students in the U.S. intending to major in the sciences were from Massachusetts and the other LTS.

The other most popular intended majors of Massachusetts students taking the SAT in 2001 included Business & Commerce (15%), Health and Allied Services (11%), Social Sciences and History (11%), and Education (8%).

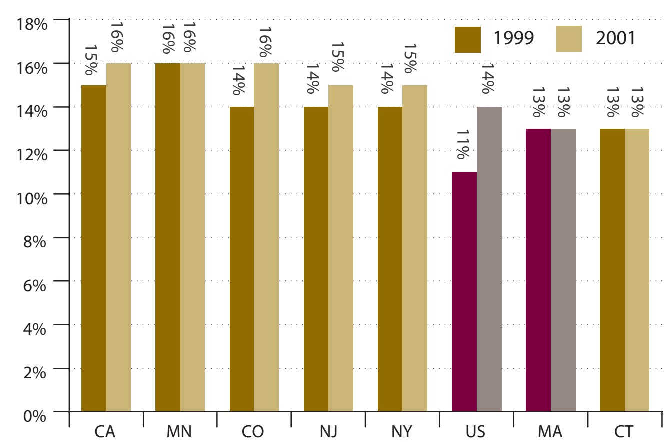
What Does This Trend Mean for Massachusetts?

From 1999 to 2001, Massachusetts experienced an increase in students interested in pursuing an engineering major in college; it is encouraging that a greater number of Massachusetts students want to study this field which is critical to the Innovation Economy. However, the percent of students interested in studying in the sciences remains unchanged over the past few years, and is one of the lowest percentages when compared to the LTS. The relatively small percentage suggests the need to bolster more interest in science fields. The need for scientific and technical workers in the state is expected to continue, as shown by the growth of the Life Sciences cluster. More emphasis should be placed on science and mathematics in grades K-12 to increase students' interest in these subjects. In addition, partnerships between business and academia, such as summer internships and scholarship offerings, can help build awareness of the importance of, and jobs requiring, technical and scientific skills in the Innovation Economy.

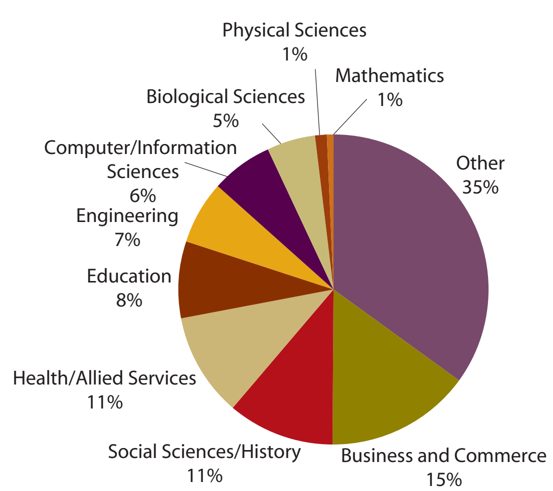
Percentage of students taking the SAT I intending to major in Engineering, Massachusetts, other LTS, and US, 1999 and 2001



Percentage of students taking the SAT I intending to major in the Sciences, Massachusetts, other LTS, and US, 1999 and 2001



Distribution of intended college majors, Massachusetts students taking the SAT, 2001



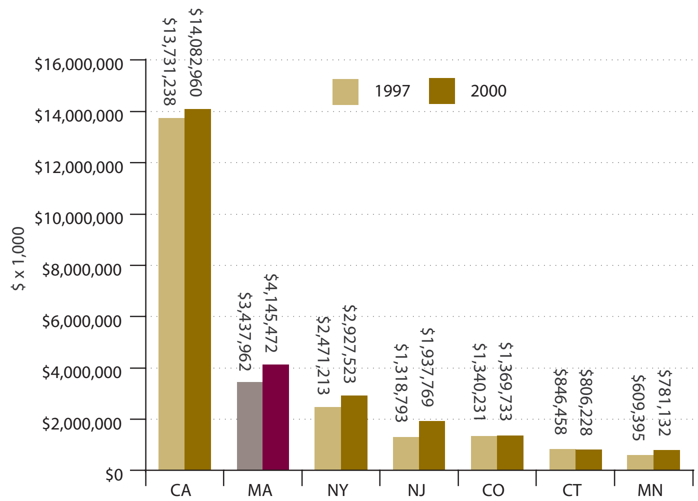
Note: Portions may not sum to 100 % due to rounding

Source of all data for this indicator: College Board Online

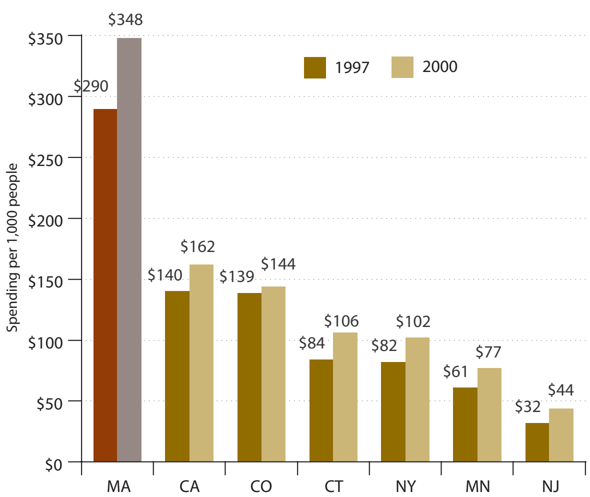
Resource Indicators

Technology Resources

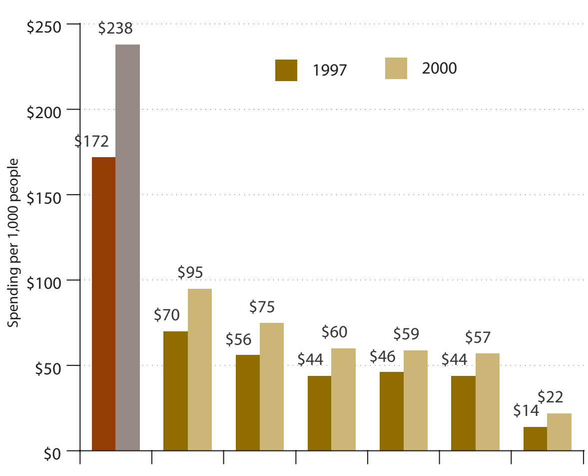
Total federal R&D expenditures in academic and nonprofit research institutions, Massachusetts and other LTS, 1997 and 2000



Federal R&D expenditures in academic and nonprofit research institutions per 1,000 people, Massachusetts and other LTS, 1997 and 2000 (2000 $ inflation adjusted)



US Department of Health and Human Services R&D expenditures, per 1,000 people, Massachusetts and other LTS, 1997 and 2000 ($2000 inflation adjusted)



Source of all the data for this indicator: National Science Foundation

Indicator 26

Federal R&D Spending and Health R&D Spending

Massachusetts ranks first among the LTS in per capita federal R&D expenditures

Why Is It Significant?

Research universities and other non-profit research institutions are pivotal in the Massachusetts economy, and federal research and development (R&D) spending is a primary source of their funding. R&D conducted by academic institutions also has a pronounced inducement effect in stimulating private sector R&D investments.

The National Institutes of Health (NIH) is the major funder of health-related research in the United States. It is the largest source of federal funding for non-defense research. NIH-funded research is a critical driver for Massachusetts biotechnology, medical device, and health services industries. More than 95% of the U.S. Department of Health and Human Services (HHS) R&D expenditures occurs through the NIH.

How Does Massachusetts Perform?

In absolute dollars, Massachusetts universities, academic health centers, and nonprofit research institutions received a total of over $4 billion in federal R&D expenditures in 2000, which was second only to California (approximately $14 billion) when compared to the LTS. From 1997 to 2000, total Massachusetts R&D dollars increased 20.3%, which was behind New Jersey (46.9%) and Minnesota (28.2%). Connecticut was the only LTS to experience a drop in federal R&D expenditures (4.8%) for the same period.

On a per capita basis, Massachusetts universities, academic health centers, and nonprofit research institutions had the highest federally-funded R&D expenditures ($348) of the LTS in 2000. The next closest LTS, California, was at less than half that amount ($162). Total federal R&D spending in these Massachusetts institutions was $2.2 billion in 2000, placing the state second among the LTS in absolute R&D spending (California ranked first in total R&D spending with $5.5 billion).

From 1997 to 2000, per capita federally-funded R&D expenditures at Massachusetts academic institutions increased 20.0%. Among the LTS, New Jersey experienced the largest increase at 37.5%, followed by Connecticut and Minnesota, each at 26.2%. Colorado had the smallest increase at 3.7%, and was the only LTS not to have a double-digit percent increase during this period.

In the field of health, Massachusetts had the highest per capita federally-funded R&D expenditures ($238) of the LTS in 2000. The state's health-related funding is more than double the next closest LTS, Connecticut ($95). Since 1993, total health R&D funding for Massachusetts has increased a total of 77.4%, second only to New Jersey (93.3%). From 1997 to 2000, HHS funding per capita for Massachusetts increased 38.4%, second only to New Jersey at 57.1%. Total federal healthcare R&D expenditures in Massachusetts were approximately $1.5 billion in 2000, placing the state second among the LTS in total federal healthcare R&D funding (California ranked first with just over $2.0 billion).

What Does this Trend Mean for Massachusetts?

Massachusetts continues to do well in attracting federal R&D funding. Strong R&D dollars reflects the collaborative effort taking place between the federal government and research institutions within the state. The high levels of health R&D expenditures attracted by Massachusetts institutions have contributed to the growth and strength of the Life Sciences cluster in the region. However, the state is vulnerable to funding changes in Washington, and it should be mindful that other states are gaining on Massachusetts. These are two areas that need to be monitored so that the state can maintain healthy levels of federal investment dollars for the long term.

Indicator 27

Corporate R&D per Employee

Massachusetts continues to have steady increase of corporate R&D spending in the knowledge-intensive key industry clusters

Why Is It Significant?

Corporate research and development (R&D) spending is an important indicator of how Massachusetts companies are investing in the future. Nationally, the private sector provides about $2 out of every $3 invested in R&D. R&D is essential for developing new products and services that help companies stay on the cutting edge, grow, and produce more jobs.

How Does Massachusetts Perform?

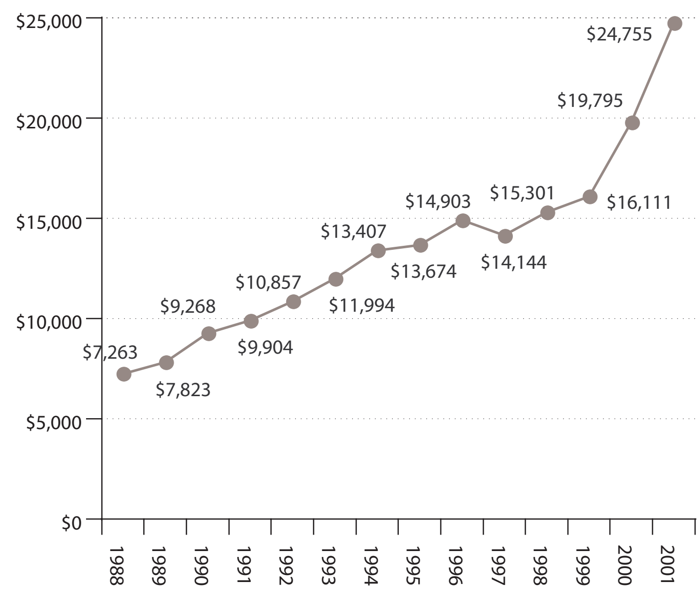
From 2000 to 2001, corporate R&D spending per employee rose 25.1% among Massachusetts publicly traded firms. Between 1988 and 2001, Massachusetts corporate R&D spending per employee has increased an at average annual rate of 9.2%.

Massachusetts key industry clusters posted significant levels of R&D per employee in 2001. The Healthcare Technology cluster had the highest R&D per employee at $47,827 per employee. Software & Communications Services ($44,974), Computers & Communications Hardware ($41,263), and Innovation Services ($36,410) also had relatively high levels of R&D investment per employee during this period.

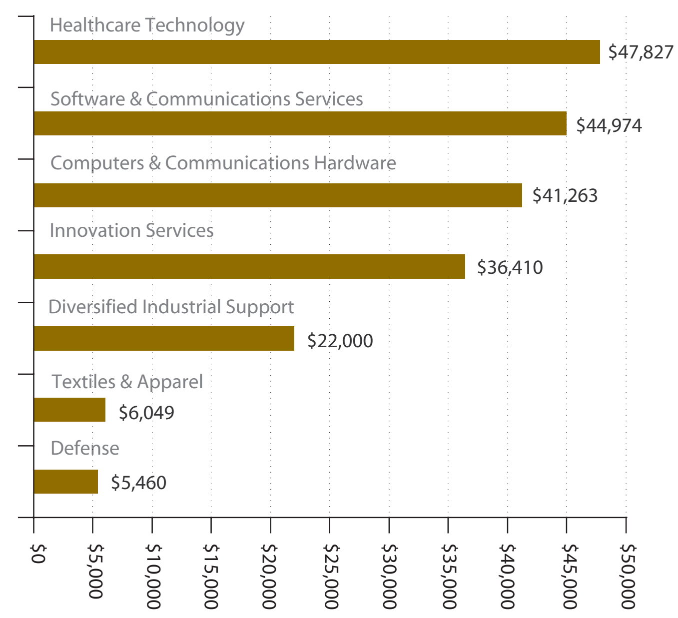
What Does this Trend Mean for Massachusetts?

R&D fuels the development of new technologies, goods, and services in the Innovation Economy. Since 1997, total corporate R&D dollars has been increasing in Massachusetts companies, even with decreases in total employment at these firms. The higher levels of corporate R&D investment by Massachusetts companies shows commitment to innovation and the development of new products and services for the state's economy. Massachusetts should continue policies that encourage corporate investment in R&D.

R&D expenses per employee for Massachusetts publicly-traded companies, 1988-2001 (unadjusted)



Corporate R&D per employee by industry cluster, publicly-traded companies with R&D expenditures, Massachusetts, 2001

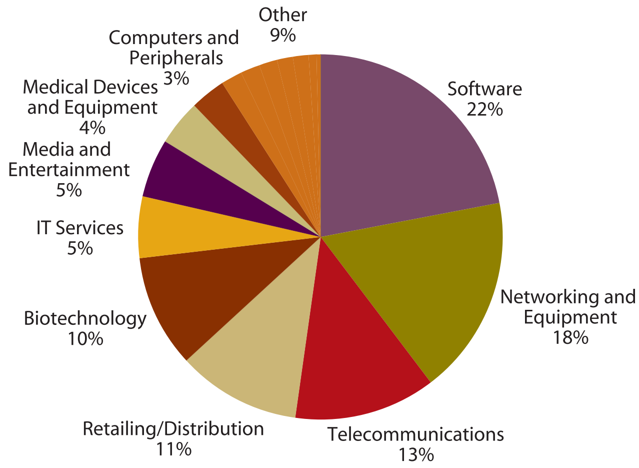


Source of all data for this indicator: Standard & Poor's

Indicator 28

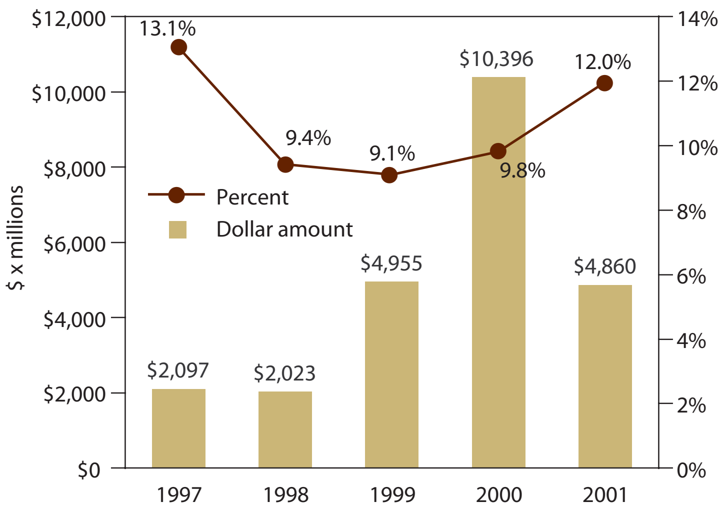
Venture Capital Although state's venture capital funding drops over 50% in 2001, returning to approximately 1999 levels, Massachusetts share of venture capital dollars awarded in US rises

Distribution of venture capital investments, Massachusetts, 2001



Note: Portions may not sum to 100 % due to rounding

Venture capital investments received by companies and as percent of total US venture capital investments, Massachusetts, 1997-2001



Source of all data for this indicator: PricewaterhouseCoopers LLP, Venture Economics, and National Venture Capital Association Money Tree Survey

Why Is It Significant?

Venture capital is one of the main sources of funding used to grow new companies. (Other sources include personal savings; investments by family, friends, private and individual investors; and short-term debt, including credit cards.) The amount of venture capital invested and the industries supported by it are predictors of new products and services, job creation, and revenue growth in a region.

How Does Massachusetts Perform?

After a record-making year in 2000, 2001 was a tough year in terms of attracting venture capital funding for Massachusetts and the other LTS. Several factors contributed to this outcome, including the breakdown of the "dot.com" and telecommunications marketplace and slowdown in economic growth in the U.S. The amount of venture capital received by Massachusetts companies reached approximately $4.9 billion in 2001, a decrease of more than 50% from 2000 ($10.4 billion). California led the LTS in venture capital investments, receiving over $16 billion in 2001, which is a decrease of 62% from the previous year ($44 billion). Among the LTS, New York and Connecticut each had a 70% decrease in total venture capital from 2000 to 2001. Massachusetts received 12.0% of the total venture capital dollars invested in the United States in 2001, up from 9.8% in 2000.

During the first two quarters of 2002, Massachusetts received approximately $1.4 billion in venture capital funding, which was 12.0% of the U.S. total (approximately $12.1 billion). In Massachusetts, the Software and Biotechnology sectors attracted the highest amounts of venture capital in the first two quarters of 2002, with a 43% total share ($340 million and $288 million, respectively) of the state's venture capital funding during this time. Telecommunications was third with 14% ($199 million), followed by Networking with 10% ($137 million).

Massachusetts continues to attract one of the largest shares of venture capital investments when compared to the LTS. The state has consistently ranked second to California in total amount of venture capital investments since 1995. During the first two quarters of 2002, Massachusetts and the six other LTS attracted more than two-thirds of all venture capital investments in the U.S.

What Does this Trend Mean for Massachusetts?

Venture financing is an important source of funding for next generation firms in the Innovation Economy. Although Massachusetts experienced a decrease in total venture capital investments from 2000 to 2001, the state continues to have a strong relative performance overall. Massachusetts share of U.S. venture capital funding has increased since 1999, and the state continues to rank second only to California in total venture capital investments. The diverse investment portfolio represented by venture-financed companies in Massachusetts is evidence that venture capitalists continue to view the state as a promising source of companies for the future. The state's significant number of venture capital firms and professional services support is indicative of the state's role as a creator and exporter of innovation, and encouraging local entrepreneurs to bring their ideas and concepts to the marketplace. Over the long term, venture capital is vital to the Massachusetts Innovation Economy, and the state should continue to strive to attract venture capital investments.

INDICATOR 29

Broadband More than half of Massachusetts homes have Internet access; national study finds Massachusetts second among LTS for best states to do e-commerce

Why Is It Significant?

Internet access is an indicator of a region's growing use of computers and its technologies. The percent of households connected to the Internet shows the public's interest in using computers and integrating Internet services, such as online commerce and e-government services, into their homes.

How Does Massachusetts Perform?

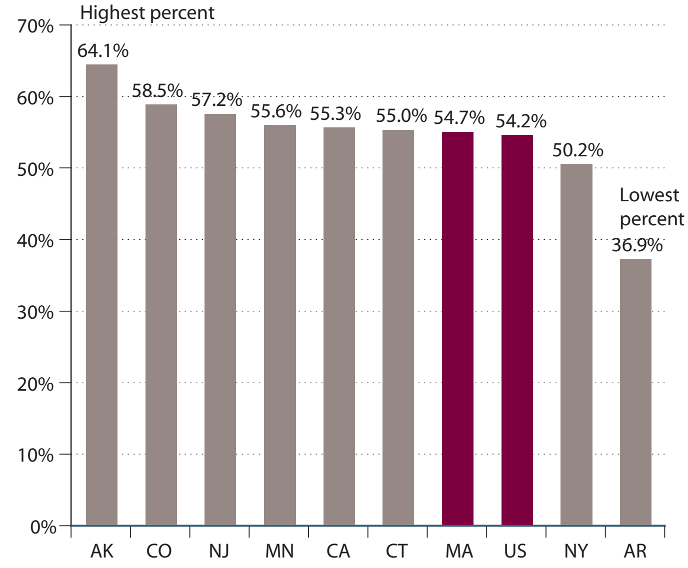
In 2001, 54.7% of Massachusetts homes had Internet access, which was higher than the U.S. average of 54.2%, but the second lowest when compared to the LTS. Colorado had the highest percent of its households with Internet access at 58.5%, followed by New Jersey at 57.2%. Alaska with 64.1% and Arkansas with 36.9% (neither are LTS) represented the highest and lowest percents of households with Internet access.

The Progressive Policy Institute (PPI) measured how state laws, regulations, and administrative actions support or hinder Internet use by Americans. PPI gave a numeric score to each state government based on its policies that allowed its community to take advantage of the Internet, which included: the ability to make purchases of certain categories of goods and services, engage in legally binding transactions, and interact with government online. In the PPI report, a higher number ranking indicates a state's strengths in making Internet transactions and business easier for citizens to use; a lower number ranking denotes a relative weakness. In 2002, Massachusetts ranked second among the LTS for best states to do e-commerce, with an overall score of 11.1. Colorado was first at 12.4, and California was last among the LTS with 5.8. Oregon ranked first in the U.S. with a score of 16.6, while South Carolina ranked last with a score of 3.1 (neither are LTS).

What Does This Trend Mean for Massachusetts?

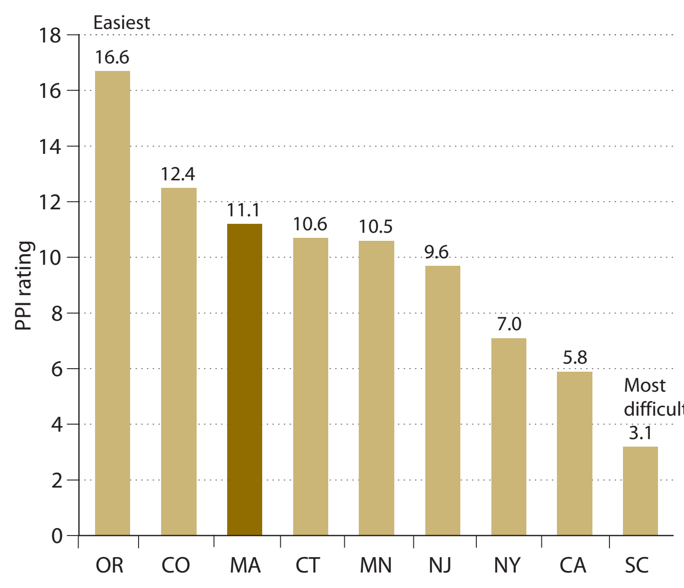
Massachusetts should strive to be a leader in homes with Internet access, particularly since Massachusetts is considered one of the easiest states for e-commerce activities. Massachusetts government should also look to expand its e-commerce offerings and online transaction capabilities (e.g., Department of Motor Vehicles) in order to be a national leader.

Percent of homes with Internet access,Massachusetts, other LTS, Alaska, and Arkansas, and US average, 2001



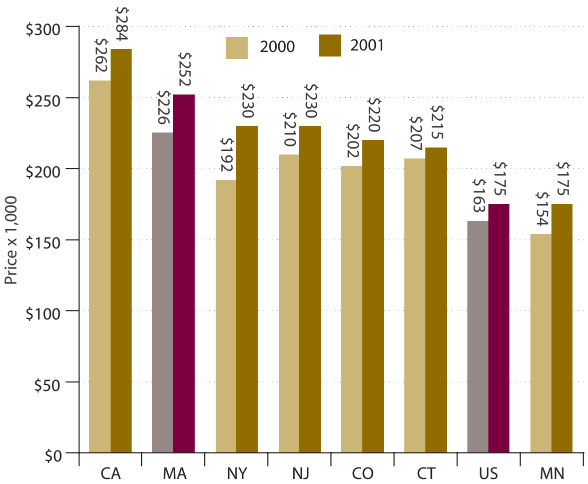
Source: Department of Commerce

Easiest and most difficult states for Internet users, Massachusetts, other LTS, Oregon, and South Carolina, 2002



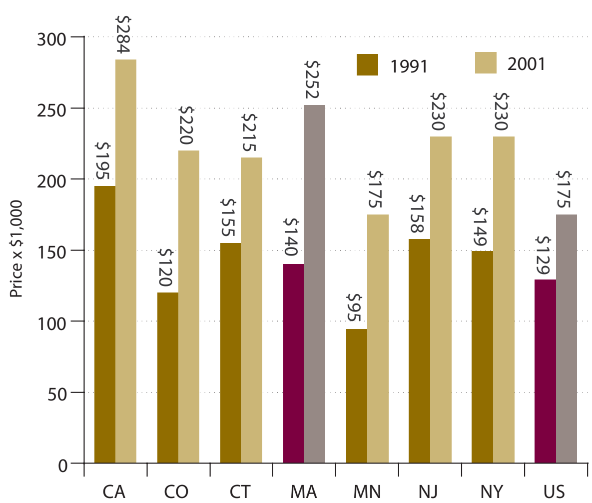
Source: Progressive Policy Institute (PPI)

Median price of single-family homes, Massachusetts, other LTS, and US, 2000 and 2001



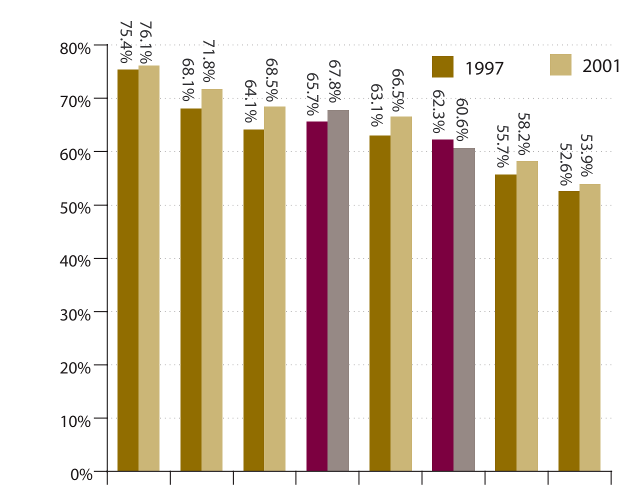
Source: Federal Housing Finance Board

Median price of single-family homes, Massachusetts, other LTS, and US, 1991 and 2001



Source: Federal Housing Finance Board

Home ownership rates, Massachusetts, other LTS, and US, 1997 and 2001



Source: U.S. Census Bureau

Indicator 30

Median Price of Single-Family Homes and Home Ownership Rates

Massachusetts continues to have second highest single-family home price compared to LTS; home ownership rate in state increases from 2000 to 2001

Why Is It Significant?

The availability and affordability of homes is a top indicator of maintaining a strong quality of life for a region. Affordable housing can help to attract and retain the often-mobile, highly-skilled workforce. Home ownership rates are also a bellwether for a state's economy, since it indicates willingness of the population to live in the state over the long term.

How Does Massachusetts Perform?

In 2001, the median price of a single-family home in Massachusetts was $252,000, the second highest among the LTS. California topped the LTS and the U.S. average with a median home price of $284,000. Among the LTS, Minnesota had the lowest median single-family home price at $175,000.

Between 1997 and 2001 in Massachusetts, the median price of a single-family home increased by 40.1%, the second highest percent increase among the LTS and considerably above the U.S. average of 25.0%. New York was first at 46.0%; while Connecticut had the lowest percent increase among the LTS at 26.5%.

In 2001, Massachusetts had a home ownership rate of 60.6%—the third lowest among the LTS. Among the LTS, Minnesota had the highest percentage of home ownership at 76.1% in 2001. As noted above, Minnesota had the lowest median single-family home price during this period. New York had the lowest home ownership percentage rate at 53.9% in 2001. Although the home ownership trend in Massachusetts from 1991 and 2001 has been in a decline, between 2000 and 2001, Massachusetts did experience a 1.2% increase in home ownership rates, which was the third highest increase when compared to the LTS.

What Does This Trend Mean for Massachusetts?

The high median sales price of a home in Massachusetts is a negative factor in the Innovation Economy. In a time of workforce mobility, the cost of housing is becoming increasingly important in determining where people want to live and work. Those who live in regions with relative high housing costs and cannot afford to buy a home are often forced into a high rental market or settle for less housing (e.g., a smaller home). Massachusetts high housing costs are a negative in attracting and retaining well-educated and highly skilled workers. Younger and relatively mobile, these workers are more likely to look outside of Massachusetts for affordable housing and be willing to relocate for it. Interest and mortgage rates are at record lows, yet home ownership remains out of reach for many. The Massachusetts home ownership rate increased from 2000 to 2001, so people are making efforts to remain in the state. The state must continue to remain vigilant, however, in helping to ensure that affordable housing is available to all its citizens.

Appendices

Appendix A

Data Sources for Special Analysis

The following is a detailed explanation of the sources and methods used for all data in the special analysis

Regions:

The special analysis focuses on six regions in the U.S.:

- Boston, MA-NH (NECMA)
- Los Angeles - Riverside - Orange County, CA (CMSA)
- New York - Northern New Jersey - Long Island, NY-NJ-CT-PA (CMSA)
- Raleigh - Durham - Chapel Hill, NC (MSA)
- San Diego, CA (MSA)
- San Francisco - Oakland - San Jose, CA (CMSA)

These six regions are defined by the U.S. Bureau of the Census. These regions include metropolitan statistical areas (MSA), consolidated metropolitan statistical areas (CMSA), and New England county metropolitan areas (NECMA). There are 258 MSAs, 18 CMSAs, and 12 NECMAs for which economic data are collected and analyzed.

The U.S. Office of Management and Budget defines metropolitan areas according to published standards that are applied to the Census Bureau's data. The basis for these regions is that of a core area that contains a large population nucleus. This nucleus is then summated with adjacent communities, all of which have a high degree of economic and social integration with that core area.

For more information on the qualifications of being an MSA, CMSA, or NECMA, one can visit the following web sites:

http://www.census.gov/population/www/estimates/aboutmetro.html
http://www.census.gov/population/www/estimates/mastand.html.

Employment and Wages:

Employment and wages data at the four-digit SIC code level are provided by Economy.com. Economy.com tracks industry employment at the economic area level using a methodology based upon individual corporations filings with State Employment Securities Agencies (SESA) and the Bureau of Labor Statistics (BLS). Data for the Life Sciences cluster are crafted from the four-digit Standard Industrial Classification (SIC) code level (SIC codes are set by the Executive Office of the President, Office of Management and Budget.). The SIC codes that represent the Life Sciences Cluster Analysis were chosen in consultation with Professor Michael Porter's Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

For this analysis, the Life Sciences cluster employment and wages were comprised by aggregating the following four-digit SIC codes:

Biotechnology/Pharmaceuticals:

2833 Medicinals and botanicals

2834 Pharmaceutical preparations

3085 Plastic bottles

2844 Toilet preparations

Medical Devices:

2835 Diagnostic substances

2836 Biological products exc. Diagnostic

3841 Surgical and medical instruments

3842 Surgical appliances and supplies

3843 Dental equipment and supplies

3844 X-ray apparatus and tubes

3845 Electromedical equipment

3851 Ophthalmic goods

Research:

6794 Patent owners and lessors

8733 Noncommercial research organizations

8731 Commercial physical research

Patents:

Patents data were derived from the U.S. Patent and Trademark Office (USPTO). Patent categories are defined by the USPTO. The following categories were chosen to create the Life Sciences patent portfolio for this analysis: Drug, Bio-Affecting and Body Treating Compositions; Chemistry: Molecular Biology and Microbiology; Synthetic Resins or Natural Rubbers; Organic Compounds Chemistry: Natural Resins or Derivatives; Peptides or Proteins; Lignins or Reaction Products Thereof; Multicellular Living Organisms and Unmodified Parts Thereof and Related Processes; Surgery(includes Class 600); Surgery(Instruments); Surgery(Medicators and Receptors); Radiation Imagery Chemistry: Process, Composition, or Product Thereof; Surgery: Light, Thermal, and Electrical Application; Prosthesis (i.e., Artificial Body Members), Parts Thereof, or Aids and Accessories Therefor; Chemistry: Analytical and Immunological Testing; Dentistry; X-Rayor Gamma Ray Systems or Devices; Surgery: Splint, Brace, or Bandage; Optics: Eye Examining, Vision Testing and Correcting; Surgery: Kinesitherapy

http://www.uspto.gov

Biotech Drug Approvals:

Data on total number of biotech drug approvals by region were derived from the Biotechnology Industry Association's (BIO) list of all biotech drug approvals in the U.S. from 1997 to present with data collected from the U.S. Food and Drug Administration.

http://www.bio.org

http://www.fda.gov

National Institutes of Health (NIH)-Small Business Innovation Research (SBIR) Awards:

Data were derived from the National Institutes of Health (NIH), CRISP database. Data are for the dollar value of awards given in each fiscal year. Phase I awards are for companies to research the technical merit and feasibility of their idea; Phase II awards build on these findings and further develop the proposal idea.

http://www.nih.gov

Graduate degrees in Life Sciences; Medical Degrees (MDs); and Bioengineering and Biomedical Engineering:

Data on graduate degrees granted in life sciences-related fields by region were derived from the Integrated Postsecondary Education Data System (IPEDS), National Center for Education Statistics.

http://nces.ed.gov/ipeds

Nobel Prize winners in Physiology and Medicine:

Data on total number of Nobel Prize winners in Physiology and Medicine by region was derived from Almaz, the Nobel Prize Internet archive. Nobel Prize winners who were affiliated with an institution located within one of the regions were included in the region. The Nobel Prize is the first international award given annually since 1901 for achievements in physics, chemistry, medicine, literature and peace. The prize consists of a medal, a personal diploma, and a prize amount.

http://www.almaz.com

Healthcare and Technical Occupations:

Data on total number of healthcare and technical occupations by region was derived from the BLS. The BLS obtains occupation figures from the Occupational Employment Statistics Survey, which is circulated annually to employers in every state and the District of Columbia. The purpose of this survey is to measure occupational employment and wage/salary data of nonagricultural establishments by industry. The category of Healthcare and Technical Occupations includes:

Chiropractors; Dentists ; Dietitians and Nutritionists ; Optometrists ; Pharmacists ; Anesthesiologists ; Family and General Practitioners ; Internists, General ; Obstetricians and Gynecologists ; Pediatricians, General ; Psychiatrists ; Surgeons ; Physician Assistants ; Podiatrists ; Registered Nurses ; Audiologists ; Occupational Therapists ; Physical Therapists ; Radiation Therapists ; Recreational Therapists ; Respiratory Therapists ; Speech-Language Pathologists ; Veterinarians ; Medical and Clinical Laboratory Technologists ; Medical and Clinical Laboratory Technicians ; Dental Hygienists ; Cardiovascular Technologists and Technicians ; Diagnostic Medical Sonographers ; Nuclear Medicine Technologists ; Radiologic Technologists and Technicians ; Emergency Medical Technicians and Paramedics ; Dietetic Technicians ; Pharmacy Technicians ; Psychiatric Technicians ; Respiratory Therapy Technicians ; Surgical Technologists ; Veterinary Technologists and Technicians ; Licensed Practical and Licensed Vocational Nurses ; Medical Records and Health Information Technicians ; Opticians, Dispensing ; Orthodontists and Prosthetics ; Occupational Health and Safety Specialists and Technicians ; Athletic Trainers; and residual, "All Other", occupations in this major group.

Data on all occupations are from the BLS. Since these data are not collected on an economic area level, it was necessary to reconstruct these data. For this analysis, each economic area was disaggregated into the counties and towns that comprise it. Then the names of the towns were matched with the names of the metropolitan areas that each state contains. These numbers were then aggregated into economic areas.

http://www.bls.gov

National Institutes of Health (NIH) Research and Development (R&D) Funding:

Data on federal health R&D funding are derived from the National Institutes of Health (NIH), Office of Extramural Research.

http://www.nih.gov

Venture Capital:

Data for total venture capital investments by region in life sciences-related industries was provided by PricewaterhouseCoopers, LLP, and Venture One Money Tree Survey. Industry category designations and regions are determined by PricewaterhouseCoopers, LLP, and Venture One.

http://www.pwcmoneytree.com

Appendix B

Data Sources for Indicators

For the 2002 *Index*,indicators are developed from existing secondary sources. Indicators from these sources usually required the reconfiguration of existing datasets. These groupings of data were derived from a wide range of sources; consequently, there are variations in the time frames used and in the specific variables that define the indicators being measured. This appendix provides notes on data sources for each indicator.

We intend to continue updating and refining the *Index* in future years, so that it can serve as an effective monitoring system. In some key areas, however, the team found that data are simply not available or are cost-prohibitive. The team searched for measures that could serve as effective proxies for unavailable data.

I. Selection of Leading Technology States (LTS) for Benchmarking Massachusetts Performance

To provide context, a goal of the *Index* is to measure Massachusetts performance on various indicators in comparison with appropriate benchmarks. Because the *Index* focuses on the Massachusetts Innovation Economy, states with similar economic strengths were selected for comparison. The set of LTS includes California, Colorado, Connecticut, Minnesota, New Jersey, and New York.

The LTS are selected based on the total number of nine key industry clusters having an employment concentration above the national level. In this way the selected LTS are comparable to Massachusetts in having the same breadth of innovative clusters.

On several indicators in the document Massachusetts is compared to an LTS average. This average is always the mean of each state's reported data, not including Massachusetts. It is not the mean of all LTS data aggregated together.

II. Inflation-Adjusted Values

Throughout the document, dollar values are presented in current dollars unless noted as real, inflation-adjusted values.

Indicators related to wages and income are adjusted using the Consumer Price Index (CPI) for all urban consumers (all items, U.S. city average). All other inflation-adjusted indicators use the calendar-year-based Gross Domestic Product (GDP) implicit price deflator (1996 base equal to 100.00) published by the Office of Management and Budget. The GDP price deflator is considered the most appropriate adjustment for various kinds of research and development activity.

III. Notes on Data Sources for Individual Indicators

Results Indicators

1. Industry Clusters
Economy.com tracks industry employment at the state level using a methodology based upon individual corporations filings with State Employment Securities Agencies (SESA) and the U.S. Bureau of Labor Statistics (BLS). In some cases, data from Economy.com was analyzed in comparison to information from the Massachusetts Department of Employment and Training (DET) to arrive at the number of jobs in some Massachusetts cluster industries. Both sets of data do not cover self-employment, employment of military personnel, or government employment. Definitions for each industry cluster are included in Appendix C.

2. Employment Diversification
This indicator was developed from Economy.com's state-level data of unemployment insurance filings between 1996 and 2001. Employment concentration is measured as the relative amount of employment in a cluster as a portion of total state employment compared with the same clusters' employment nationally as a portion of total U.S. employment. For each cluster, the level of national employment is indexed at 1.0. Therefore, Postsecondary Education employment at 2.9 is almost three times more concentrated in Massachusetts than at the national level. The average annual growth rate is the rate of change in industry cluster employment over the five periods from 1996 to 2001. The size of each circle on the chart reflects the relative size of employment in Massachusetts. The largest circle, Financial Services, employed 145,889 people in 2001.

3. Average Pay in Key Industry Clusters
Data from Economy.com are derived from payroll data reported as part of unemployment insurance (UI) filings. The average pay estimate for each cluster is the mean payroll per employee in 2001 current dollars.

4. Pay Per Worker in All Industries
Data for Massachusetts, LTS and the U.S. are derived from Economy.com.

5. Median Household Income
Data on median household income for Massachusetts, LTS, and U.S. are from the U.S. Census Bureau, Current Population Survey, 2001.

http://www.census.gov

6. Internet Job Postings
Data for number of Internet job postings per 10,000 in the labor force by state are derived by dividing the total number of Internet job postings by the total number in the labor force. Data on total number of job postings by state are from Monster.com as of September, 2002. Since Monster.com's Internet job postings change on a daily basis, job postings data for previous months and years are not available. Data on total labor force by state are from the U.S. Bureau of Labor Statistics.

http://www.monster.com

http://www.bls.gov

7. Perception of Business Climate and Consumer Confidence Index
Data are from the Massachusetts High Technology Council's annual business climate survey, 1987-2002.

http://www.mhtc.org

U.S. consumer confidence data are from a monthly survey conducted by the Conference Board. A yearly statistic is computed by averaging the monthly surveys for that year. The 2002 data cover through September 2002.

http://www.conferenceboard.org

Massachusetts consumer confidence data are from a quarterly survey conducted by Mass Insight in cooperation with the New England Economic Project (NEEP). A yearly statistic is computed by averaging the quarterly surveys for that year. Massachusetts consumer confidence data for 2002 covers September 2002. It is scaled to allow for comparison to U.S. consumer confidence; a score of 100 or better denotes high consumer confidence.

http://www.neepecon.org

8. Manufacturing Exports
The Office of Trade and Economic Analysis in the U.S. Department of Commerce tracks the dollar value of exported manufactured goods from all U.S. states through the Exporter Location Series. Percentages reported in this indicator are for the change in dollar value.

http://www.commerce.gov

Destination of Massachusetts exports for 2001 was derived

Employment Concentration

State	Computer/ Comm. Hardware	Financial Services	Healthcare Technology	Innovation Services	Software Comm. Services	2001 LTS	2002 LTS	No. of 9 key clusters above 1.0
MA	2.37	1.61	1.59	1.61	1.24	✔	✔	9
CT	1.40	2.13	1.92	0.76	1.10	✔	✔	6
CA	2.27	0.89	1.39	1.32	1.24	✔	✔	6
NJ	0.45	1.46	2.90	1.45	1.41	✔	✔	5
MN	1.90	1.19	1.47	0.68	0.89	✔	✔	5
NY	0.80	1.67	0.99	1.03	0.89	✔	✔	4
CO	1.73	0.92	0.91	1.31	2.02	✔	✔	4

from the Massachusetts Institute for Social and Economic Research (MISER).

http://www.umass.edu/miser

Data on manufacturing exports presented in this indicator do not include the value of software exports. There are currently no measures to track the exports of services and goods less tangible than manufactured products by state. The U.S. software industry estimates that about fifty percent of its products are exported; approximately $5 billion in software produced by Massachusetts firms is exported, which is in addition to the state's total value of all other manufacturing exports, which was approximately $17 billion in 2001.

Innovation Process Indicators

9. Number and Type of Patents Issued
Patents per capita data for Massachusetts and other LTS are provided by the U.S. Patent and Trademark Office (USPTO). Patent distribution by industry sectors are from CHI Research, Inc. Industry category designations are determined by CHI Research, Inc.

http://www.uspto.gov

10. Invention and Patent Applications
Indicator data are from the Association of University Technology Managers' (AUTM) annual licensing survey of universities, hospitals, and research institutions. For this analysis the Massachusetts universities which provided information for the AUTM report include: Massachusetts Institute of Technology (MIT), Harvard University, Boston University, Brandeis University, University of Massachusetts (all campuses, including the Medical Center), Tufts University, and Northeastern University. Massachusetts hospitals/research institutions included are: Massachusetts General Hospital, Children's Hospital Boston, Brigham and Women's Hospital, Woods Hole Oceanographic Institute, Dana-Farber Cancer Institute, New England Medical Center, Beth Israel-Deaconess Medical Center, St. Elizabeth's Medical Center of Boston, and Schepens Eye Research Institute.

Prior year patent application data for MIT was developed by their Technology Licensing Office.

11. Technology Licenses and Royalties
Data on licensing agreements involving Massachusetts institutions are also from AUTM. These data are from the same institutions providing patent and invention disclosure information in indicator number 10.

12. FDA Approval of Medical Devices and Biotech Drugs
Information is provided by the U.S. Food and Drug Administration (FDA) via the Freedom of Information Act. FDA approval of investigational device exemptions (IDEs) allows for clinical trials to begin on particularly high-risk medical devices. Medical device companies are also required to secure pre-market approvals (PMAs) before intricate medical devices are allowed market entry.

http://www.fda.gov

Data on total number of biotech drug approvals by state were derived from the Biotechnology Industry Association's (BIO) list of all biotech drug approvals in the U.S. from 1997 to present with data collected from the U.S. Food and Drug Administration.

http://www.bio.org

http://www.fda.gov

13. New Business Incorporations
Data are provided by the Massachusetts Secretary of the Commonwealth's Office.

14. Small Business Innovation Research (SBIR) Awards
Data are provided by the Small Business Administration (SBA) and U.S. Department of Commerce. Data are for the number and dollar value of awards distributed in each fiscal year. Phase I awards are for companies to research the technical merit and feasibility of their idea; Phase II awards build on these findings and further develop the proposal idea.

http://www.sba.gov

15. Initial Public Offerings (IPOs) and Mergers & Acquisitions (M&As)
The total number and distribution by industry sector of filed initial public offerings (IPOs) by state and for the U.S. are provided by IPO.com. IPO.com's industry classifications for IPOs are based upon the four-digit Standard Industrial Classification (SIC) code level.

http://www.ipo.com

Data on total number of mergers and acquisitions (M&As) by state and the U.S. are provided by Mergerstat. M&A data represent all entities that have been acquired by another for all years presented in the indicator.

http://www.mergerstat.com

16. NASDAQ Firms' Market Value
The dataset contains the market capitalization (value) of all publicly traded firms listed on the NASDAQ Exchange on March 31st of each year from 1997-2002. Market capitalization for an individual company is defined as the product of the number of shares outstanding times the share price on a given day.

17. Number of Fast Growth "Gazelle" Companies
The number of fast growth "gazelle" companies is derived from a special data run conducted by Standard & Poor's Compustat of publicly traded companies headquartered in Massachusetts. This dataset tracks all publicly traded companies filing 10K and 10Q reports with the Securities and Exchange Commission (SEC) between 1986 and 2001. This dataset has been updated for 2001 using information from corporate 10K filings as reported by COMPUSTAT, Global Researcher, and the SEC.

David Birch of Cognetics, Inc., in Cambridge, coined the term "gazelle."

18. Corporate Headquarters and "Technology Fast 500" Firms
Data on total number of corporate headquarters by state are provided by infoUSA.com.

Data on location of Tech Fast 500 companies located in Massachusetts and the LTS are provided by Deloitte and Touche, LLP. To be eligible for the Fast 500, a company must be a technology company, defined as follows: own proprietary technology that contributes to a significant portion of the operating revenues; devote a significant proportion of revenues to R&D of technology; base-year operating revenues must be at least $50,000 U.S. dollars (USD) or $75,000 Canadian dollars (CD), current-year operating revenues must be at least $1 million USD and CD; be in business a minimum of five years; and be headquartered within North America.

http://www.public.deloitte.com/fast500

Resource Indicators

19. Population Growth Rate, Unemployment Rate, and College and University Enrollments
Data on population growth rate by state and the U.S. are derived from the U.S. Census Bureau.

http://www.census.gov

Data on unemployment rate by state and for the U.S. are provided by the U.S. Bureau of Labor and Statistics.

http://www.bls.gov

Data on percent changes in total public and private college and university enrollments for MA, LTS, and U.S. are derived from the National Center for Education Statistics (NCES). This survey, which is sent out to approximately 3958 schools in the U.S., has been part of NCES survey work since 1966. Degree granting institutions are defined as postsecondary institutions that are eligible for Title IV federal financial-aid programs and grant an associate's or higher degree. A private school or institution is one that is controlled by an individual or agency other than a state of, a subdivision of a state, or the federal government, which is usually supported primarily by other than public funds, and the operation of whose program rests with other than publicly elected or appointed officials. Private schools and institutions can be either not-for-profit and proprietary institutions. A public school or institution is one that is controlled and operated by publicly elected or appointed officials and derives its primary support from public funds.

http://nces.ed.gov

20. Migration
Total foreign and domestic migration data are provided by the U.S. Census Bureau.

http://www.census.gov

Data on distribution of immigrants for Massachusetts are derived from the U.S. Immigration and Naturalization Services (INS). Data include legal immigration from abroad, net undocumented immigration, emigration, and net movement from Puerto Rico and the United States mainland.

http://www.ins.gov/graphics/index.htm

21. Workforce Education
Data on appropriations of state and local tax funds for operational expenses of public higher education for Massachusetts and the LTS are provided by Grapevine Center for Higher Education, Illinois State University. Grapevine reports on total state effort for higher education, including tax appropriations for universities, colleges, community colleges, and state higher education agencies.

http://coe.ilstu.edu/grapevine

Data on average tuitions at public and private four-year colleges and universities for Massachusetts and the LTS are derived from the U.S. Department of Education and Massachusetts Board of Higher Education.

http://www.doe.mass.edu

http://www.ed.gov

22. High School Dropout Rates
Data are provided by the Massachusetts Department of Education.

http://www.doe.mass.edu

23. Engineering and Computer Science Degrees; Scientists and Engineers in the Labor Force
Data on total number of engineering degrees and degrees by ethnicity are provided by the American Association of Engineering Societies (AAES). The AAES tracks the number of engineering degrees awarded each year from over 300 accredited institutions throughout the United States.

http://www.aaes.org

Data on the total number of computer science degrees are provided by the National Science Foundation (NSF). The U.S. Department of Education, National Center for Educational Statistics (NCES) could not release 1999 data for its degree completion's survey. The NCES decided to move to the next year for timely reporting, and leave 1999 blank.

http://www.nsf.gov

Data on scientists and engineers as a percent of the total workforce are derived from data on scientists and engineers from the NSF and population data from the U.S. Census Bureau. The Division of Science Resources Studies (SRS) of the NSF publishes data on scientists and engineers in its annual Science and Engineering State Profiles. Data for state rankings and totals include the 50 States, District of Columbia, and Puerto Rico.

http://www.census.gov

http://www.nsf.gov

24. Computers in Education
Data for percent of schools that access Internet through a high-speed connection and students per Internet-connected computer, for Massachusetts, LTS, and U.S. are provided by Education Week's Technology Counts 2002 report.

http://www.edweek.org

25. Student Interest in Engineering and Science
Data for intended majors of students taking the SAT in Massachusetts and the LTS are provided by The College Board Online, Profile of College Bound Seniors, 2001. The Profile of College-Bound Seniors presents data for 2001 high school graduates who participated in the SAT Program during their high school years. Students are counted once no matter how often they tested, and only their latest scores and most recent Student Descriptive Questionnaire (SDQ) responses are summarized. The college-bound senior population is relatively stable from year to year; moreover, since studies have documented the accuracy of self-reported information, SDQ information for these students can be considered a highly accurate description of the group.

http://www.collegeboard.com

26. Federal R&D Spending & Federal Health R&D Spending
Data on federal R&D spending at academic and nonprofit research institutions are provided by the NSF. This includes the NSF's university-associated federally funded research and development centers.

http://www.nsf.gov

Data on federal health R&D spending at academic and nonprofit research institutions are provided by the NSF. Data are for all R&D expenditures by the U.S. Department of Health and Human Services; more than 95% of these expenditures are funded through the National Institutes of Health.

http://www.nsf.gov

27. Corporate R&D per Employee
Data are derived from the annual 10K reports filed by publicly-traded corporations with the SEC using Standard & Poor's COMPUSTAT database. Industry R&D per employee was calculated for all companies that reported any R&D expenditures. Only those companies that filed both employment and R&D expense data are included in the data.

28. Venture Capital
Data for total venture capital investments in Massachusetts and the U.S., and venture capital investments by industry activity are provided by PricewaterhouseCoopers, LLP, Venture Economics, and the National Venture Capital Association Money Tree Survey. Industry category designations are determined by PricewaterhouseCoopers, LLP, Venture Economics, and the National Venture Capital Association.

http://www.pwcmoneytree.com

29. Broadband
Data on percent of homes with Internet access for MA, LTS, and U.S. comes from the U.S. Department of Commerce. This report utilizes data from the Department of Commerce's U.S. Census Bureau, taken from the Census Bureau's September 2001 Current Population Survey (CPS) of approximately 57,000 sample households. For each household, Census Bureau interviewers spoke to a person (called the "respondent") who was at least 15 years old and was considered knowledgeable about everyone in the household. For purposes of collecting data at the household level (such as type of connection to the Internet), the respondent provided information pertaining to the "householder" or "reference person," who is an adult in the household who either owns or has signed for the rent on the residence.

http://www.census.gov

Data on easiest and most difficult states for e-commerce for MA, LTS, and other states are provided by the Progressive Policy Institute (PPI). A higher number ranking indicates a state's strengths in making Internet transactions and business easier for citizens to use; a lower number ranking denotes the opposite. In order to assess what are the easiest and most difficult states for Internet users, this report examines the 50 states and the District of Columbia, identifying the extent to which they impose industry-specific protectionist laws, tax Internet access, enable Internet users to transact electronically with state government, and recognize the legal validity of digital signatures. Each category directly affects the environment Internet users encounter in their states, and each category is something that is under direct control of state government. For example, PPI looked at whether consumers could buy wine, cars, insurance, contact lenses, and number of other goods and services online. The more they could, the higher the state's score. By combining this and other factors, the PPI calculated a score for each state based on its friendliness toward Internet users.

http://www.ppionline.org

30. Median Sales Price of Single-Family Homes and Homeownership Rates
The Federal Housing Finance Board provides data for median sales price of single-family homes. Data are collected from the Finance Board's Monthly Survey of Rates and Terms on Conventional Single-Family Nonfarm Mortgage Loans. Single-family homes are defined in two ways. They can be unit structures detached from any other house, such as one-family homes and mobile homes or trailers to which one or more permanent rooms have been added; and, they can be unit structures attached to another structure, but with one or more walls extending from the ground to roof separating it from the adjoining structure, such as double houses or townhouses. The median statistic represents the value in the middle of a data set.

http://www.fhfb.gov

Homeownership rates data are from the U.S. Census Bureau.

http://www.census.gov

Appendix C

I. Industry Cluster Definitions

The analysis of key industry clusters within Massachusetts begins with a disaggregation of all Massachusetts state industry activity to the four-digit Standard Industrial Classification (SIC) code level. (SIC codes are set by the Executive Office of the President, Office of Management and Budget. These codes were last revised in 1987.) Employment, payroll, and the number of establishments for all four-digit industries are examined. Industry data are analyzed through the following measures:

- Employment concentration relative to that of the nation
- Payroll per employee relative to the state average
- Employment as a share of total state employment
- Average annual growth rate, and absolute change, of employment
- Absolute number of establishments

Clusters are crafted from those interrelated SIC code industries that showed themselves to be individually significant according to the above measures.

Computers & Communications Hardware

3571 Electronic computers
3572 Computer storage devices
3575 Computer Terminals
3661 Telephone and telegraph apparatus
3663 Radio & TV communications equipment
3669 Communications equipment, nec
3577 Computer peripheral equipment, nec
3672 Printed circuit boards
3674 Semiconductors and related devices
3675 Electronic capacitors
3679 Electronic components, nec
3695 Magnetic and optical recording media
3699 Electrical equipment & supplies, nec
3823 Process control instruments
3825 Instruments to measure electricity

Defense

3483 Ammunition, except for small arms, nec
3484 Small arms
3671 Electron tubes
3724 Aircraft engines and engine parts
3761 Guided missiles and space vehicles
3769 Space vehicle equipment, nec
3812 Search and navigation equipment
3827 Optical instruments and lenses
3829 Measuring & controlling devices, nec

Diversified Industrial Support

2992 Lubricating oils and greases
3061 Mechanical rubber goods
3069 Fabricated rubber products, nec
3081 Unsupported plastics film & sheet
3082 Unsupported plastics profile shapes
3087 Custom compound purchased resins
3291 Abrasive products
3357 Nonferrous wiredrawing & insulating
3398 Metal heat treating
3399 Primary metal products, nec
3462 Iron and steel forgings
3469 Metal stampings, nec
3471 Plating and polishing
3479 Metal coating and allied services
3491 Industrial valves
3511 Turbines and turbine generator sets
3545 Machine tool accessories
3547 Metalworking machinery, nec
3554 Paper industries machinery
3555 Printing trades machinery
3559 Special industry machinery, nec
3561 Pumps and pumping equipment
3562 Air and gas compressors
3567 Industrial furnaces and ovens
3568 Power transmission equipment, nec
3569 General industrial machinery, nec
3599 Industrial machinery, nec
3625 Relays and industrial controls
3629 Electrical industrial apparatus, nec
3643 Current-carrying wiring devices
3999 Manufacturing industries, nec

Financial Services

6036 Savings institutions, not Federally chartered
6111 Federal and Federally-sponsored credit
6159 Misc. business credit institutions
6211 Security brokers, dealers, and flotation companies
6282 Investment advice
6289 Services allied with the exchange of securities
6311 Life insurance
6324 Hospital and medical service plans
6331 Fire, marine, and casualty insurance
6411 Insurance agents, brokers, and services
7322 Adjustment and collection services
7323 Credit reporting services

Healthcare Technology

2833 Medicinals and botanicals
2834 Pharmaceutical preparations
2835 Diagnostic substances
2836 Biological products exc. diagnostic

Appendix C

3821	Laboratory apparatus and furniture
3826	Analytical instruments
3841	Surgical and medical instruments
3842	Surgical appliances and supplies
3844	X-ray apparatus and tubes
3845	Electromedical equipment
3851	Ophthalmic goods
8071	Medical laboratories
Innovation Services	
8711	Engineering services
8712	Architectural services
8731	Commercial physical research
8732	Commercial nonphysical research
8734	Testing laboratories
8741	Management services
8742	Management consulting services
8743	Public relations services
8733	Noncommercial research organizations1
Postsecondary Education	
8221	Colleges, universities and professional schools
8222	Junior colleges and technical institutes
8299	Schools and educational services, nec
Software & Communications Services	
7371	Computer programming services
7376	Computer facilities management
4812	Radiotelephone communications
4813	Telephone communications, exc. radio
4841	Cable and other pay television services
7372	Prepackaged software
7373	Computer integrated systems design
7374	Data processing and preparation
7375	Information retrieval services
7377	Computer rental & leasing
7378	Computer maintenance & repair
7379	Computer related services, nec
Textiles and Apparel	
2221	Broadwoven fabric mills, manmade
2231	Broadwoven fabric mills, wool
2253	Knit outerwear mills
2257	Weft knit fabric mills
2261	Finishing plants, cotton
2262	Finishing plants, manmade
2269	Finishing plants, nec
2295	Coated fabrics, not rubberized
2297	Nonwoven fabrics
2298	Cordage and twine
2299	Textile goods, nec
2337	Women's and misses' suits and coats
2386	Leather and sheep-lined clothing
2389	Apparel and accessories, nec
2391	Curtains and draperies
3021	Rubber and plastics footwear
3111	Leather tanning and finishing
3131	Boot and shoe cut stock and findings
3149	Footwear, except rubber, nec
3171	Women's handbags and purses
3172	Personal leather goods, nec
3911	Jewelry, precious metal
3915	Jewelers' materials & lapidary work
3961	Costume jewelry
5131	Piece goods and notions
5136	Men's and boys' clothing
5137	Women's and children's clothing
5139	Footwear

nec - not elsewhere classified

Data Contributors

Special thanks to the following organizations that contributed data and expertise:

American Association of Engineering Societies
Association of University Technology Managers
Bureau of Labor Statistics, U.S. Department of Labor
Bureau of the Census, U.S. Department of Commerce
CHI Research, Inc.
Collaborative Economics
College Board
Deloitte and Touche, LLP
Donahue Institute, University of Massachusetts
Economy.com
Education Week
Federal Housing Finance Board
Grapevine Center for Higher Education, Illinois State University
InfoUSA.com
Institute for Strategy and Competitiveness, Harvard Business School
International Trade Administration, U.S. Department of Commerce
IPO.com
Mass High Tech
Mass Insight
Massachusetts Alliance for Economic Development
Massachusetts Biotechnology Council
Massachusetts Biotechnology Initiatives
Massachusetts Department of Education
Massachusetts High Technology Council
Massachusetts Institute for Social and Economic Research
Massachusetts Institute of Technology
Massachusetts Software & Internet Council
Massachusetts Telecommunications Council
MassMEDIC
Mergerstat
Monitor Group, LP
National Center for Education Statistics, U.S. Department of Education
National Science Foundation
New England Economic Project
PricewaterhouseCoopers, LLP
Progressive Policy Institute
Secretary of the Commonwealth
Small Business Administration
Solutions by Francisco Ruiz
Standard & Poor's
University of Massachusetts, all campuses
U.S. Department of Commerce
U.S. Department of Education
U.S. Food and Drug Administration

The *Index* Project

Index Project Staff

Director: **Thomas Hubbard**, MTC Vice President, Technology Development & Analysis

Manager: **Jennifer Banks**, MTC Project Manager

Facilitator: **Jeff Lockwood**, MTC Director, Cluster Program Development

Press Relations: **Chris Kealey**, MTC Communications Director

Contributor: **Robert Kispert**, MTC Director, Federal Programs

Research: **Nicholas Jolly**, MTC Intern

Research: **Eleanor Michael**, MTC Intern

Graphic Design and Production; Web Design: **Christine Raisig**, MTC Publications Manager

Interactive Edition on cd-rom: **Eric Schiowitz**, MTC Web Developer

Support Staff: **Ticia Allain-Martin**, MTC Administrative Assistant

Web Support Staff: **Angela Evers**, MTC Desktop Specialist

Additional copies of the *Index of the Massachusetts Innovation Economy* are available for $20.00 per copy for individuals and corporations ($15.00 per copy for quantities over 20), and for $10.00 per copy for non-profit organizations and educational institutions ($7.50 per copy for quantities over 20). An interactive version of the *Index* on cd-rom is also available for $5.

Orders may be placed through the MTC web site at *www.masstech.org*, or by telephone.

To order additional copies or for additional information call 508-870-0312.

The *Index* is available at no cost by downloading from *www.masstech.org*.