2004 Index of the Massachusetts Innovation Economy

MASSACHUSETTS
TECHNOLOGY
COLLABORATIVE

John Adams Innovation Institute

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Prepared by:
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2004 Index
of the Massachusetts Innovation Economy

The Massachusetts Technology Collaborative (MTC) is the state's development agency for renewable energy and the innovation economy, which is responsible for one-quarter of all jobs in the state. We work with cutting-edge companies to create new jobs and stimulate economic activity in communities throughout the Commonwealth.

MTC's mission is to support the state's innovation economy by acting as a catalyst between the private sector, government and academia. Its major programs include renewable energy, nanotechnology, support for university-based R&D with close industry involvement, and advanced technologies in health care which improve quality and lower costs.

As our name suggests, we use a collaborative approach to achieving the organization's mission. We bring together leaders from industry, academia, and government to advance technology-based solutions that lead to economic growth and a cleaner environment in Massachusetts.

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.

Prepared by the:
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THE MASSACHUSETTS INNOVATION ECONOMY: Time to hit the accelerator

We present this year's *Index* on a note of hope, and a note of urgency.

A note of hope because, once again, the *Index* demonstrates that the Commonwealth enjoys extraordinary resources for innovation, and because we see much evidence from the Governor, the Legislature, the state's colleges and universities, and the private sector that there is a new commitment to collaboration in the state.

A note of urgency because employment in the state's Innovation Economy continues to shrink, led by losses in Information Technology-related industries that continue to this day. Meanwhile, real household median income in the state continues to fall-not a positive trend for a state with high costs, particularly high housing costs. From 2001 to 2003, Massachusetts had the largest decline in median household income compared to our competitors among Leading Technology States (LTS) and the U.S. And in 2003, the state's median home price reached $295,000, which was the second highest among the LTS and well above the U.S. average of $197,900.

Less than 25% of the state's workforce now works in the Innovation Economy. Massachusetts faces the challenge of restoring jobs lost in these sectors (more than 94,000 jobs since 2000)—one that must be met by more successful conversion of innovation into new products, new businesses and new jobs. To be sure, research and development is itself a big business in Massachusetts: latest data available shows federally supported research in the state totaled $4.6 billion in 2002. But too often there is disconnect between innovation in our laboratories, and business and job creation in our economy.

The life sciences sector is a promising exception. The 2004 *Index* once again documents continuing and gathering strength in the state's life sciences research community and in new investment in healthcare technology ventures. Massachusetts is in a position to be a global leader in the life sciences. A recent study from the Milken Institute in California suggests that employment in the biotechnology industry alone could increase by 65 percent over ten years. However, the state's employment base in life sciences is only about 1-2% of overall employment in Massachusetts.

We will need growth in a much wider array of industries, or in new industries in a wider spectrum of markets, if we are to offset job losses in far larger industry clusters such as Software & Communications Services and Computer & Communications Hardware.

Fortunately, we have a world-class inventory of innovations among our research institutions and among our entrepreneurs. Unfortunately, in today's global economy, innovations are pieces of intellectual property that are traded in an international market much like any other set of goods. We need to make the strongest possible connection between Massachusetts-bred innovations, in a wide variety of fields, and new business development that diversifies our economy by serving a wide variety of international markets.

And that's only part of the job.

The Commonwealth's colleges and universities are talent magnets that continue to draw thousands of people to our state every year. Massachusetts enjoys the single biggest 'net surplus' of college freshmen of all the LTS; that is, a surplus of freshmen coming into the state, compared to our own residents who leave to go to school elsewhere. According to a 2003 report from The Boston Foundation and the Greater Boston Chamber of Commerce, about half of Boston-area students remain in the state for some time after graduation, including a disproportionately high share of graduates who enter technical occupations. But our good fortune in attracting talented out-of-state residents should not blind us to the compelling need to raise educational attainment among our own, long-time residents.

As the *Index* demonstrates, the state still suffers from chronic out-migration, in years both good and bad. Out-migration reached a ten-year high in Massachusetts in 2003. While out-migration acts to keep our unemployment rate low, it saps our ability to rapidly capitalize on new business development that is generated by our great innovation resources of scientific research, technology development and venture investment. As studies by MassINC and the University of Massachusetts have shown, the workers most apt to leave the state and the region over time are those with the greatest employment options: the highly-educated. The ticket to growing the Innovation Economy, and a sustainable standard of living, is improving and expanding educational opportunities for our citizens.

We sense a new commitment in the state to think hard about the mission of the state's public and private colleges and universities, in keeping with the new spirit of commitment to find collaborative initiatives to promote greater conversion of our home state innovations into new jobs.

Now is the time for us to pick up speed: more innovation, quicker conversion of innovation to new businesses and new jobs, bolstered by a workforce that the Commonwealth will—in words recently uttered by former General Electric CEO Jack Welch on this topic—"educate the hell out of".

It's time to hit the accelerator.

The Massachusetts Innovation Economy is responding to the upturn in the U.S. economy in several key indicators, including more new initial public offerings (IPOs), increases in technology-focused firms, and a growing share of venture capital. The state also has a high concentration of relatively high-paying, highly-skilled occupations, such as life sciences and professional & technical jobs. However, the state's Innovation Economy continues to be constrained by increases in domestic out-migration, rising home prices, and relatively low levels of state fiscal support for public higher education.

Also, the 2004 *Index* demonstrates that several competitor states are gaining on or outpacing the Commonwealth's historic strengths when it comes to key industry employment and attracting and retaining talent. This can be seen in the indicators that focus on key industry clusters growth rates, college enrollments, and housing affordability.

Results:

⇓ From 2002 to 2003, total employment in the nine key industry clusters in Massachusetts decreased 4.3% to approximately 775,000 people. The Postsecondary Education cluster was the only such cluster to register an increase in jobs (560 new jobs, a 0.5% increase). Since 2001, total key industry cluster employment has been declining in the state.

⇑ Of the 10 major occupational groupings created for the 2004 *Index*, Massachusetts has an above average concentration relative to the nation in occupations with average wages that are above the state average for all industries ($42,830). These occupations include: Professional & Technical ($75,324), Life, Physical, & Social Sciences ($57,630), Arts & Media ($46,500), Education ($44,750), Healthcare ($43,310), and Construction ($43,225). [See chart below.]

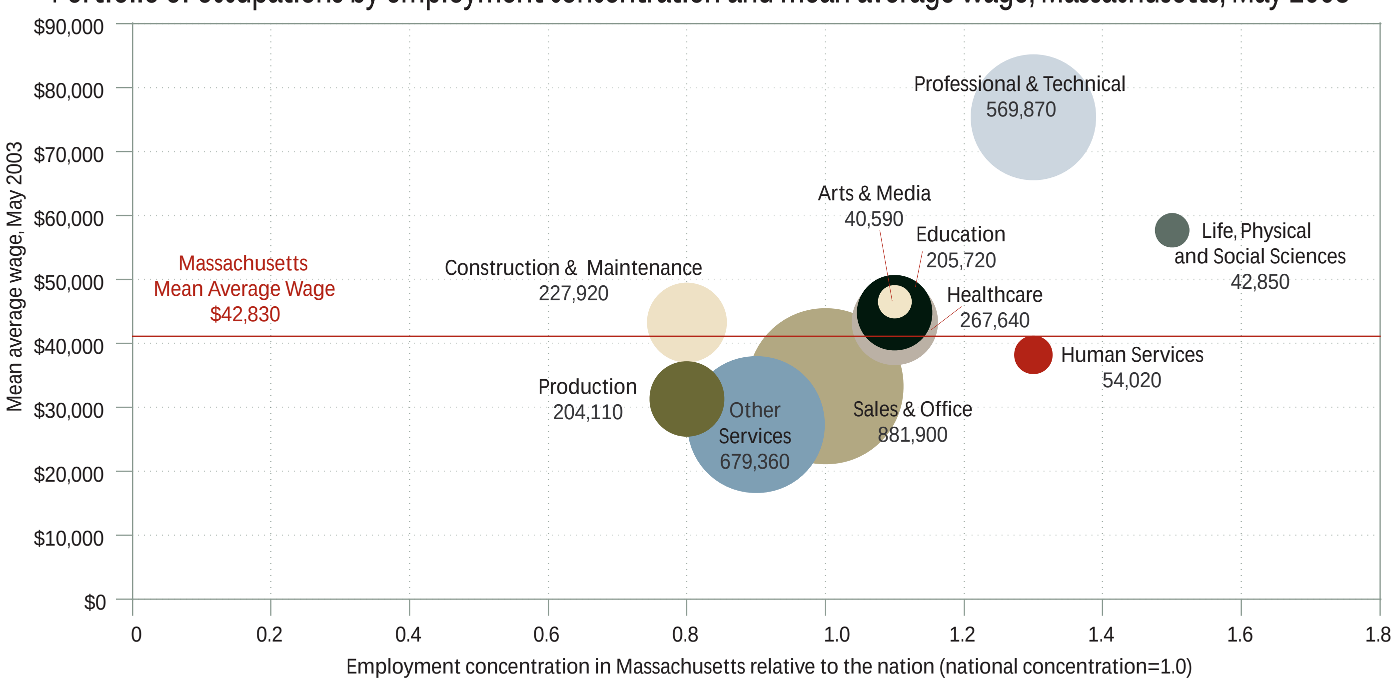
Technology Development and Business Development Pipeline:

⇑ Massachusetts received a total of 799 Small Business Innovation Research (SBIR) awards in 2002, a 26.2% increase from 2001 and the largest number of awards received in a single year in over ten years.

⇔ The IPO market in Massachusetts is rebounding in 2004, although the numbers continue to be relatively small when looking at the late 1990s. After just 1 IPO in 2002, and 3 in 2003, at the time of publication, there have been 9 IPOs in Massachusetts. The majority of these are in Healthcare Technology.

⇑ After experiencing a decline in total number of Technology Fast 500 firms from 1999 to 2002, Massachusetts experienced a 28.6% increase in these companies from 2002 to 2003 (28 to 36 firms).

Portfolio of occupations by employment concentration and mean average wage, Massachusetts, May 2003



Note: Numeral below name of occupational category is May 2003 total employment
Source: Occupational Employment Statistics, Bureau of Labor Statistics

⇑ Massachusetts continues to attract a sizable share of all venture capital when compared to the Leading Technology States (LTS), and is second only to California in total venture capital investments. During the first two quarters of 2004, Massachusetts received approximately $1.5 billion in venture capital funding, which was 14% of the U.S. total ($10.6 billion). In 2003, several of the LTS experienced decreases in venture capital funding, including Minnesota (-20%), California (-14%), and New York (-13%).

Talent Pipeline:

⇓ From 2002 to 2003, more than 45,000 people moved out of Massachusetts, a 60.6% increase from the previous year (28,074). This contributed to the state's highest net loss in migration (-11,652) in ten years.

⇓ In 2003, the median price of a single-family home in Massachusetts was $295,000, the second highest among the LTS and significantly higher than the U.S. average ($197,900). Massachusetts' median price of a single-family home increased 10% from 2002 to 2003.

⇔ From 1991 to 2001, the state's private degree granting institutions experienced a decrease in enrollments (-0.3%), the only LTS to have a decline. Enrollments in Massachusetts public degree granting institutions, however, increased 3.5% during that decade.

⇓ Massachusetts continued to rank last in public higher education expenditures among the LTS with per capita appropriations of $122 in fiscal year 2004. The state also had the largest decrease in funding (-19.3%) from 2003 to 2004 compared to the LTS.

⇑ In 2003, Massachusetts 4th and 8th graders scored well, relative to the U.S. and to the LTS, in the National Assessment of Educational Progress (NAEP) reading and mathematics exams. Massachusetts 4th graders led the LTS in reading with a score of 228 (based on a NAEP scale of 0-500, with 500 being the highest possible score). For 8th graders, Massachusetts led the LTS in reading with a score of 273. In mathematics, the state's average score for 8th graders (287) was second only to Minnesota (291), and 4th graders tied with Minnesota in score (242).

Research Pipeleine:

⇑ Total federal R&D spending in Massachusetts academic and nonprofit research institutions climbed to more than $4.6 billion in 2002, placing the state second among the LTS in absolute R&D spending. From 2001 to 2002, R&D funding on a per capita basis also increased in Massachusetts.

⇑ The number of invention disclosures reported annually by Massachusetts academic and nonprofit research institutions increased 7.4% from 1,377 in 2001 to 1,479 in 2002. Massachusetts universities, hospitals and nonprofit research institutions filed 812 patent applications in 2002, up 8.4% from the previous year. Since 1999, the total number of new patent applications from universities, hospitals, and nonprofit research institutions has been rising in Massachusetts.

The direction of the arrow reflects the performance of the Massachusetts Innovation Economy in the 2004 *Index*:

⇑ Denotes a strength

⇔ Indicates mixed progress

⇓ Denotes a sign of weakness

Several of the 2004 *Index* indicators point to Massachusetts working to recover from the recent recessionary period. However, advances in technology and worker mobility have created more opportunities for other states to gain on the innovative strengths of Massachusetts. Given the critical role innovation plays in the competitiveness of Massachusetts, falling behind the competition in this regard threatens the long-term viability of not only the Innovation Economy but of the state's economic health overall. The state must continually strive to have a leading Innovation Economy and to ensure all of its citizens have access to educational and skills opportunities, and affordable housing so they can be active participants in the state's economic growth and development.

The Framework for Innovation

The *Index* measures the progress of 17 indicators related to the Massachusetts Innovation Economy. Innovation is a complex process. No economic model can do full justice to the interplay of talent, finance, and new ideas that determines first whether an innovation will occur, and then if it succeeds in generating real economic growth. The objective of the *Index* is to create a broad outline of the innovation process in the economy so one can benchmark the Innovation Economy in Massachusetts with other competitor states and to identify trends in the leading indicators over time.

The 2004 *Index* disaggregates the state's innovation process into four parts: three resource pipelines (Technology & Business Development, Talent, and Research) and the Results that appear and impact the pipelines. These four components are delineated by a set of indicators that track the performance of the Innovation Economy.

Selecting Indicators

Indicators are quantitative measures that tell how well the state is doing: whether the state is going forward or backward; 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
- Are statistically measurable on an ongoing 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

Tracking the Massachusetts Innovation Economy over time is crucial for regularly assessing its strength and resilience.

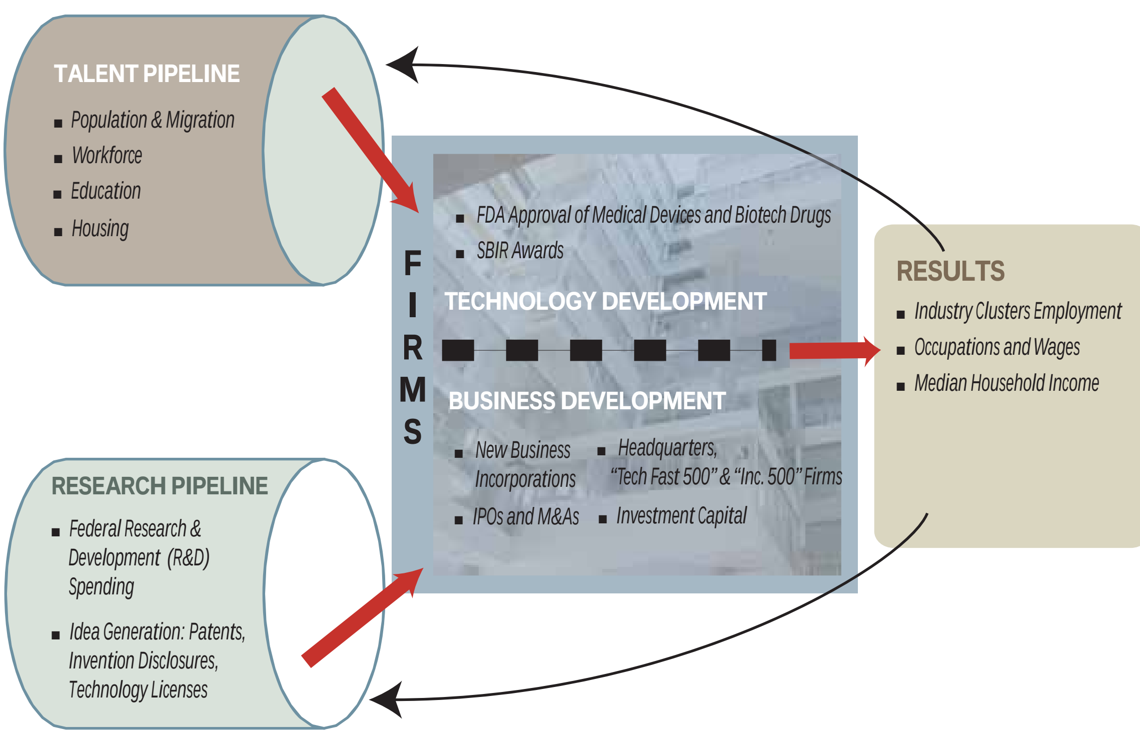
At the same time, benchmark comparisons can provide an important context for understanding how Massachusetts is doing in a relative sense. Thus, in some cases, the Massachusetts indicator is compared with the national average or with a composite measure of six competitive Leading Technology States (LTS). The six LTS chosen for comparison throughout the 2004 *Index* are the same as those used in the past three years: California, Colorado, Connecticut, Minnesota, New Jersey, and New York. Appendix A describes the methodology for selecting the LTS.

Nine Key Industry Clusters

The 2004 *Index* monitors the impact of innovation through the key industry clusters that are critical to the state's economy. Nine industry clusters that significantly affect the state and are linked uniquely to the Innovation Economy are identified. These clusters range from the long-established, such as Postsecondary Education and Defense Manufacturing & Instrumentation, to relatively new industry clusters such as Software & Communications Services (which includes telecommunications), and Innovation Services (which includes engineering services and management consulting services). Appendix B provides a detailed definition for each of these clusters.

Together, these nine clusters account for 24% of non-government (private) employment in Massachusetts. Government employment, which is not counted in the industry clusters analysis, includes Federal, State and local workers, postal workers, and education workers at the state and local level.

Framework for Innovation

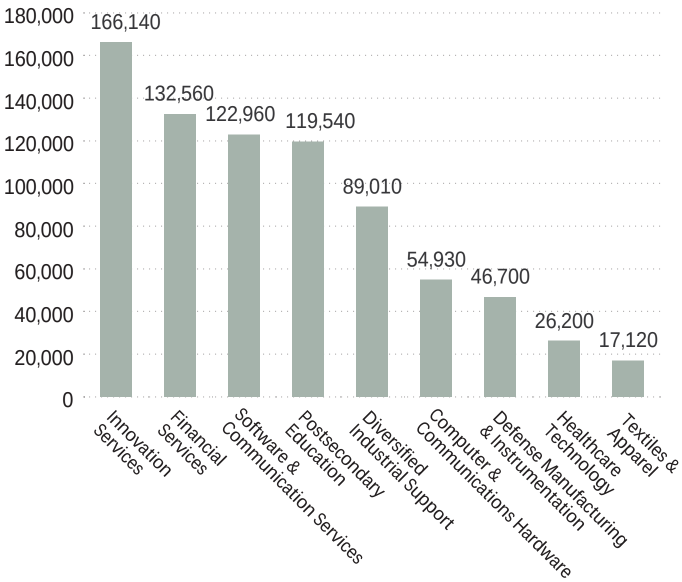


INDICATOR 1

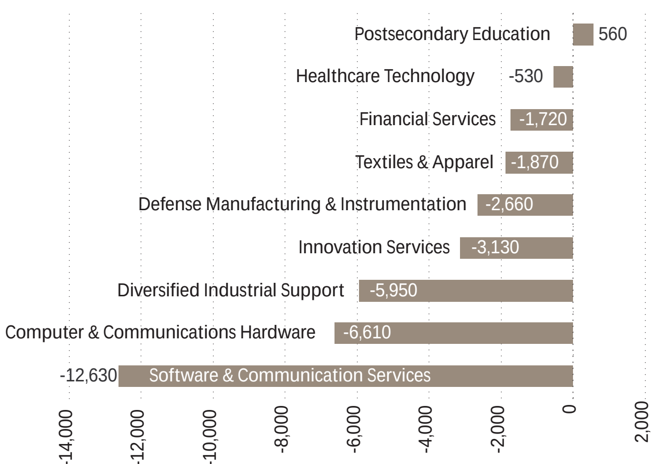
Industry Clusters Employment

Almost all of the key industry cluster employment, and total employment in the state, decreased from 2002 to 2003. Computer & Communications Hardware and Software & Communication Services clusters experienced highest job loss among the key industry clusters, while Postsecondary Education was the only cluster to add jobs.

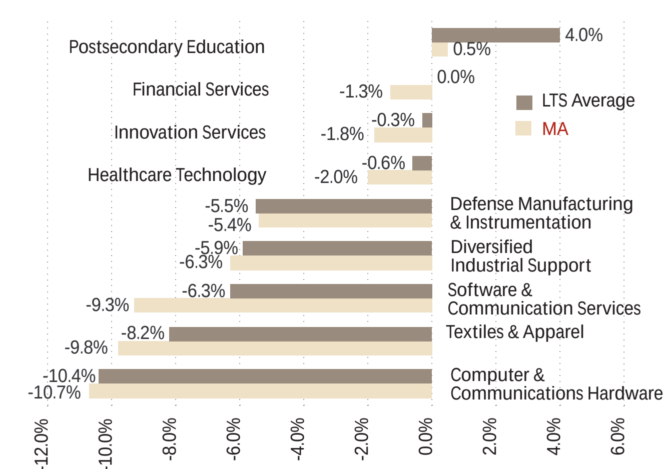
Total employment, nine key industry clusters, Massachusetts, 2003



Net employment change, nine key industry clusters, Massachusetts, 2002–2003



Percent change in cluster employment for Massachusetts and LTS average, 2002–2003



Source of all data for this indicator: Economy.com

Why Is It Significant?

Industry clusters are important to the Massachusetts economy. The nine key industry clusters, defined as geographic concentrations of interdependent industries, comprise 24% of all non-government jobs in Massachusetts. Each cluster is more highly concentrated within the Massachusetts economy than similar clusters on average in the U.S. Such high concentration is a reflection of current or past competitive advantage that helped the cluster grow in the state.

How Does Massachusetts Perform?

From 2002 to 2003, total employment in the nine key industry clusters decreased 4.3% to just over 775,000 people. Since 2000, total key industry cluster employment has been declining in the state. The decrease in total jobs statewide was 1.7%, which was a smaller decline than the previous year (2.2%). The Innovation Services cluster was the largest employer among the nine key industry clusters in 2003 with 166,140 people, and Textiles & Apparel was the smallest at 17,120.

The state's clusters that are closely linked to the Telecommunications and Information Technology (IT) industries continue to contract in total number of jobs. The Massachusetts Software & Communication Services cluster shed 12,630 jobs (a decrease of 9.3%), which was a smaller loss than the previous year (22,050 jobs, a 14.0% decrease). Although all the Leading Technology States (LTS) and the U.S. experienced a decrease in Software & Communication Services cluster employment from 2002 to 2003, Massachusetts had the largest decline. The state's Computer and Communications Hardware cluster lost 6,610 jobs for the same period (a decrease of 10.7%). All the LTS and the U.S. experienced a decrease in Computer & Communications Hardware cluster employment.

From 2002 to 2003, the state's Postsecondary Education cluster was the only cluster to register an increase in jobs (560 new jobs, a 0.5% increase). This growth, however, lagged behind the LTS average (4.0%) and U.S. (1.9%) in this cluster. The Massachusetts Healthcare Technology cluster experienced the smallest decline in total employment (-530 jobs) for the same period. The state's Diversified Industrial Support and Textiles & Apparel clusters continue to contract over time, shedding jobs since the late 1990s.

What Does this Trend Mean for Massachusetts?

Slow key industry cluster employment growth in and of itself is not bad news—especially in light of slow population growth in the state. What is important, however, is that Massachusetts continues to grow its Innovation Economy.

The employment decreases, especially in computers, software, and telecommunications, means the state must focus on finding new clusters to nurture, since many of these jobs have likely moved offshore or were lost due to changing technology. It also means there will be retraining needed for those displaced if they are not to join the exodus of talent to other regions, or be unable to find a job.

INDICATOR 2

Occupations and Wages

Massachusetts is highly concentrated in relatively high-paying, highly skilled jobs. State lags LTS and U.S. in occupational growth in several industries.

Why Is It Significant?

Occupational employment and wages are important indicators in understanding both the types of job opportunities created by a region's economy and the financial benefits it provides to a state's labor force. The mix of occupations in a state can show the levels of educational attainment and professional experience that are needed in the local economy. For this indicator, the 22 major occupation categories from the U.S. Bureau of Labor Statistics' Occupational Employment Statistics (OES) program have been aggregated into 10 occupational categories.

How Does Massachusetts Perform?

Massachusetts is highly concentrated in occupations that require high levels of educational attainment, and these occupations command wages that are 1.5 to 2 times as high as the state's average wage ($42,830). In May 2003, the occupations that were most concentrated in the state relative to the U.S. were Life, Physical & Social Sciences (1.5 times as concentrated), Professional & Technical, and Human Services (each at 1.3 times). Of all occupational groups in Massachusetts, the highest average wages were found in Professional & Technical (which includes management, financial, and computer occupations) at $75,324, followed by Life, Physical & Social Sciences at $57,630, and Arts & Media (which includes graphic designers and editors) at $46,500. While Massachusetts has a higher employment concentration in these occupations than the nation, just over half of the state's employment can be found in Sales & Office (29%) and Other Services (22%) jobs. In May 2003, both paid below the mean average wage in Massachusetts at $33,255 and $27,273, respectively. [For more wage and employment concentration data, please see chart on page 4.]

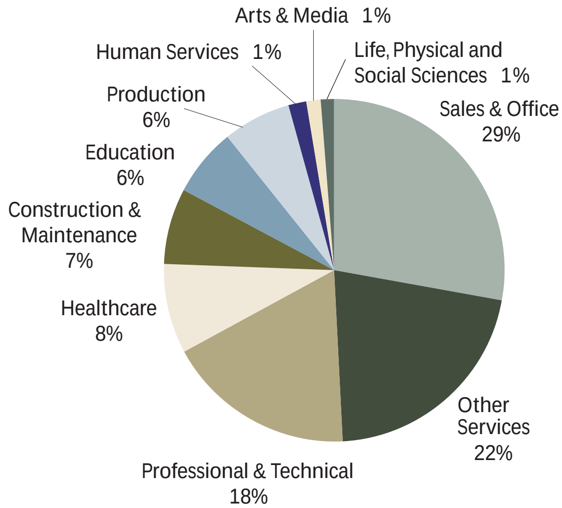
From 1999 to May 2003, the top growth occupations in Massachusetts were: Life, Physical & Social Sciences (7.6%), Arts & Media (2.5%), Human Services (2.3%), and Education (1.7%). However, the state's average annual growth rate in most occupational categories lagged the LTS average, and in Professional & Technical, Healthcare, and Sales & Office, Massachusetts growth rates decreased over time, while all of the LTS increased its total number of employees in these occupational categories. Both Massachusetts and the LTS experienced the same decline in Production occupations (-4.4%).

The average annual growth rate for all occupations in Massachusetts and the LTS as a whole were near zero (-0.2% and 0.3%, respectively) during this period because of the recession and recovery. Also, some occupations have experienced declines for different reasons. Some occupations, such as Professional & Technical, showed declines in employment primarily because of the recession, while other occupations, such as Production, are in secular decline.

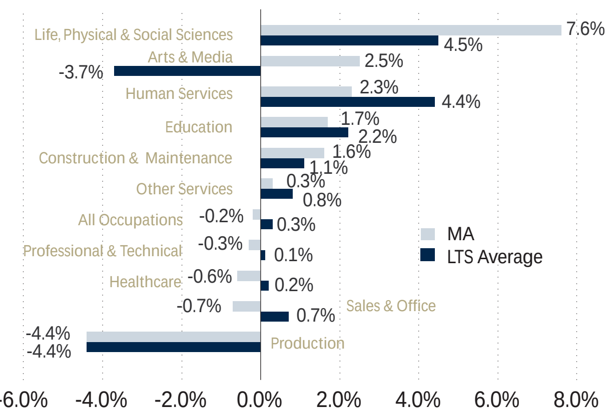
What Does this Trend Mean for Massachusetts?

The occupational distribution shows that Massachusetts is a generator of innovative and relatively high-paying jobs. Life, Physical, and Social Sciences occupations are highly-concentrated in Massachusetts and command high wages, a sign of competitive strength for the state. But the fraction of overall employment in this category is relatively small compared to other occupational categories. At the same time Production jobs, which are less concentrated in Massachusetts yet have a relatively high number in terms of employment, have not grown over time. The state should work towards building and retaining an adequate labor force to meet the employment needs of local companies, and take steps to encourage all its citizens to participate in the Innovation Economy through access to educational institutions and training programs.

Distribution of occupations, Massachusetts, May 2003



Percent change in occupations, Massachusetts and LTS average, 1999–May 2003



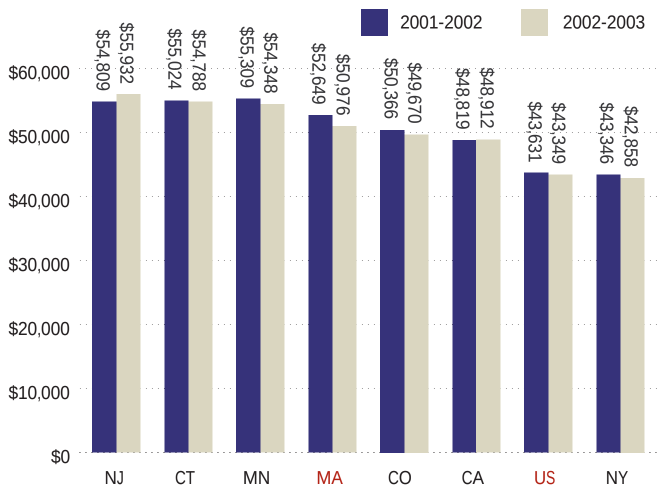
Source of all data for this indicator: Occupational Employment Statistics, Bureau of Labor Statistics

INDICATOR 3

Median Household Income

Massachusetts has fourth highest median household income among the LTS. State's income experiences a decline in growth from 2001 to 2003, along with several other LTS.

Median household income, Massachusetts, LTS, and US, 2001–2003 (2 year moving average)



Source: U.S. Census Bureau

Why Is It Significant?

Successful economies create opportunities to increase incomes. Rising incomes reflect a region's ability to keep wages in line with inflation and rising costs of living. This indicator compares the median household incomes of families by state and for the U.S.

How Does Massachusetts Perform?

In 2003, Massachusetts' median household income was $50,976, placing the state fourth among the LTS. New Jersey had the highest median household income at $55,932, while New York had the lowest at $42,858. The median household income in the U.S. for the same period was $43,349.

From 2001 to 2003, Massachusetts median household income declined 3.2%, the highest decline when compared to the LTS. New Jersey had the highest growth rate in median income at 2.0%, followed by California at 0.2% for the same period. Several of the LTS have seen a decrease in median household income over time, including Minnesota (-1.7%), Colorado (-1.4%), and New York (-1.1%). The growth rate in median household income in the U.S. also declined slightly during this period ($43,631 to $43,349, a -0.6% decrease).

What Does this Trend Mean for Massachusetts?

Massachusetts experienced a decline in median household income from 2001 to 2003, which shows that family incomes are not keeping pace with the state's high costs of living. The recent recessionary period has affected the income growth rates due to rises in unemployment rates (especially in job losses in the software and telecommunications industries), market volatility, and sluggish business recovery. While Massachusetts' median income continues to remain higher than the U.S. average, it remains lower than several of the LTS.

INDICATOR 4

FDA Approval of Medical Devices and Biotech Drugs

Massachusetts and most of the LTS experience a decline in number of 510(k) medical device approvals, but state has second highest number of PMAs among the LTS. Massachusetts has record year for biotech drug approvals in 2003.

Why Is It Significant?

In the U.S. Food and Drug Administration (FDA) approval process, two of the three application categories used to classify medical devices are premarket approvals (PMAs) for more sophisticated devices and 510(k)s for less sophisticated instruments or product improvements. [The other application category used for medical devices is investigational device exemptions (IDEs).] The most complex, highest-risk, and newest technologies tend to be classified as IDEs or PMAs. Approval rates reflect innovation in medical device manufacturing and important linkages to the teaching hospitals, where many of these instruments undergo clinical investigation. According to MassMEDIC, the association of medical device manufacturers in the state, there are 221 medical device companies based in Massachusetts that are responsible for more than $5 billion in annual shipments.

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 received 271 510(k) approvals for medical devices in 2003, a 14.5% decrease from the previous year (317), and the second highest one-year decline when compared to the Leading Technology States (LTS). Connecticut experienced a 35.8% decline in total number of 510(k) approvals for this period. Only New York experienced an increase in 510(k) medical device application approvals (8.4%) for the same period. Among the LTS, California ranked first in 510(k) approvals with 641, while Connecticut was last with 43 approvals in 2003.

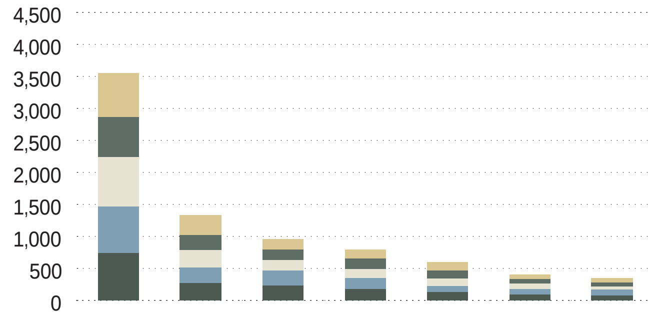
In 2003, Massachusetts had 4 PMAs, placing the state second among the LTS. California led the LTS in total number of PMAs with 10, followed by Massachusetts then New Jersey with 3 PMAs. Connecticut, Colorado, and New York had no PMAs in 2003.

In 2003, Massachusetts companies received a record 12 biotech drug approvals from the FDA, placing the state in a tie for second among the LTS with New Jersey, and just behind the LTS leader California, which had 13 biotech drug approvals. New York had 6 drug approvals, and Minnesota had 1 drug approval in 2003. Colorado and Connecticut had no biotech drug approvals that year. Other U.S. states with multiple biotech drug approvals for the same year included Washington (3), Maryland (2), and North Carolina (2). From 1999 to 2003, Massachusetts companies received a total of 24 biotech drug approvals, placing the state third among the LTS in biotech drug approval activity for this period. Among the LTS, California ranked first with 50 biotech drug approvals, followed by New Jersey with 28.

What Does this Trend Mean for Massachusetts?

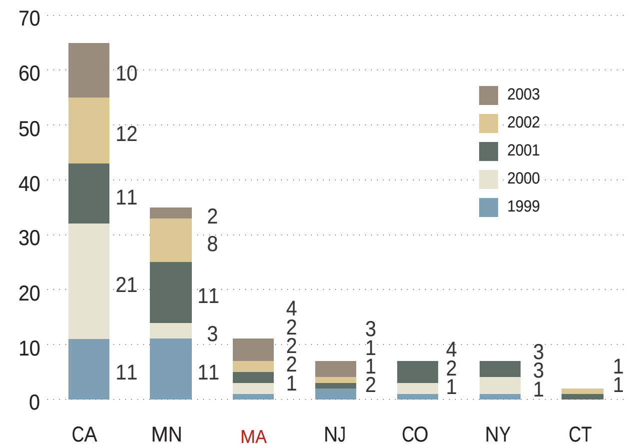
Massachusetts is very competitive in biotechnology and life sciences industries. Biotech drug approvals represent the end result of years of research and investment. Growth in the number of biotech drug approvals encourages further capital investments in life sciences research. The life sciences industries present in Massachusetts are strong, both currently and historically. The state should encourage collaboration between universities, companies, and the teaching hospitals and nonprofit research organizations. Every effort should be made at the federal level to promote funding for research and development (R&D) and supporting infrastructure so that there is a consistent stream of new drugs and devices coming into the pipeline.

Total number of 510k approvals, Massachusetts, other LTS, 1999-2003

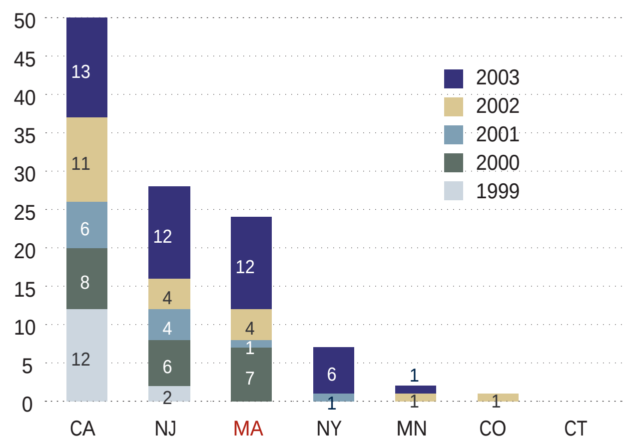


	CA	MA	NJ	NY	MN	CO	CT
1999	734	244	242	165	100	88	93
2000	769	277	162	139	117	74	56
2001	628	230	164	161	131	72	58
2002	682	317	164	143	128	70	67
2003	641	271	146	155	122	70	43

Total number of premarket approvals (PMAs), Massachusetts, other LTS, 1999-2003



Total number of biotechnology drug approvals by the Food and Drug Administration (FDA), Massachusetts and other LTS, 1999–2003



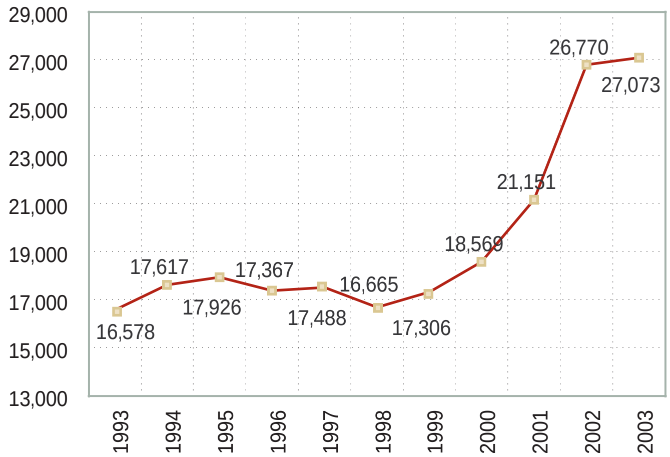
Source of all data for this indicator: Food and Drug Administration

INDICATOR 5

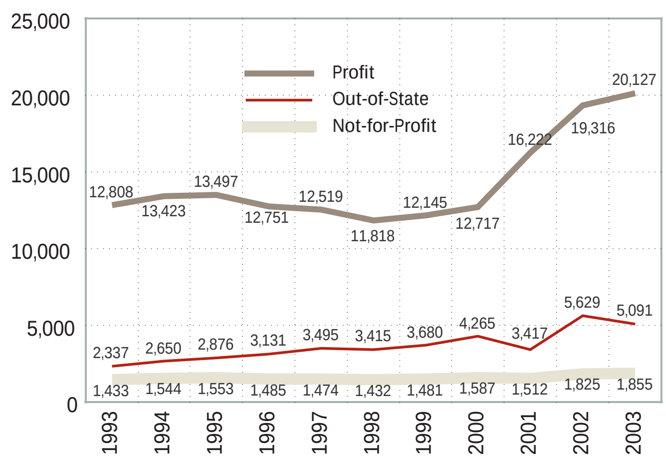
New Business Incorporations

New business incorporations experience modest increase in 2003. Total number of for-profit businesses in Massachusetts increases, while number of new out-of-state business incorporations decreases from 2002 to 2003.

Number of new business incorporations, Massachusetts, 1993–2003



Number of new business incorporations by category, Massachusetts, 1993–2003



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

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.

How Does Massachusetts Perform?

In 2003, 27,073 new business incorporations were registered with the Secretary of State—a 1.1% increase from 2002 (26,770). Of all new business incorporations registered in 2003, 74% were for-profit businesses; 7% were not-for-profit businesses; and 19% were out-of-state corporations (which includes profit and not-for-profit). The upward trend in the total number of new business incorporations since 1998 has been very significant in Massachusetts.

The total number of new out-of-state business incorporations in Massachusetts decreased 9.6% from 2002 to 2003, compared to a 64.7% increase the previous year. The number of new for-profit business incorporations in Massachusetts increased 4.2% from 2002 to 2003, which was a larger increase than not-for-profit incorporations, which experienced a 1.6% increase in the state.

What Does this Trend Mean for Massachusetts?

The increase in new business incorporations in Massachusetts is good news, for it shows that the state has a strong environment for entrepreneurs and new businesses. While new for-profit businesses increased in the state, the total number of out-of-state business incorporations declined from 2002-2003, the first decline since the 2000-2001 time period. The state should continue to support programs and policies that encourage the formation of new businesses.

INDICATOR 6

Small Business Innovation Research Awards (SBIRs)

Massachusetts has record year in 2002 in both total number and value of SBIR awards. Other LTS also have significant increases in both areas.

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 source of financing for start-up companies. Nationally, 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.

How Does Massachusetts Perform?

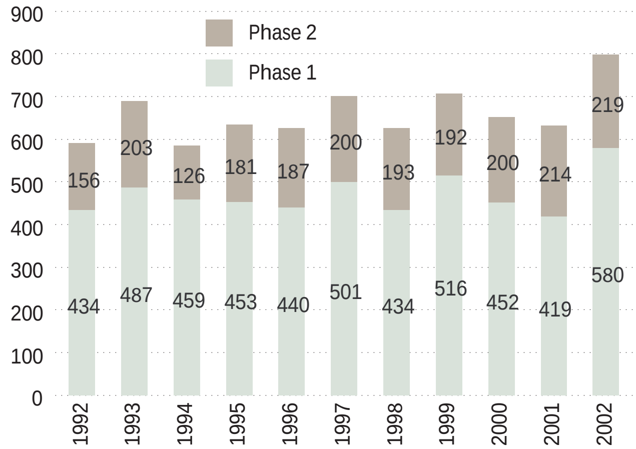
Since the inception of the program in 1983, Massachusetts has consistently ranked second behind California in total number of awards and dollar amounts received from the SBIR program. Massachusetts received a total of 799 SBIR awards in 2002, a 26.2% increase from 2001 and the largest number of awards received in a single year since the *Index* began tracking SBIR awards data. On a per capita basis, Massachusetts had the highest award rate in 2002 (12.43 awards per 100,000 people) when compared to the Leading Technology States. Colorado was second among the LTS with 6.52 awards per capita, followed by California (3.41) and Connecticut (3.00).

In 2002, the total dollar value of SBIR awards to Massachusetts companies was $216 million. Phase II awards are significantly larger in dollar value than Phase I awards. While Phase I awards represented 27.6% ($60 million) of the SBIR awards in Massachusetts in 2002, Phase II awards accounted for 72.3% ($156 million) of the total dollar value in the state. The distribution of Phase I and Phase II dollars is similar among the LTS. Historically, approximately 75-80% of Massachusetts SBIR and Small Business Technology Transfer (STTR) funding comes from either the Department of Defense (DoD) or Health and Human Services (HHS). In 2002, the value of STTR funding to Massachusetts companies was approximately $9 million dollars, up 10% from 2001 ($8.2 million).

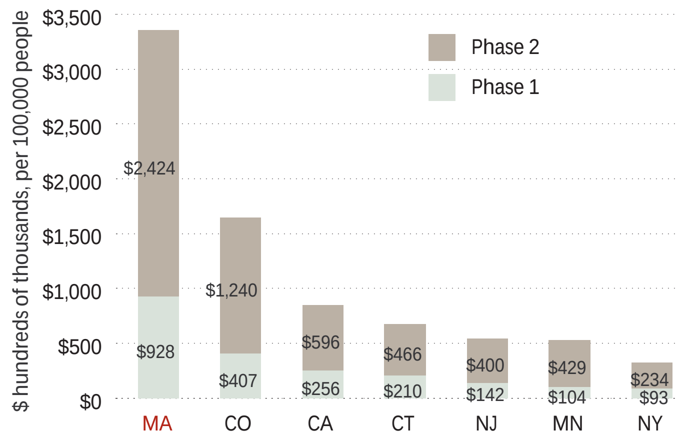
What Does this Trend Mean for Massachusetts?

This is good news for Massachusetts. The state continues to be a national leader in SBIR awards in 2002. Federal grant awards are a critical component to the state's Innovation Economy, especially since the venture capital community's share of start-up and seed funding has declined since the mid 1990s. SBIR funding plays an important role in providing the needed start-up and seed funding to local technology companies. Massachusetts should continue to work with federal agencies in Washington to insure robust funding for this program.

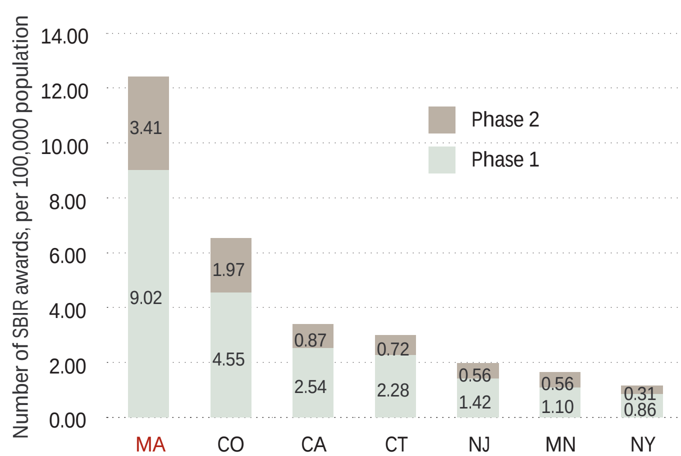
Number of SBIR awards to Massachusetts companies by phase, 1992–2002



Value of SBIR awards to Massachusetts and other LTS companies by phase, per 100,000 people, 2002

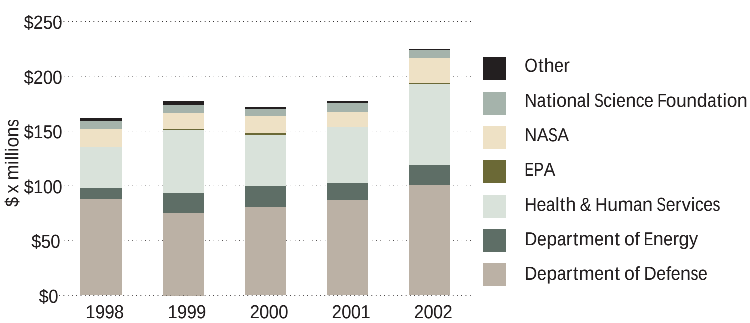


Number of SBIR awards to Massachusetts and other LTS companies by phase, per 100,000 people, 2002



Source of all data for this indicator: Small Business Administration

Distribution of Massachusetts SBIR and Small Business Technology Transfer (STTR) Awards by Federal Agency, 1998-2002

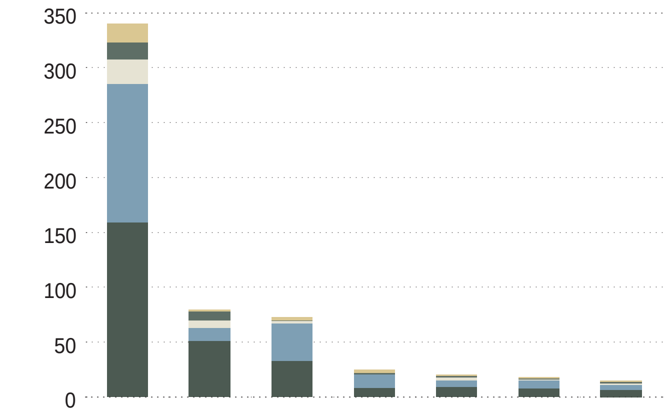


INDICATOR 7

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

Massachusetts market experiences increase in number of IPOs from 2002 to 2003, although numbers continue to remain relatively small when compared to previous years. M&A activity increases in Massachusetts in 2003.

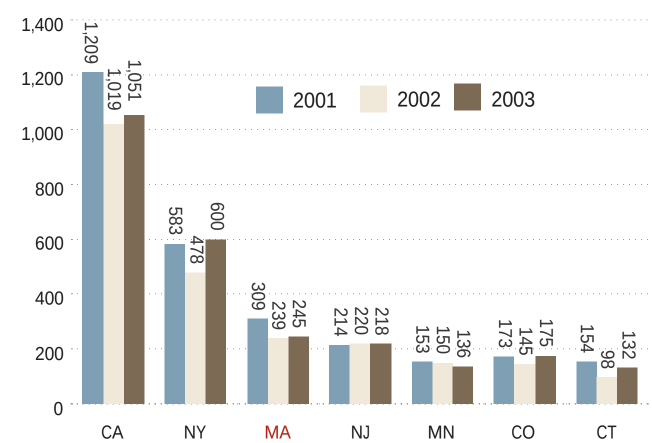
Total number of initial public offerings (IPOs), Massachusetts and other LTS, 1999–2003



	CA	NY	MA	CO	NJ	MN	CT
2003	17	2	3	3	1	1	1
2002	15	8	1	2	1	1	2
2001	23	7	2	0	3	1	1
2000	126	12	34	12	6	7	5
1999	159	51	33	8	9	8	6

Source: Renaissance Capital

Total number of mergers and acquisitions (M&As) activity of acquired companies located in Massachusetts, other LTS, 2001–2003



Source: Mergerstat

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 rapidly growing companies. Innovation-based companies may be attractive to other firms seeking to diversify, accelerate new product development, expand sales or market share, and create an integrated service model that can further develop technologies and products.

How Does Massachusetts Perform?

The IPO market is regaining strength in Massachusetts and the U.S. after the precipitous fall from 2000 to 2001. Massachusetts had three IPOs in 2003, up from just one in 2002. In 2003, Massachusetts was tied with Colorado for second among the LTS, with California leading in IPO activity with 17 IPOs. Forty-one percent of all the IPOs in the U.S. in 2003 were located in Massachusetts and the six other LTS.

The IPO market in Massachusetts continues to rebound in 2004. At the time of publication, there have been nine IPOs in Massachusetts. The Healthcare Technology cluster had five of the IPOs—Alnylam Pharmaceuticals, Critical Therapeutics Inc., Idenix Pharmaceuticals, Momenta Pharmaceuticals, and NeuroMetrix. The other four IPOs were in Computer & Communications Hardware (Color Kinetics), Financial Services (First Ipswich Bancorp), Software & Communications Services (Phase Forward) and Other Industries (Beacon Roofing Supply). This placed Massachusetts third among the LTS in total number of IPOs.

The total number of M&As in Massachusetts increased 2.5%, from 239 in 2002 to 245 in 2003, which was the fourth highest increase when compared to the LTS. Among the LTS, Connecticut experienced the largest increase (34.7%) in the number of M&As from 2002 to 2003, while Minnesota and New Jersey were the only LTS to have a decline in total number of M&As (-9.3% and -0.9%, respectively). Nationally, the number of M&As increased 11.9% during this period. In 2003, approximately 38% of all M&A activity in the United States occurred in the seven LTS.

What Does this Trend Mean for Massachusetts?

The IPO rebound in Massachusetts is good news. The U.S. economy is turning around as well as in Massachusetts. However, the IPO numbers for the state are still small, significantly below California, and highly dependent on factors and conditions in financial markets not related to Massachusetts. Successful IPOs in Massachusetts enhance the attractiveness of the region for talented innovation workers from other states and countries. It is important for the state to aggressively court start-up companies and encourage these types of firms to grow in Massachusetts. The increases in M&A activity in Massachusetts reflects a more vibrant economy overall, for buyers are seeking strategic and financial value in acquiring businesses that they could not achieve organically. This market activity also shows that Massachusetts companies are desirable assets to firms that are willing to pay to acquire them. The Commonwealth's M&A activity should be watched closely to ensure that it does not lose too many corporate headquarters and potential opportunities for firms to expand and grow within the state.

INDICATOR 8

Corporate Headquarters, Number of "Technology Fast 500" Firms, and Number of "Inc 500" Firms

Massachusetts number of corporate headquarters experiences small decrease from 2002 to 2003. Total number of Technology Fast 500 firms headquartered in Massachusetts increases in 2003. State has slight decline in total number of Inc. 500 firms, as do the other LTS.

Why Is It Significant?

Corporate headquarters are important "anchors" for a region. They generate and acquire new businesses, and corporations typically keep their key strategists and development-related activities near its headquarters. Corporate headquarters tend to have greater community ties, including philanthropic support, than do branch offices.

To be considered a Technology Fast 500 firm by Deloitte and Touche, LLP, a company must meet several criteria, including devoting a significant proportion of its revenues to research and development spending in technology, be in business for at least five years, and be headquartered in North America.

To be eligible for the Inc. 500 company list by Inc. Magazine, a company must meet numerous criteria, including being an independent and privately held company, have a four year sales history, and be based in the United States.

How Does Massachusetts Perform?

In 2003, Massachusetts was home to the corporate headquarters of 203 firms with 500 or more employees, a 3.3% decrease compared to the previous year (210), and the second highest decline compared to the LTS. Connecticut experienced the largest drop in corporate headquarters (-6.8%), while Colorado was the only LTS to experience an increase in corporate headquarters, from 92 firms in 2002 to 98 in 2003, a 6.5% increase.

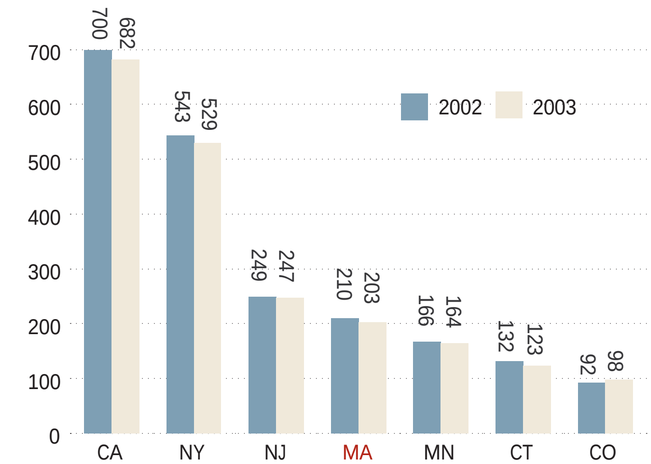
After experiencing a decline in total number of Technology Fast 500 firms from 1999 to 2002, Massachusetts had an increase in "Tech Fast 500" firms in 2003, from 28 firms in 2002 to 36 firms (28.6% increase). Among the LTS, California (127) ranked first, followed by Massachusetts then New Jersey with 23 firms. In Massachusetts, Software companies comprised 55% of all "Tech Fast 500" firms, followed by Life Sciences (19%) and Internet (8%) companies. In 2003, 49% of all Technology Fast 500 firms in the U.S. were headquartered in the seven LTS.

In 2003, Massachusetts was home to 20 "Inc. 500" companies, placing the state third among the LTS. California was first with 50 Inc. 500 firms, followed by New York with 26 firms. Since 2001, all the LTS have experienced a decline in total number of "Inc. 500" firms. In Massachusetts, all but one of the firms that made the 2002 but not the 2003 list remains in the state (one company moved to New York). Sixty percent of the "Inc. 500" companies located in Massachusetts are classified in either the Innovation Services or Software & Communications Services clusters. Twenty-seven percent of all "Inc. 500" Firms in the U.S. are located in the seven LTS.

What Does this Trend Mean for Massachusetts?

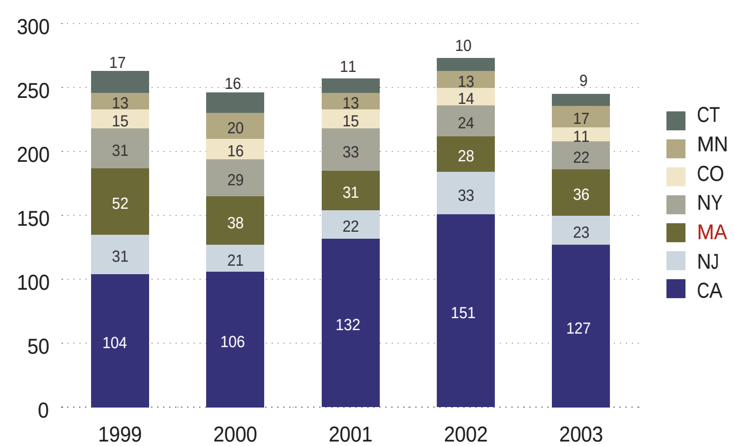
Massachusetts is holding up well in terms of total number of fast-growing companies. Although the state has seen an overall decline in total number of "Fast 500" firms from 1999 to 2003, approximately two-thirds of all Massachusetts firms that made the list in 1999 remain in business in the state today. The decline in total number of corporate headquarters with more than 500 employees was small. The state, however, wants to see this number growing. Corporate headquarters are often the site of R&D and highly-educated workers. The state should try to attract more corporate headquarters of all kinds, from technology-focused to traditional industries.

Number of corporate headquarters located in Massachusetts and other LTS, corporations with more than 500 employees, 2002 and 2003



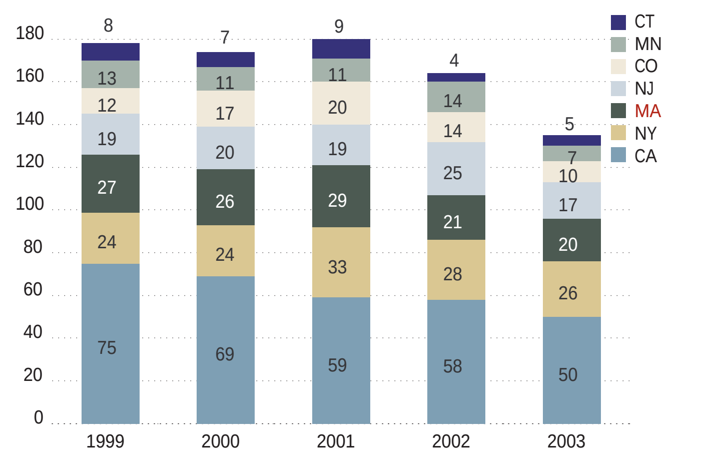
Source: Reference USA

Total number of "Tech Fast 500" firms located in Massachusetts and other LTS, 1999–2003



Source: Deloitte and Touche, LLP

Total number of "Inc 500" companies located in Massachusetts and other LTS, 1999–2003



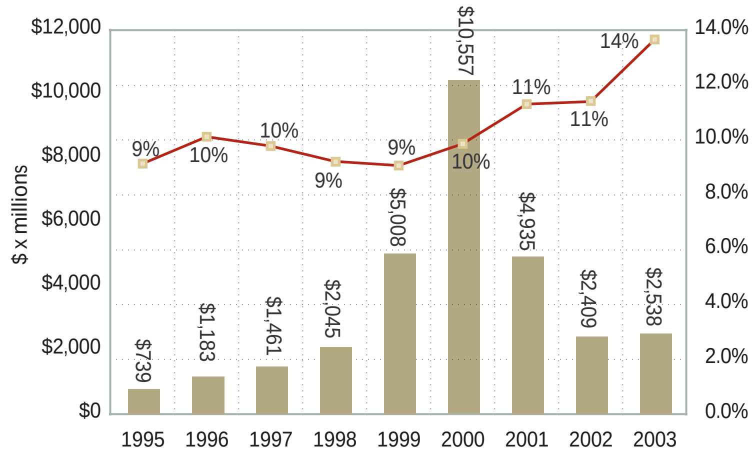
Source: Inc. Magazine

INDICATOR 9

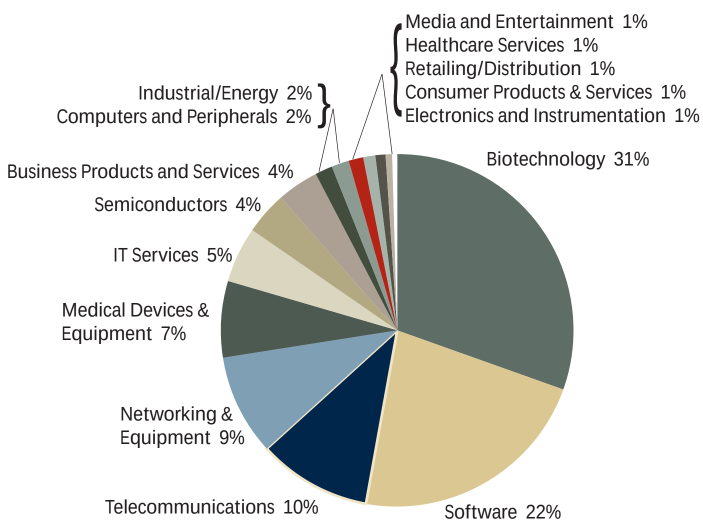
Investment Capital

Venture capital increased in Massachusetts from 2002 to 2003, while U.S. had a decrease in investments. Angel investment in early stage firms continues to increase and play a critical role in the Massachusetts Innovation Economy.

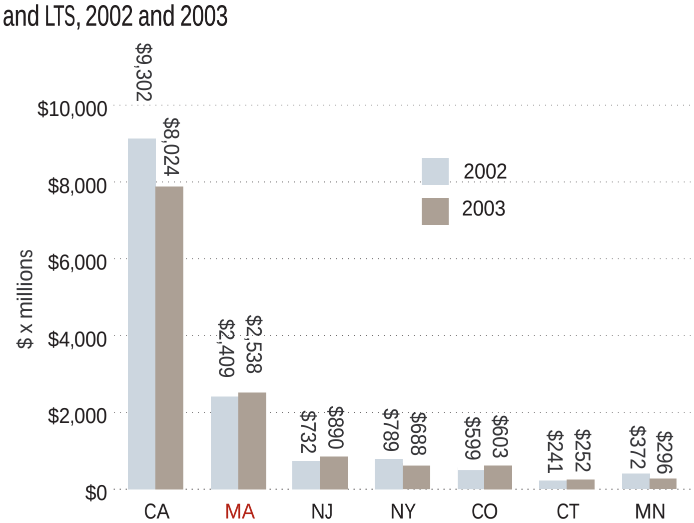
Venture capital investments received by companies and as a percent of total US venture capital investments, Massachusetts, 1995–2003



Distribution of venture capital investments, Massachusetts, 2003



Total venture capital investments, Massachusetts and LTS, 2002 and 2003



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

Why Is It Significant?

In addition to government research grants, private investment capital funds the creation and development of new companies in the Innovation Economy, and the types of jobs available in the future. Private investment capital comes from many sources: an entrepreneur's own funds (personal savings, short-term debt), angel investors (organized firms, friends and family), and professional venture capital firms.

How Does Massachusetts Perform?

Venture capital investments in Massachusetts rebounded moderately in 2003 after three years of decline. Approximately $2.5 billion was invested in the state's firms, an increase of 5.3% from 2002 ($2.4 billion). The 2003 total represents about 14% of all venture funds invested in the U.S., up from 11% in 2002. In 2003, the Biotechnology and Software industry sectors attracted the highest amounts of venture capital in Massachusetts, with more than half of the total share ($764 million and $562 million, respectively). Through the first two quarters of 2004, Massachusetts attracted approximately 14% ($1.5 billion) of total U.S. venture capital investments ($10.6 billion).

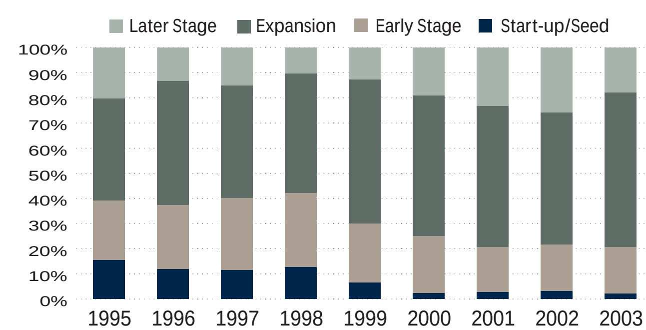
Over time, Massachusetts is consistently second to California and outpaces the other LTS in total venture capital investments. From 2002 to 2003, several of the LTS experienced a decline in venture funding, including Minnesota (-20.4%), California (-13.7%), and New York (-12.9%). In 2003, Massachusetts and the LTS attracted 71% of all venture capital investments made in the U.S., with California (43%) and Massachusetts (14%) attracting more than half of all funding.

Data on angel investments by state is not yet readily available, although U.S. numbers have begun to be compiled. The Kauffman Foundation estimates that angel investment totaled about $18.1 billion in 2003, up from $15.7 billion in 2002. The University of New Hampshire's Center for Venture Research reported that the top sectors for angel investors in 2003 were Software (26%), followed by Life Sciences (13%), and Computer Hardware (12%).

What Does this Trend Mean for Massachusetts?

The recent recession reduced the willingness of venture capital firms to make new investments, so the upturn in 2003 is a welcome sign that funds for companies have begun to flow again. While the dollar increase is not large, the state's share of U.S. venture capital investments grew to a nine-year high in 2003, demonstrating relative strength of the innovative environment in Massachusetts. Venture capital patterns remain conservative; in 2003 start-up/seed investments (as a proportion of all venture funding) remained at a historically low level. The continuing flow of angel investor capital and federal research grants (such as SBIRs) are becoming more important for emerging firms in Massachusetts that need early stage financing.

Distribution of Massachusetts venture capital investments, by stage of financing, 1995–2003



INDICATOR 10

Population Growth Rate, Migration, and Distribution of Immigrants

Massachusetts continues to have a relatively low population growth rate. Massachusetts experiences largest increase in domestic out-migration in more than ten years. Immigration from abroad shows modest increase in 2003.

Why Is It Significant?

Massachusetts's low population growth constrains the expansion of its workforce and may inhibit business growth and economic development. Migration thus becomes an important factor in the state's ability to sustain an adequate workforce and its long-term prosperity. 'Net positive' migration (more people moving in than moving out) can compensate for the state's slow population growth, particularly if new migrants bring skills and educational backgrounds that sustain highly-innovative industries that create high-paying and productive jobs.

How Does Massachusetts Perform?

From 1993 to 2003, Massachusetts experienced an average annual population growth rate of 0.7%, slightly higher than Connecticut and New York with the lowest rate, each at 0.6%. The nation grew at 1.2% annually during the same period. Among the LTS, Colorado had the highest average annual population growth rate at 2.5%, followed by California (1.3%), then Minnesota (1.1%).

In 2003, Massachusetts experienced a net outflow of just over 45,000 domestic migrants (45,000 Massachusetts residents moved out of the state). This was the highest level of net domestic out-migration since 1990, when the state suffered a net outflow of more than 69,000 residents. International immigration to Massachusetts in 2003 totaled over 33,000 residents, a 3.7% increase from 2002 and the highest number of international in-migrants in more than ten years. Even this high level of immigration has not fully offset domestic out-migration over time in Massachusetts. Total net migration (net domestic migration and international immigration) yielded a loss of more than 11,000 residents.

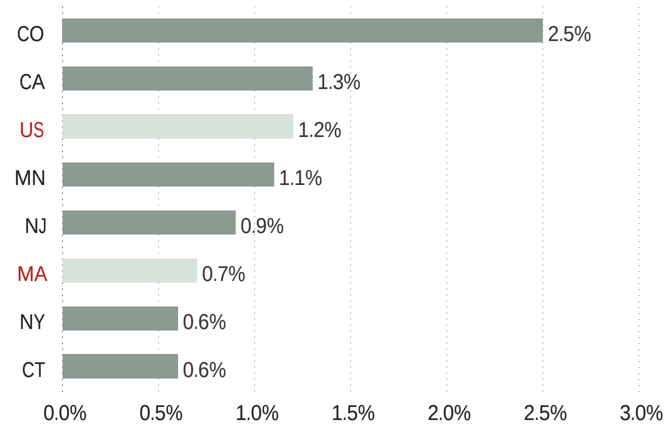
In 2002, more than 31,000 immigrants entering the U.S. indicated Massachusetts as their intended state of residence. This represented 3.0% of all immigrants coming to the U.S., and a 34.6% increase from the year before for the state. Immigrants from Asia had the highest percentage (33%) intending to reside in Massachusetts, followed by Europe (23%), the Caribbean (15%) and South America (11%).

What Does this Trend Mean for Massachusetts?

Recent findings by the MassINC, the University of Massachusetts (UMASS) Donahue Institute, and MassHousing publication *MASS.migration* show that both out-migration and in-migration held steady throughout the 1990s, with out-migrants modestly outnumbering in-migrants. When the recent recession arrived in late 2000, net domestic out-migration surged as fewer people moved to Massachusetts and larger numbers moved out. As their report shows, "both in-migrants and out-migrants as a group tend to be younger, more highly educated and more involved in key innovation industry clusters than the state's workforce as a whole." While some foreign immigrants (and foreign students in particular) have been important to the Innovation Economy, foreign immigration does not offset the state's annual losses through domestic migration.

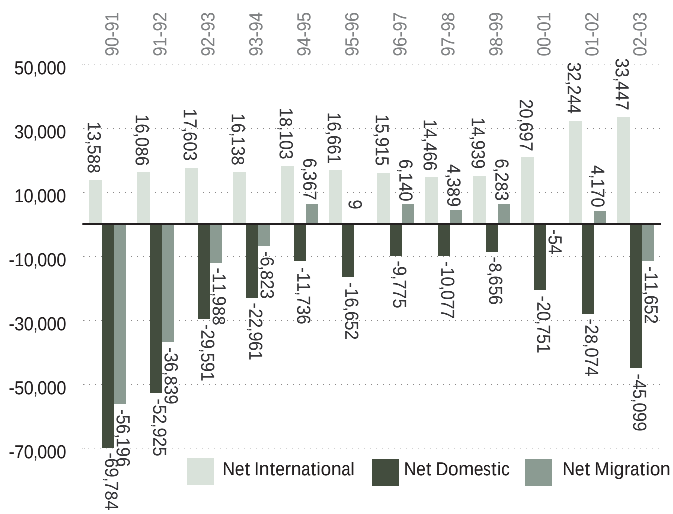
The recent recession and what some see as a "jobless recovery" casts the state's chronic out-migration in a new light. Some of the key industry sectors that have been most attractive to younger, highly-educated, migration-prone workers are among the sectors that have been particularly hard hit by job cuts. Lean times in once fast-growing industries, such as Software, may well result in even slower overall growth in the state's Innovation Economy workforce. The Commonwealth must find ways to assist its residents to gain education and skills for opportunities in new, emerging industries in the state.

Average annual population growth rate, Massachusetts, other LTS, and US, 1993–2003



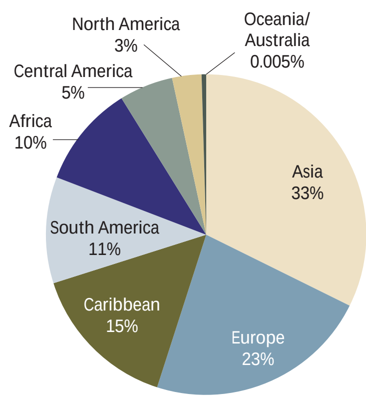
Source: U.S. Census Bureau

International migration and net domestic migration, Massachusetts, July 1990–July 2003



Source: U.S. Census Bureau

Distribution of immigrants admitted by region of birth intending to reside in Massachusetts, 2002



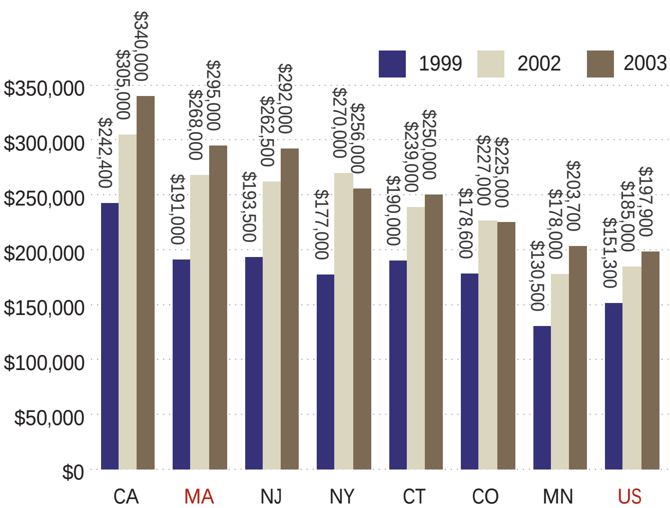
Source: U.S. Citizenship and Immigration Services

INDICATOR 11

Median Price of Single-Family Homes, Home Ownership Rates, and Housing Starts

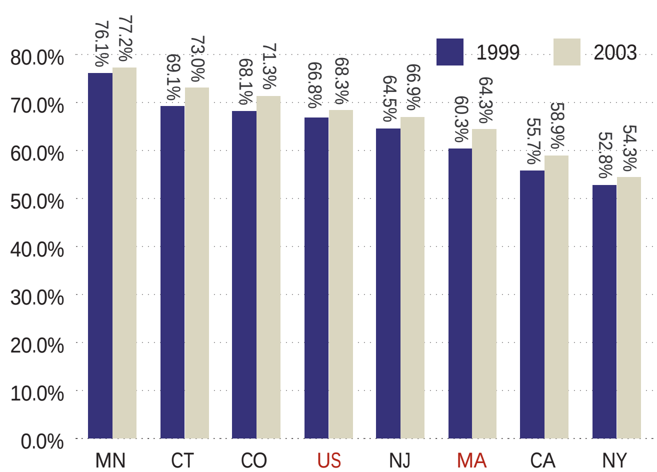
Massachusetts has second highest median price of single-family homes compared to the LTS. Although home ownership rate continues to rise in Massachusetts, state rate lags most of the LTS. Massachusetts number of new housing starts is relatively low.

Median price of single-family homes, Massachusetts, other LTS, and US, 1999, 2002 and 2003



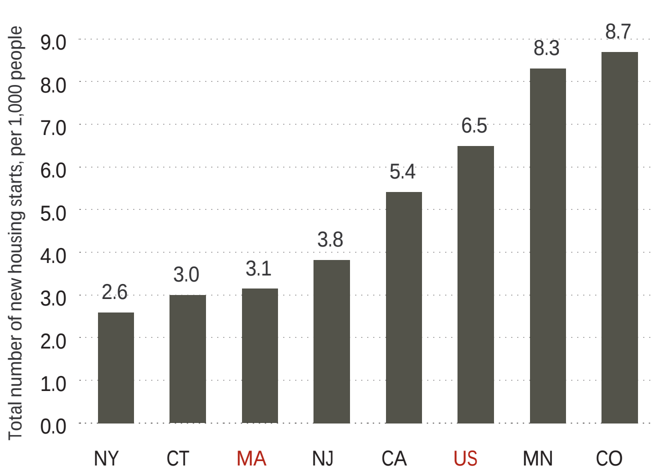
Source: Federal Housing Finance Board

Home ownership rates, Massachusetts, other LTS, and US, 1999 and 2003



Source: US Census Bureau

Per capita new housing starts, Massachusetts, LTS, and US, 2003



Source: U.S. Census Bureau

Why Is It Significant?

The availability and affordability of homes are top indicators of maintaining a strong quality of life for a region. Affordable housing can help to attract and retain young, mobile, and highly skilled workers. Home ownership rates are also a bellwether for a state's economy, since they indicate willingness of the population to live in the state over the long term and a desire to make an investment in the community.

How Does Massachusetts Perform?

In 2003, the median price of a single-family home in Massachusetts was $295,000, the second highest among the LTS and higher than the U.S. average ($197,900). California topped the LTS and the U.S. with a median home price of $340,000, with New Jersey in third place at $292,000. Minnesota had the lowest median single-family home price at $203,700.

From 2002 to 2003, Massachusetts' median price of a single-family home increased 10.1%, which was the fourth-highest compared to the LTS. Minnesota had the highest increase in median home price (14.4%), followed by California (11.5%), and New Jersey (11.2%). In sharp contrast, Colorado and New York experienced a decrease in median price for a single-family home (0.9% and 5.2%, respectively) for the same period. Between 1999 and 2003 in Massachusetts, the median price of a single-family home increased at an average annual rate of 9.1%, the second highest increase among the LTS (after Minnesota at 9.3%) and significantly above the U.S. average (5.5%). Colorado had the lowest average annual increase at 4.7% for this period.

In 2003, Massachusetts had a home ownership rate of 64.3%—the third lowest among the LTS and lower than the U.S. average (68.3%). Among the LTS, Minnesota had the highest home ownership rate at 77.2% in 2003. As noted above, Minnesota had the lowest median single-family home price during this period. New York and California had the lowest home ownership rates at 54.3% and 58.9%, respectively, in 2003. From 2002 to 2003, Massachusetts experienced a 2.6% increase in home ownership rates, which was second only to Colorado (3.2%) and a higher increase when compared to the LTS average (0.8%) and the U.S. (0.6%). New York and New Jersey were the only LTS to experience a decrease in home ownership at 1.3% and 0.4%, respectively, for the same period.

In 2003, on a per capita basis, Massachusetts had 3.1 new housing starts per 1,000 people, which was the third lowest when compared to the LTS. Colorado was first with 8.7 new housing starts per capita, followed by Minnesota with 8.3 housing starts. New York ranked last among the LTS with 2.6 housing starts per 1,000 in the population.

What Does This Trend Mean for Massachusetts?

The state's high housing costs can hurt recruitment and retention of skilled workers. Even though the state's incomes are relatively high, its housing prices are very high, and the state's home ownership rates are relatively low. Massachusetts' home ownership rate has been increasing over time; this could be attributed to attractive interest rates that are making it more appealing to purchase a home. The Commonwealth should try to expand the housing supply so that citizens have access to affordable housing and the opportunities to be homeowners.

INDICATOR 12

Educational Attainment, Engineering Degrees Awarded, and Scientists & Engineers in the Labor Force

State has highest percentage of its adult population with a bachelor's degree or higher compared to the LTS. Number of engineering degrees granted in Massachusetts from 2002 to 2003 continues to increase. Massachusetts has largest share of scientists and engineers in the labor force compared to the LTS and U.S.

Why Is It Significant?

The educational attainment of the workforce is a fundamental indicator of how well a region can generate and support knowledge-based, innovation-driven economic growth. Regions that are well-served by postsecondary engineering 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 2003, 37.6% of the Massachusetts adult population (age 25 years and over) had a bachelor's degree or higher, placing the state first among the LTS and ahead of the U.S. (27.2%). From 1993 to 2003, the Massachusetts adult population with a college degree or higher has increased a total of 25%, which was the second-highest increase among the LTS, and slightly higher than the U.S. (24%). Minnesota experienced the largest increase of its population with a bachelor's degree or higher at 40% for the same period.

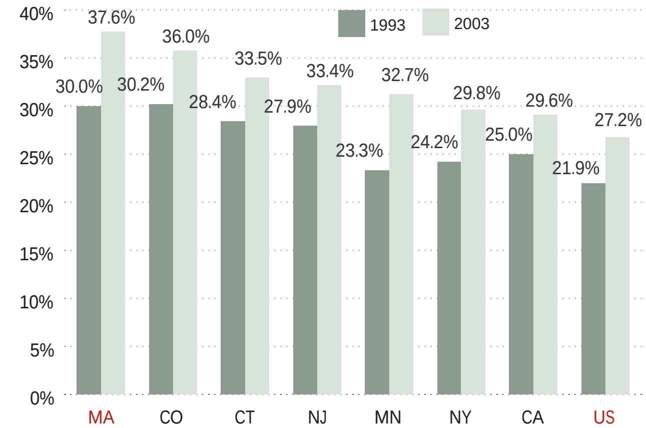
Massachusetts experienced a 3.6% increase in total number of engineering degrees awarded, from 4,660 in 2002 to 4,826 in 2003, which was well below the U.S. increase of 10.5%. At the undergraduate level, the number of engineering degrees awarded by Massachusetts schools had a modest increase of 1.7% (2,548 versus 2,591). Nationally, undergraduate engineering degrees increased 9.3% during the same period. At the graduate level, the number of master's engineering degrees awarded by Massachusetts institutions increased by 7.5% in 2003, a smaller increase than in the U.S. total (14.5%). The total number of engineering PhDs awarded in Massachusetts continued to decrease (3.5%). Nationally, there was a 2.8% increase in the number of engineering PhDs from 2002 to 2003. In 2003, Massachusetts private higher education institutions granted the majority of engineering degrees at 83%, while public higher education institutions granted 17% of all engineering degrees.

In 1999, scientists and engineers comprised 14.0% of Massachusetts total labor force, which was the highest share compared to the LTS and the U.S. (8.2%). Colorado was second with 12.0% of its labor force comprised of scientists and engineers, followed closely by Connecticut (11.9%). California had the smallest share of scientists and engineers in the labor force at 9.5%. From 1995 to 1999, among the LTS, Minnesota increased its share of scientists and engineers in its labor force by 10.7%, more than double the rate of the next closest state Colorado (4.4%). Massachusetts share of scientists and engineers in its labor force increased 1.5%, which was slightly lower than the U.S. rate (1.6%). California (-5.4%) and New Jersey (-2.2%) both experienced a decline in its share of scientists and engineers in the workforce.

What Does This Trend Mean for Massachusetts?

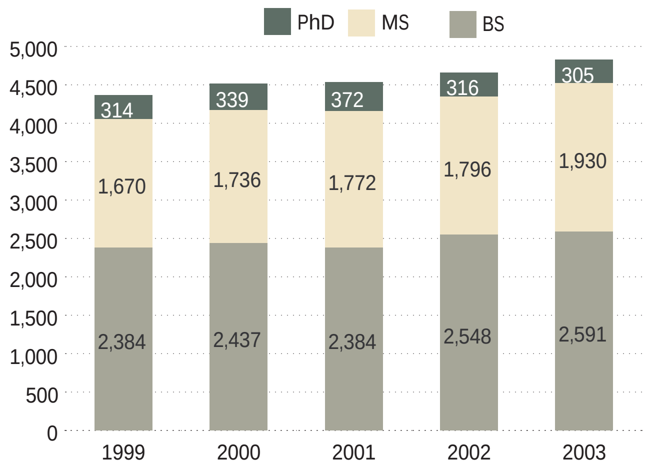
An educated workforce lies at the heart of the Innovation Economy, and its people are the state's most valuable resource. The state must continue efforts to get students in early grades to pursue math and science degrees and careers. Engineering and scientific workers, in particular, characterize innovative and high-tech sectors, and play a key role in the creation and development of new products, processes, and technologies.

Percent of adult population with a bachelor's degree or higher, Massachusetts, LTS and US, 1993 and 2003



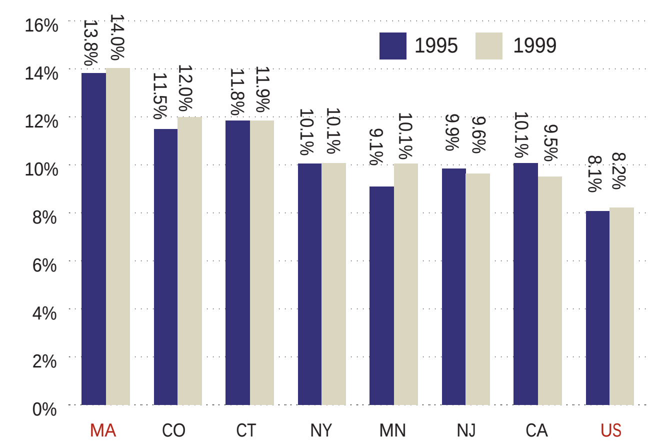
Source: U.S. Census Bureau

Number of engineering degrees awarded by Massachusetts schools, by degree level, 1999–2003



Source: American Association of Engineering Societies

Scientists and engineers as a share of the total labor force, Massachusetts, LTS, and US, 1995 and 1999



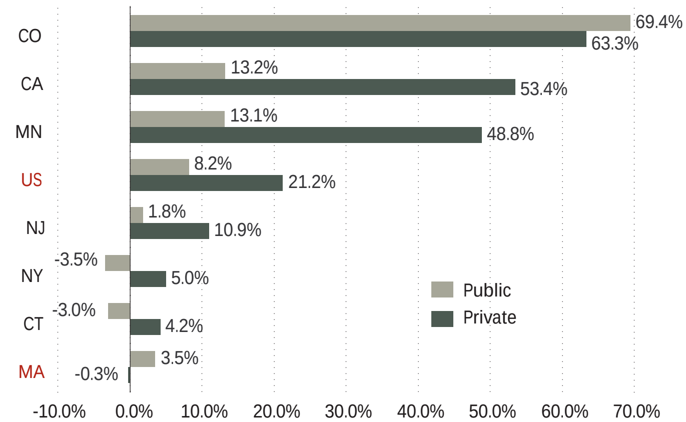
Source: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT); and U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics

INDICATOR 13

University Enrollments and Public Higher Education Spending

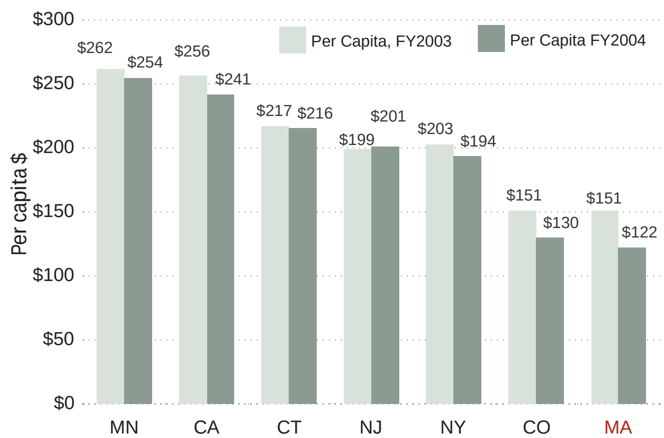
Massachusetts public higher education institutions experience increase in enrollments, but state is only LTS to experience a decline in private higher education enrollments. Massachusetts has lowest per capita state appropriations for public higher education operational expenses compared to the LTS.

Percent change in total enrollments, public and private degree granting institutions, Massachusetts, other LTS, and US, 1991–2001



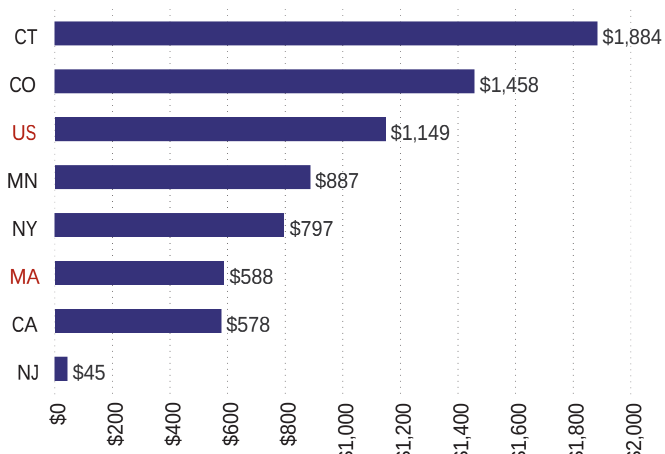
Source: National Center for Educational Statistics: Digest of Education Statistics

Appropriations of state/local tax funds for operating expenses of public higher education, per capita, Massachusetts and other LTS, fiscal years 2003 and 2004



Source: Grapevine Center for the Study of Education Policy

State higher education capital expenditures per full time equivalent (FTE) student, Massachusetts, LTS and US, 2002



Source: National Association of State Budget Offices and The National Center for Education Statistics

Why Is It Significant?

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. Local colleges and universities are an important contributor to a diverse and well-educated population, and provide the learning and skills needed for jobs in the Innovation Economy. Investments in the local higher education system are important to strengthening the region's innovation infrastructure.

How Does Massachusetts Perform?

From 1991 to 2001, Massachusetts enrollments in public degree granting institutions increased 3.5%, compared to an 8.2% increase for the nation. Among the LTS, Colorado had the highest increase at 69.4%, followed by California at 13.2%, and Minnesota at 13.1%. New York and Connecticut were the only two LTS to experience a decrease (-3.5%, and -3.0%, respectively). Private degree granting institutions in Massachusetts experienced a 0.3% decrease from 1991 to 2001, and was the only LTS to have a decline in these enrollments. The national increase in private degree granting institutions during this period was 21.2%. Colorado (63.3%) and California (53.4%) experienced the largest increases in these enrollments during this decade. These two states have also led the LTS in population growth rates over the past ten years.

For fiscal year (FY) 2004, Massachusetts ranked last among the LTS with per capita state appropriations of $122 towards public higher education expenditures; from the previous year relative to the LTS, Massachusetts also had the largest decrease in funding (-19.3%). Minnesota ranked first among the LTS in FY2004 at $254, followed by California at $241, then Connecticut at $216. Among the LTS, on a per capita basis, only New Jersey increased per capita funding for public higher education ($199 to $201) from 2003 to 2004.

In 2002, when looking at state spending for public higher education per full time equivalent (FTE) student, Massachusetts spent $588 per student on public higher education, which was lower than most of the LTS. California was just below Massachusetts with $578 per FTE student, while Connecticut and Colorado led the LTS at $1,884 and $1,458, respectively, for the same period. The U.S. average was $1,149 per FTE for the same year.

What Does This Trend Mean for Massachusetts?

Massachusetts enrollments in public colleges and universities continued to grow in the 1990s. Public higher education funding, however, has been very low relative to the LTS and has been on the decline. At the same time, private sector higher education enrollments in the state have fallen in contrast to increases at all the other LTS. These trends threaten Massachusetts competitive advantage as an academic powerhouse. One of the state's key competitive strengths is attracting students both locally and worldwide—in turn, attracting high technology companies. According to the President's Office at the University of Massachusetts, 79% of recent graduates work in Massachusetts, and 66% of alumni continue to work and live in the state. The Commonwealth needs to more aggressively support public higher education institutions and help recruit more students from outside the state to expand the base of talent and further bolster Massachusetts' Innovation Economy and its reputation as an academic hub.

INDICATOR 14

Elementary and High School Education

Massachusetts fourth and eighth grade students score relatively high in national reading and mathematics assessment exams. High school student interest in fields critical to the Innovation Economy is mixed over time.

Why Is it Significant?

Strong skills in reading and mathematics are essential for the attainment of advanced education and experience. The academic performance of 4th and 8th grade students in national assessment exams is an indicator of strengths in these important skills, and point to the quality of the future workforce.

Strong mathematical, scientific, and communications skills are a prerequisite for many occupations in the Innovation Economy, usually requiring a high school diploma at minimum, but more likely a college degree or higher. Most colleges and universities require the Scholastic Assessment Test (SAT) as part of the admissions requirement. The profile of intended majors of college-bound seniors who take the SAT is a valuable indicator of the interests that high school students have in those fields that are critical to the growth of the Innovation Economy.

How Does Massachusetts Perform?

In 2003, Massachusetts 4th and 8th graders scored well, relative to the U.S. and to their Leading Technology State (LTS) counterparts, in the National Assessment of Educational Progress (NAEP) reading and mathematics exams. Massachusetts 8th graders led the LTS in reading with a score of 273 (based on a NAEP scale of 0-500, with 500 being the highest possible score). In mathematics, Massachusetts 8th graders scored 287, placing it second to Minnesota (291) of the LTS for the same period. Massachusetts fourth graders led the LTS in scoring in reading (228), and co-led with Minnesota in mathematics (242) for the same period.

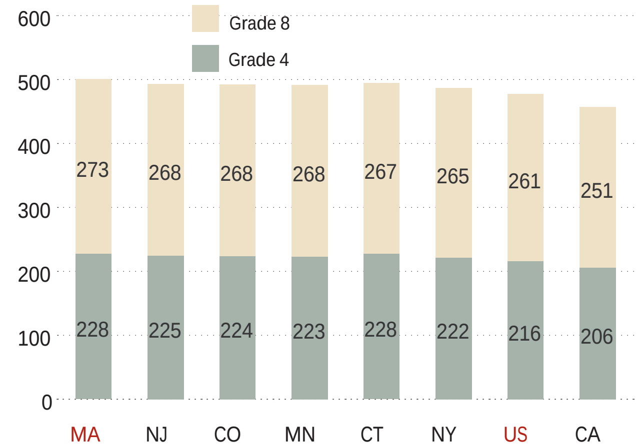
NAEP test scores in Massachusetts differ depending on the type of community a school is located. The average difference in test scores is 24 points between students taking the NAEP exams from central city schools and the urban fringes and rural areas. For example, in 2003, among 8th graders in the state taking the mathematics NAEP exam, the average score in the central city was 228, while the average score in the rural schools and urban fringes were higher (247 and 248, respectively).

In 2003, the most popular intended college majors of Massachusetts high school students taking the Scholastic Assessment Test (SAT) included Business and Commerce (14%), Health/Allied Services (12%), and Social Sciences/History (11%). From 1999 to 2003, there has been a slight decline in interest in the fields of Business and Commerce (15% to 14%), Health/Allied Services (13% to 12%), and Biological Sciences (6% to 5%). However, there has been an increase in student interest from 1999 to 2003 in the majors of Engineering (6% to 7%) and Mathematics (0% to 1%). When compared to the LTS, Massachusetts high school student interest in the majors of Computer, Engineering & Information Science (12%) and Health/Allied Services (12%) lag the LTS average (17% and 13%, respectively) and the U.S. (15% and 16%, respectively).

What Does This Trend Mean for Massachusetts?

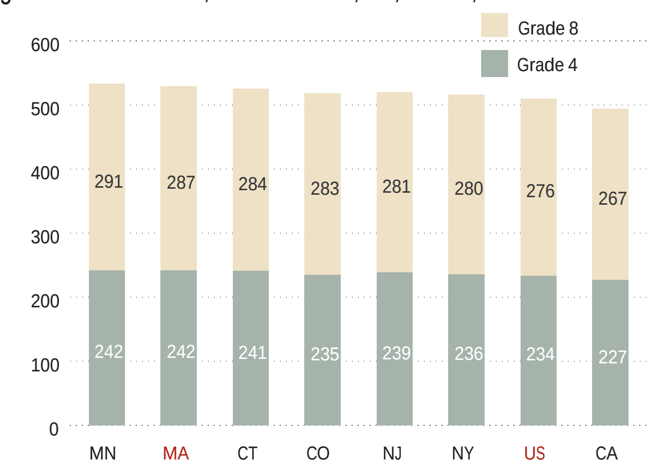
The state's strong NAEP scores are good news for Massachusetts. Well-educated people are critical to the growth of the Innovation Economy. Even though progress is being made on increasing test scores, the state needs to make sure that all residents have access to the education and skills needed to participate in the Innovation Economy. The upward trend in average NAEP scores needs to be encouraged and continued. The growth of high school students wanting to major in Engineering, and the sustained levels of interest in Computer & Information Sciences and Physical Sciences are encouraging signs, but follow-through should not be taken for granted.

National assessment of educational progress (NAEP) scores, grade 4 and 8 reading, Massachusetts, LTS, and US, 2003



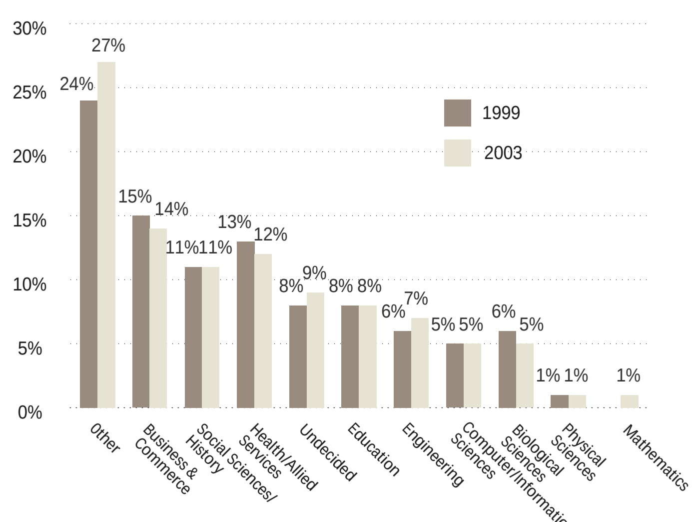
Source: National Center for Education Statistics

National assessment of educational progress (NAEP) scores, grade 4 and grade 8 mathematics, Massachusetts, LTS, and US, 2003



Source: National Center for Education Statistics

Distribution of intended college majors, high school students taking the Scholastic Assessment Test (SAT), Massachusetts, 1999 and 2003



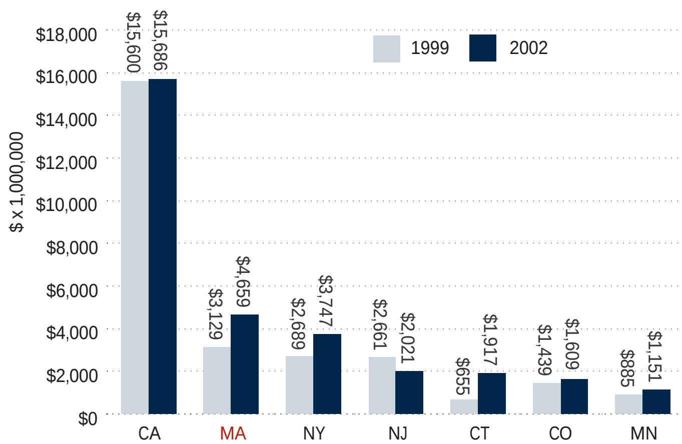
Source: The College Board

INDICATOR 15

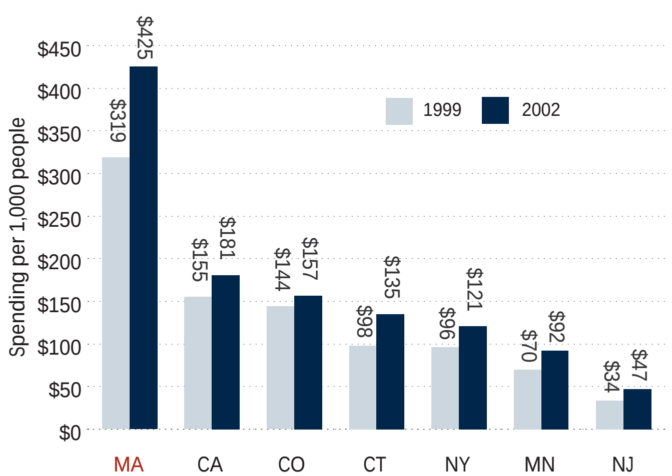
Federal R&D Spending and Health R&D Spending

Massachusetts continues to rank second only to California in total federal R&D spending, and ranks first among the LTS in per capita funding.

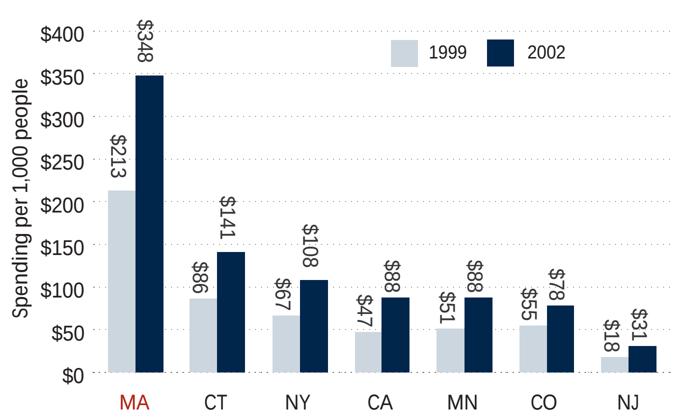
Total federal R&D expenditures in academic and nonprofit research institutions, Massachusetts, other LTS, 1999 and 2002



Federal R&D expenditures in academic and nonprofit research institutions per 1,000 people, Massachusetts, other LTS, 1999 and 2002



U.S. Department of Health and Human Services R&D expenditures, per 1,000 people, Massachusetts, other LTS, 1999 and 2002



Source of all data for this indicator: National Science Foundation

Why Is It Significant?

Research universities and other academic centers are pivotal in the Massachusetts economy, and federal 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 occur through the NIH.

How Does Massachusetts Perform?

In absolute dollars, Massachusetts universities, academic health centers, and nonprofit research institutions received a total of approximately $4.6 billion in federal R&D expenditures in 2002, which was second only to California ($15.7 billion) when compared to the Leading Technology States (LTS). From 1999 to 2002, total Massachusetts R&D dollars increased at an average annual rate of 10.5%, second only to Connecticut (30.8%). New Jersey was the only LTS to experience a funding decrease (-6.6%).

Total federal R&D spending in Massachusetts academic and nonprofit research institutions (not including health-related R&D) was more than $2.4 billion in 2002, placing the state second only to California ($6.3 billion) in absolute R&D spending when compared to the LTS. New Jersey had the lowest amount of federal R&D spending at approximately $460 million. From 2001 to 2002, Massachusetts federal R&D spending increased 5.9%, which was second only to Connecticut (18.6%), and just ahead of California and New York (each at 5.7%) among the LTS.

On a per capita basis, Massachusetts had the highest federally-funded R&D expenditures ($425) of the LTS in 2002. The next closest LTS, California, was at less than half that amount ($181). From 1999 to 2002, per capita federally-funded R&D expenditures at Massachusetts academic institutions increased at an average annual rate of 7.5%. Among the LTS, Connecticut and New Jersey experienced the largest increases at 8.4% each, while Colorado had the smallest increase at 2.2%.

In absolute dollars, total federal healthcare R&D expenditures in Massachusetts were approximately $2.2 billion in 2002, placing the state second among the LTS in health-related R&D funding (California ranked first with just over $3.1 billion). On a per capita level, Massachusetts had the highest federally-funded health R&D expenditures ($348) of the LTS in 2002. The state's health-related funding is more than double the closest LTS, Connecticut ($141). From 2001 to 2002, HHS funding per capita for Massachusetts increased 31.8%, which was a lower increase than most of the LTS, including first-ranked Connecticut (38.8%), New Jersey (36.8%), California (36.2%), and Minnesota (34.7%).

What Does this Trend Mean for Massachusetts?

Massachusetts continues to excel in competing for federal R&D dollars, a vital component of which the state's Innovation Economy. Strong R&D dollars reflect the collaborations between the federal government and research institutions within the state. Several LTS are becoming more aggressive in looking to attract more federal dollars. It is very important that the state continue to keep its strong competitive advantage in this important area of science and technology-related research and development.

INDICATOR 16

Number & Type of Patents Issued, Invention Disclosures, and Patent Applications

Massachusetts leads the LTS in patents per capita, and experiences the second highest increase in total number of patents. Patent portfolio is diverse in the state. Invention disclosures and patent applications activity continued to increase in the Commonwealth.

Why Is It Significant?

Patents reflect the initial discovery and registration of innovative ideas. Strong patent activity usually reflects significant conduct of research and development with potential commercial relevance.

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.

How Does Massachusetts Perform?

In 2003, Massachusetts innovators were granted 61 patents per 100,000 residents, placing the state first among the LTS in patents per capita. The absolute number of patents in Massachusetts increased 8.3% from 2002 to 2003, the highest increase when compared to the LTS. Several of the LTS experienced a decline in total number of patents, including Connecticut (-7.6%) and New Jersey (-6.4%). The total number of patents issued in the U.S. increased 1.1% for the same period.

Patents in Massachusetts span a wide range of sectors. From 1999 to 2003, Healthcare was the most active area, with 28% of all patents, as compared to 26% between 1994 and 1998. Miscellaneous Industry & Transportation was second with 21% of all patents from 1999 to 2003, followed by Computer Hardware & Software (18%) and Chemicals (10%).

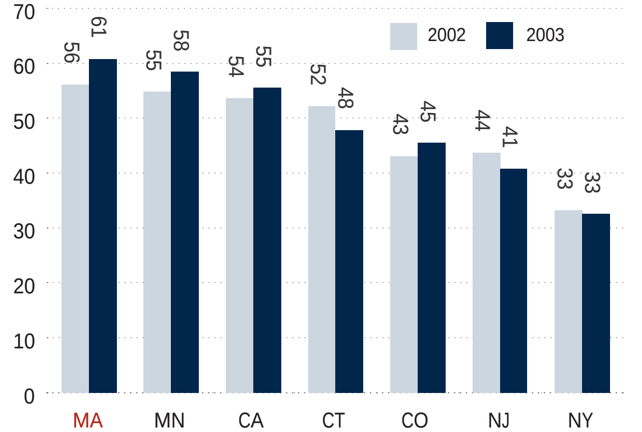
The number of invention disclosures reported annually by Massachusetts academic and nonprofit research institutions increased 7.4% from 1,377 in 2001 to 1,479 in 2002. Since 1992, over 60% of these invention disclosures have originated at universities, with the remainder based in hospitals and other nonprofit research institutions. Of the hospitals and other nonprofit research institutions, Massachusetts General Hospital (MGH) accounted for more than one-third of all invention disclosures (38.0%) in 2002. Among the universities, the Massachusetts Institute of Technology (MIT) was responsible for more than half (52.8%) of all the inventions disclosed for the same year.

Massachusetts universities, hospitals and nonprofit research institutions filed 812 patent applications in 2002, an 8.4% increase from the previous year (749). Since 1999, the total number of new patent applications from universities, hospitals, and nonprofit research institutions has been rising in Massachusetts. While patent applications filed by hospitals and nonprofit research institutions increased by 31.0% from 2001 to 2002, patent applications filed by universities declined 3.5% during this period. MIT (52%), Harvard University (13%), and the University of Massachusetts (11%) accounted for approximately three-quarters of all patent applications filed by universities.

What Does this Trend Mean for Massachusetts?

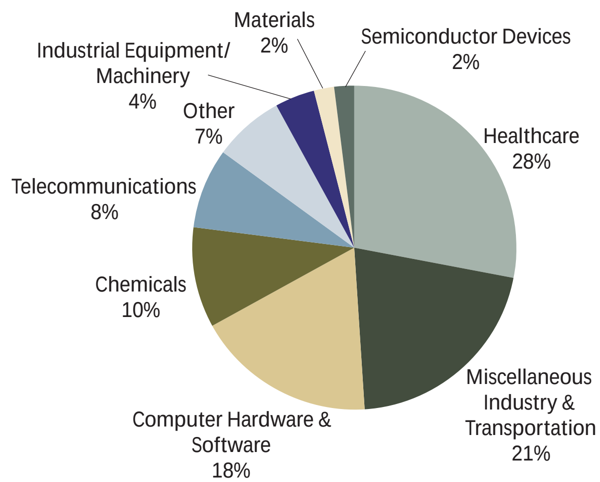
This indicator shows strong idea generation taking place in Massachusetts. The high number of patents and invention disclosures indicate that opportunities are present for existing and new companies to take advantage of converting this intellectual property to new products and services. The total number of patents and invention disclosures are up, and the number of new patent applications increased more than 30% in one year. These data highlights another key role played by educational institutions in the Innovation Economy.

Number of patents issued to state residents, per capita, Massachusetts, other LTS, 2002 and 2003



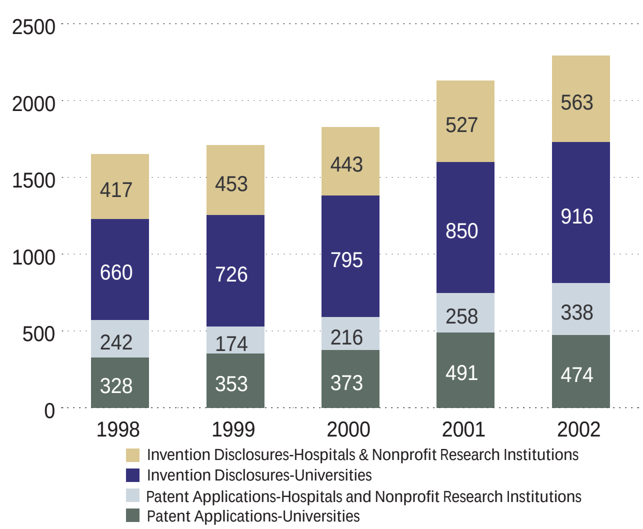
Source: U.S. Patent and Trademark Office; U.S. Census Bureau

Distribution of patents issued, Massachusetts, 1999–2003



Source: Adam Jaffe et al: The NBER U.S. Patent Citations Data File: Lessons, Insights, and Methodological Tools and U.S. Patent and Trademark Office

Number of invention disclosures and patent applications received by major universities, hospitals, and nonprofit research institutions, Massachusetts, 1998-2002



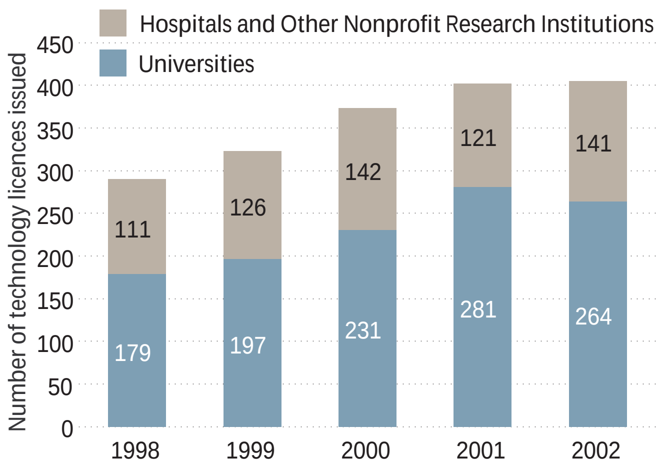
Source: Association of University Technology Managers (AUTM)

INDICATOR 17

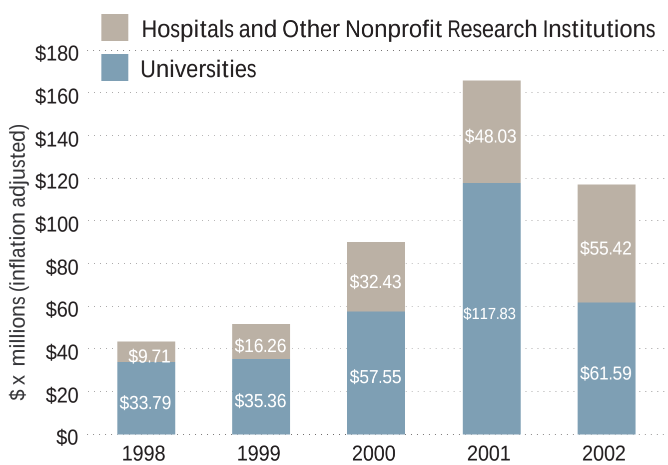
Technology Licenses and Royalties

After boom year, Massachusetts universities experience a decrease in total number of technology licenses. Hospitals and nonprofit research institutions have an increase in licenses from 2001 to 2002. Technology license royalties experienced a decline for same period.

Number of technology licenses issued by major universities, hospitals, and other nonprofit research institutions, Massachusetts, 1998–2002



Value of gross licensing income received by major universities, hospitals and nonprofit research institutions, Massachusetts, 1998–2002



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

Why Is It Significant?

Technology licenses provide a vehicle for the transfer of intellectual property (e.g., patents, trademarks) from universities, hospitals, and other research organizations to companies that will commercialize the technology. Royalties from these licenses reflect both the perceived value of the intellectual property in the commercial marketplace, as well as an income stream generated by actual sales of products and services embodying the licensed intellectual capital. Royalties and license fees also flow back to the institutions to support further research activities.

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, are indicators of the success of technology-transfer efforts by universities, hospitals, and research institutions.

How Does Massachusetts Perform?

New technology licenses issued by major universities, hospitals and research institutions in Massachusetts experienced a small increase of 0.7% from 402 in 2001 to 405 in 2002. The Massachusetts Institute of Technology (MIT) and Harvard University together generated more than half of all licenses executed in 2002 among universities, hospitals, and other nonprofit research institutions.

After a record year in 2001, gross royalties received from institutional licensing in Massachusetts decreased 29.5% from approximately $165 million in 2001 to $117 million in 2002. However, 2002 royalties are still well above the licensing revenues received from 1998 to 2000. In 2002, the four institutions in Massachusetts receiving the highest amount of royalties were, in descending order: Massachusetts General Hospital ($29.6 million), MIT ($28.7 million), Harvard University ($19.8 million), and the University of Massachusetts (all campuses) ($14.9 million). Since 1998, the University of Massachusetts has consistently increased its value of gross licensing income, growing at an average annual rate of nearly 50%.

What Does this Trend Mean for Massachusetts?

The increases in new technology licenses show the effectiveness of technology transfer in Massachusetts. Gross royalties from local institutions did experience a decline from 2001 to 2002. However, given the nature of technical change, royalties that come from technology licenses are variable. The fact that industrial firms and new companies are willing to pay these fees is a clear indicator of the value of the innovations created at the universities and research institutions. The state should encourage practices that bring industry and academic institutions together and at the same time, continue to support ways that improve technology licensing and innovative activities.

Data Availability

For the 2004 *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. MTC intends to continue updating and refining the *Index* report in future years, so that it can serve as an effective monitoring system.

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 Massachusetts and: 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.

Employment Concentration

State	Computer/ Comm. Hardware	Financial Services	Healthcare Technology	Innovation Services	Software Comm. Services	2003 LTS	2004 LTS	No. of 9 key clusters above 1.0
MA	1.95	1.10	1.05	1.26	1.37	-	-	9
CT	1.15	1.66	1.64	0.95	1.11	✓	✓	7
CA	1.95	0.91	1.10	1.14	1.56	✓	✓	6
NY	0.90	1.28	0.89	1.17	1.01	✓	✓	5
MN	1.42	1.14	0.93	0.81	1.03	✓	✓	5
NJ	0.61	1.20	2.46	1.16	1.29	✓	✓	4
CO	1.38	0.95	0.75	1.17	1.79	✓	✓	3

II. Notes on Data Sources for Individual Indicators

RESULTS

1. Industry Clusters Employment

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). Data do not cover self-employment, employment of military personnel, or government employment. Definitions for each industry cluster are included in Appendix B.

http://www.economy.com

2. Occupations and Wages

Data on occupations and wages are from the U.S. Bureau of Labor Statistics' Occupational Employment Statistics (OES) program. The OES produces employment and wage estimates for over 700 occupations. These are estimates of the number of people employed in certain occupations, and estimates of the wages paid to them. Self-employed persons are not included in the estimates. The OES data covers all full-time and part-time wage and salary workers in non-farm industries.

The OES uses the Standard Occupational Classification (SOC) system, which is used by all Federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. The 22 major occupational categories of the OES were aggregated by MTC into 10 major occupational categories for this analysis. MTC grouped occupational categories according to related industry sectors, comparable pay scales, and other associated data. For this indicator, MTC consulted with the Massachusetts Department of Unemployment Assistance (DUA), Collaborative Economics in Mountain View, California, and The Donahue Institute at the University of Massachusetts.

The 10 occupational categories included in this indicator are:

Arts & Media=Arts, design, entertainment, sports, and media occupations

Construction & Maintenance=Construction and extraction occupations; Installation, maintenance, and repair occupations

Education=Education, training, and library occupations

Healthcare=Healthcare practitioner and technical occupations; Healthcare support occupations

Human Services=Community and social services occupations

Life, Physical & Social Sciences=Life, physical, and social science occupations

Professional & Technical=Management occupations; Business and financial operations occupations; Computer and mathematical occupations; Architecture and engineering occupations; Legal occupations

Production=Production occupations

Sales & Office=Sales and related occupations; Office and administrative support occupations

Other Services=Protective service occupations; Food preparation and serving related occupations; Building and grounds cleaning and maintenance occupations; Personal care and service occupations;

Transportation and material moving occupations; Farming, fishing, and forestry occupations

http://www.bls.gov/oes/home.htm

For additional reports that look at occupations and wages:

Joint Venture Silicon Valley Index 2004:

http://www.jointventure.org/2004index/index.html

Massachusetts Department of Unemployment & Training:

http://www.detma.org/

3. Median Household Income

Data on median household income for Massachusetts, LTS, and U.S. (two-year-average) are from the U.S. Census Bureau, Current Population Survey, 2002, 2003, and 2004 Annual Social and Economic Supplements. Income is in 2003 dollars.

http://www.census.gov

TECHNOLOGY DEVELOPMENT AND BUSINESS DEVELOPMENT PIPELINE

4. FDA Approval of Medical Devices and Biotech Drugs

Information about medical device approvals in the U.S. is provided by the U.S. Food and Drug Administration (FDA) via the Freedom of Information Act (FOIA). Medical device companies are required to secure premarket approvals (PMAs) before intricate medical devices are allowed market entry. A 510k is an approval sought by a company for a device that is already on the market and is looking for approval on components that do not affect the type of device, such as new packaging or new name. 510k's have a higher approval rate than PMAs and thus, are in larger numbers compared to PMAs.

FDA approval of new biotech drugs is comprehensive, requiring clinical trials and an extensive review process. Since 1938, every new drug has been the subject of a new drug approval (NDA) process before U.S. commercialization.

http://www.fda.gov

5. New Business Incorporations

Data are provided by the Office of the Secretary of the Commonwealth.

http://www.state.ma.us/sec

6. 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

The distribution of SBIR and Small Business Technology Transfer (STTR) awards for Massachusetts by federal funding agency is provided by the Small Business Association, Tech-Net. The Small Business Technology Transfer Program fact sheet describes the STTR as similar to the SBIR program in that both programs seek to increase the participation of small businesses in federal R&D and to increase private sector commercialization of technology developed through Federal R&D. For both Phase I and Phase II STTR projects, at least 40% of the work must be performed by the small business, and at least 30% of the work must be performed by a non-profit research institution. Such institutions include federally-funded research and development centers (for example, DOE national laboratories), universities, non-profit hospitals, and other non-profits.

http://tech-net.sba.gov/

7. 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 Renaissance Capital, Greenwich, Connecticut. Industry classifications for IPOs are based upon the *Index*'s definition of the nine key industry clusters.

http://www.ipohome.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

8. Corporate Headquarters, Number of "Technology Fast 500" Firms, and Number of "Inc. 500" Firms

Data on total number of corporate headquarters with 500 or more employees by state are provided by Reference USA.

http://www.referenceusa.com

Data on location of Technology Fast 500 companies (Tech Fast 500) located in Massachusetts and the LTS are provided by Deloitte and Touche, LLP. To be eligible for the Fast 500 list, a company must be a technology company, defined as follows: own proprietary technology that contributes to a significant portion of the operating revenues, or devote a significant proportion of revenues to R&D of technology; 1997 operating revenues must be at least $50,000 U.S. dollars (U.S.D) or $75,000 Canadian dollars (CD); 2001 operating revenues must be at least $1 million U.S.D and CD; be in business a minimum of five years; and be headquartered within North America.

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

Data on location of Inc. 500 companies located in Massachusetts and the LTS are provided by Inc. Magazine. To be eligible for the Inc. 500 list, a company must meet six basic criteria, which includes: company is independent and privately held (not a subsidiary or a division.); company had sales of at least $200,000 in 2000; company has a four-year sales history that includes an increase in 2003 sales over 2002 sales-sales in 2000 must be for a full 12 months; if a company has less than 12 months of sales in 2000, it is not eligible for the 2004 Inc. 500; in 2003, a company's net sales were at least $2,000,000; company is not a franchisee, holding company, regulated bank, or utility; and company is based in the United States.

http://www.inc.com/inc500/

9. Investment Capital

Data for total venture capital investments in Massachusetts, the LTS, and the U.S., venture capital investments by industry activity, and distribution of venture capital by stage of financing 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

Data cited in text about total angel investor market investments in the U.S. are provided by the University of New Hampshire, Center for Venture Research (The Center). Industry category designations are determined by The Center.

http://www.unh.edu/cvr/

TALENT PIPELINE

10. Population Growth Rate, Migration, and Distribution of Immigrants

Data on population growth rate by state and the U.S. are derived from the U.S. Census Bureau.

http://www.census.gov

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

http://www.census.gov

Data on distribution of immigrants by region of birth intending to reside in 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

MASS.migration was a joint project of MassINC, The Donahue Institute at the University of Massachusetts, and MassHousing. To view the entire report, visit:

http://www.massinc.org

11. Median Price of Single-Family Home, Home Ownership Rates, and Per Capita Housing Starts

The Federal Housing Finance Board provides data for median sales price of single-family homes that have been sold. 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 come from the U.S. Census Bureau.

http://www.census.gov

Data on total number of housing starts by state are provided by the U.S. Census Bureau, Manufacturing, Mining, and Construction Statistics. Population data is for July 2003 and is also provided by the U.S. Census Bureau.

http://www.census.gov/const/www/permitsindex.html

12. Educational Attainment, Engineering Degrees Granted, and Scientists & Engineers in the Labor Force

Data on percentage of adult population with a bachelor's degree or higher for Massachusetts, the LTS, and the U.S., are from the U.S. Census Bureau, Current Population Survey.

http://www.census.gov/population

Data on total number of engineering degrees 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 scientists and engineers as a share of the total the labor force for Massachusetts, the LTS, and the U.S. are from the National Science Foundation's Science and Engineering Indicators 2004 report. Data were derived from the following sources: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT); and U.S. Department of Labor, Bureau of Labor Statistics, and Local Area Unemployment Statistics. Scientists and engineers are defined as people with a bachelor's or higher degree in a science or engineering field or who worked in a science and engineering (S&E) occupation in 1993.

http://www.nsf.gov/sbe/srs/seind04/start.htm

13. University Enrollments and Public Higher Education Spending

Data on percentage 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 3,958 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/

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 the Study of Education Policy, 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. Examples of operating expenses include salaries and wages and maintenance of offices.

http://coe.ilstu.edu/grapevine

Data on state higher education capital expenditures per full time equivalent (FTE) student were compiled by the Donahue Institute, University of Massachusetts. Raw data on total capital expenditures for public higher education is provided by the National Association of State Budget Offices. Total enrollment data is provided by the National Center for Education Statistics. Examples of capital expenditures include funds used by a university to acquire or upgrade physical assets and investments in land, buildings, or research and development.

http://www.donahue.umassp.edu/

http://www.nasbo.org/

http://nces.ed.gov/

14. Elementary and High School Education

Data on 4th and 8th grade reading and mathematics test scores are provided by the U.S. Department of Education, National Center for Education Statistics. The National Assessment of Educational Progress (NAEP), also known as "the Nation's Report Card," is the only nationally representative and continuing assessment of what America's students know and can do in various subject areas. Since 1969, assessments have been conducted periodically in the following subjects: reading, mathematics, science, writing, U.S. history, civics, geography, and the arts. For the 2004 *Index*, the subjects of reading and mathematics were chosen because all LTS and the U.S. administered the exams in the comparison years.

http://nces.ed.gov/nationsreportcard/

Data for intended majors of students taking the Scholastic Assessment Test (SAT) in Massachusetts and the LTS are provided by The College Board Online, Profile of College Bound Seniors, 2003. The Profile of College-Bound Seniors presents data for 2003 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

RESEARCH PIPELINE

15. Federal R&D Spending & 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.

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 by the National Institutes of Health.

http://www.nsf.gov

16. Number & Type of Patents Issued, Invention Disclosures and Patent Applications

Patents per capita data for Massachusetts and other LTS are provided by the U.S. Patent and Trademark Office (U.S.PTO).

http://www.uspto.gov

Patent distribution by industry sectors are based on analyses developed by Jaffe et al: The NBER U.S. Patent Citations Data File: Lessons, Insights, and Methodological Tools. These data comprise detail information on almost 3 million U.S. patents granted between January 1963 and December 1999, all citations made to these patents between 1975 and 1999 (over 16 million), and a reasonably broad match of patents to Compustat (the data set of all firms traded in the U.S. stock market). These data are described in detail in Hall, B. H., A. B. Jaffe, and M. Tratjenberg (2001). "The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools." NBER Working Paper 8498. All users of these data should read this paper, and should cite it as the source of the data. Further documentation on uses of the patent citation data, including the methodology paper and a CD containing the complete dataset itself, is available in the book Patents, Citations and Innovations: A Window on the Knowledge Economy by Adam Jaffe and Manuel Trajtenberg, MIT Press, Cambridge (2002). The book may be ordered from MIT Press. ISBN 0-262-10095-9.

http://mitpress.mit.edu/main/home/default.asp?sid=944AB2DA-BD6F-4B39-8A43-6E97507A570E

Invention disclosures and patent applications 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/nonprofit research institutions include: Massachusetts General Hospital, Children's Hospital Boston, Brigham and Women's Hospital, Woods Hole Oceanographic Institute, Center for Blood Research, 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.

http://www.uspto.gov

http://www.autm.net

17. 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.

http://www.autm.net

The North American Industry Classification System (NAICS) has replaced the U.S. Standard Industrial Classification (SIC) system. NAICS was jointly developed by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America. For more information about NAICS, visit: http://www.census.gov/epcd/www/naics.html

Starting in 2003, the *Index* moved from the four-digit Standard Industrial Classification (SIC) to the North American Industry Classification System (NAICS) to study the key industry clusters. The analysis of key industry clusters within Massachusetts begins with a disaggregation and examination of all Massachusetts state industry activity to the four-digit NAICS code level. (NAICS was developed in cooperation with the U.S. Economic Classification Policy Committee, Statistics Canada, and Mexico's Instituto Nacional de Estadistica, Geografia e Informatica. These codes were last revised in 2002.) Industry data are analyzed through the following measures:

- Employment concentration relative to that of the nation
- Employment as a share of total state employment

Clusters are crafted from those interrelated NAICS code industries that have shown to be individually significant according to the above measures. The nine key industry clusters as defined by the *Index* reflect the changes in employment concentration in the Massachusetts Innovation Economy that has occurred over time.

Computer & Communications Hardware

3341 Computer and Peripheral Equipment Manufacturing
3342 Communications Equipment Manufacturing
3343 Audio and Video Equipment Manufacturing
3344 Semiconductor and Other Electronic Component Manufacturing
3346 Manufacturing and Reproducing Magnetic and Optical Media
3351 Electric Lighting Equipment Manufacturing
3359 Other Electrical Equipment and Component Manufacturing

Defense Manufacturing & Instrumentation

3329 Other Fabricated Metal Product Manufacturing
3336 Engine, Turbine, and Power Transmission Equipment Manufacturing
3345 Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
3364 Aerospace Product and Parts Manufacturing

Diversified Industrial Support

3222 Converted Paper Product Manufacturing
3259 Other Chemical Product and Preparation Manufacturing
3261 Plastics Product Manufacturing
3262 Rubber Product Manufacturing
3279 Other Nonmetallic Mineral Product Manufacturing
3314 Nonferrous Metal (except Aluminum) Production and Processing
3321 Forging and Stamping
3322 Cutlery and Handtool Manufacturing
3326 Spring and Wire Product Manufacturing
3328 Coating, Engraving, Heat Treating, and Allied Activities
3332 Industrial Machinery Manufacturing
3333 Commercial and Service Industry Machinery Manufacturing
3335 Metalworking Machinery Manufacturing
3339 Other General Purpose Machinery Manufacturing
3353 Electrical Equipment Manufacturing
3399 Other Miscellaneous Manufacturing

Financial Services

5211 Monetary Authorities - Central Bank
5221 Depository Credit Intermediation
5231 Securities and Commodity Contracts Intermediation and Brokerage
5239 Other Financial Investment Activities
5241 Insurance Carriers
5242 Agencies, Brokerages, and Other Insurance Related Activities
5251 Insurance and Employee Benefit Funds
5259 Other Investment Pools and Funds

Healthcare Technology

3254 Pharmaceutical and Medicine Manufacturing
3256 Soap, Cleaning Compound, and Toilet Preparation Manufacturing
3391 Medical Equipment and Supplies Manufacturing
6215 Medical and Diagnostic Laboratories

Innovation Services

5411 Legal Services
5413 Architectural, Engineering, and Related Services
5416 Management, Scientific, and Technical Consulting Services
5417 Scientific Research and Development Services
5418 Advertising and Related Services
5419 Other Professional, Scientific, and Technical Services
5614 Business Support Services

Postsecondary Education

6112 Junior Colleges
6113 Colleges, Universities, and Professional Schools
6114 Business Schools and Computer and Management Training
6115 Technical and Trade Schools
6116 Other Schools and Instruction
6117 Educational Support Services

Software & Communication Services

5111 Newspaper, Periodical, Book, and Directory Publishers
5112 Software Publishers
5171 Wired Telecommunications Carriers
5172 Wireless Telecommunications Carriers (except Satellite)
5173 Telecommunications Resellers
5174 Satellite Telecommunications
5175 Cable and Other Program Distribution
5179 Other Telecommunications
5181 Internet Service Providers and Web Search Portals
5182 Data Processing, Hosting, and Related Services
5415 Computer Systems Design and Related Services
8112 Electronic and Precision Equipment Repair and Maintenance

Textiles & Apparel

3132 Fabric Mills
3133 Textile and Fabric Finishing and Fabric Coating Mills
3141 Textile Furnishings Mills
3149 Other Textile Product Mills
3152 Cut and Sew Apparel Manufacturing
3161 Leather and Hide Tanning and Finishing
3162 Footwear Manufacturing
3169 Other Leather and Allied Product Manufacturing

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Center for Venture Research, University of New Hampshire

Collaborative Economics

College Board

CommonAngels

Deloitte and Touche, LLP

Donahue Institute, University of Massachusetts

Economy.com

Federal Housing Finance Board

Federal Reserve Bank of Boston

Grapevine Center for the Study of Education Policy, Illinois State University

Inc. Magazine

Massachusetts Division of Unemployment Assistance

Massachusetts Institute of Technology, Sloan School of Management

Mergerstat

National Association of State Budget Offices

National Center for Education Statistics, U.S. Department of Education

National Science Foundation

National Venture Capital Association

Navigator Technology Ventures

Office of the Secretary of the Commonwealth

PricewaterhouseCoopers, LLP

Reference USA

Renaissance Capital

Small Business Administration

The Kauffman Foundation

U.S. Bureau of Labor Statistics

U.S. Census Bureau

U.S. Citizenship & Immigration Services

U.S. Patent & Trademark Office

Venture Economics

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