Tracking Innovation

North Carolina Innovation Index 2003

NC Board of Science and Technology
Advancing science and technology throughout North Carolina

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Special thanks to Karen Becker for the design and layout of this document, and to Linda Kastleman for editing assistance. Thanks also to Henry Renski, North Carolina Department of Commerce, for assistance with data collection and analysis.

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North Carolina Board of Science and Technology

North Carolina Department of Commerce
Board of Science and Technology

Michael F. Easley, ***Governor*** **James T. Fain III,** ***Secretary***

December 2003

To the Citizens of North Carolina:

Tracking Innovation 2003 is a report on the state of North Carolina's innovation economy. It compares our performance as measured by twenty-five innovation indicators with indicators from six strong states and the United States as a whole. It is a comprehensive update of a similar index published by the Board of Science and Technology in 2000 as part of the *Vision 2030 Project*.

What this index reveals about North Carolina is interesting. We excel as a state in inputs to innovation: research and development activity, intellectual capital, entrepreneurial activity, and small business funding – all of which continue to increase over time. Our technology-intensive economy continues to grow, as does our generation of intellectual property. Indeed, despite the national trends that ultimately affected the economies of all states in 2002, North Carolina continues to have one of the fastest growing technology economies in the U.S.

However, this growth has not yet translated into uniformly high incomes for all of our citizens. As our knowledge-based industries have continued to grow, the benefits of this growth have not yet been fully distributed throughout the state. We must not lag behind in the development of resources to enhance and sustain intellectual property in the marketplace and in the development of our workforce and technological infrastructure.

This report is, therefore, also a call to action. States that compete do not stand still. North Carolina is known around the world for the farsighted investments that it has made in the past in support of its high-technology future. The North Carolina Board of Science and Technology is pleased to have played a key role in many of these and through its actions to serve as a model for many states wishing to create a high-skill, high-technology future for their citizens.

We must, however, continue to be proactive and innovative in embracing and using science and technology policy to foster economic development. Our future success will be determined by what we do now – the quality of our vision, how we invest, how we prioritize, and how we respond to the challenges of an evolving economy. This index serves to guide decision makers in our state on ways to enhance our competitiveness in this future global, knowledge-based economy.

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Introduction

Innovation fuels a knowledge-based economy; it creates new industries, makes existing ones globally competitive, and drives future economic growth. With this report, the second in a series that began with the publication of *Tracking Innovation 2000,*[1] North Carolina joins a growing number of states that regularly monitor innovation trends within their borders.

This is a report on the state of North Carolina's innovation economy. It focuses on North Carolina's performance in five key categories of innovation indicators weighed against that of the United States overall and six comparison states that are strong in terms of innovation and technology (GA, MA, MI, PA, TX, VA). These indicators form a basis for understanding the link between innovation, resources, and economic results in the North Carolina economy.

Summary Findings

Relative to the U.S. overall, North Carolina ranks better than average on over half the measures presented in this report. *Table ES-1* provides the summary rankings of North Carolina and the six comparison states presented in this report. North Carolina's average rank is 4.5 across all measures (on a scale from 1 to 7, with 1 being best). *Table ES-2* presents North Carolina's performance on selected measures[2] against the comparison states used in this study. Each measure is detailed in the body of the report.

Findings by Category

- **Performance Outcome**: North Carolina has one of the fastest growing economies in the U.S., but that growth has not yet translated into uniformly high incomes for its residents.
- **Economic Structure**: North Carolina's technology-intensive economy is growing, but it remains narrowly focused and geographically concentrated.
- **Innovation Outcome**: North Carolina is gaining in intellectual property generation, but it lags behind in resources to enhance and sustain intellectual property in the marketplace.
- **Innovation Input**: North Carolina has substantial levels of research and development activity, intellectual capital, entrepreneurial activity, and small business funding, all of which continue to increase over time.
- **Preparation**: North Carolina lags behind in its workforce development and technological infrastructure.

ES-1 Summary Rankings, North Carolina and Comparison States*

State	MA	VA	TX	PA	GA	NC	MI
Rank Order	1	2	3	4	5	6	7
Average Rank Over All Measures	2.8	3.5	3.9	4.3	4.4	4.5	4.7

* Small differences in average rank may not be statistically significant.

1. *Tracking Innovation 2000*, issued by the North Carolina Board of Science and Technology, was the first report to provide comprehensive baseline information on innovation and technology in North Carolina. An electronic copy is available at *http://www.ncscienceandtechnology.com*.
2. Only the measures that can be ranked meaningfully are included in Table ES-2.

ES-2 Innovation Index Summary, Selected Measures[1]

	Fig.	Measure	Rank, comparison states (On a scale from 1 to 7, with 1 being best) 1	2	3	4	5	6	7	
Performance Outcome	1-1	Percent Change in Gross State Product, 1990–01	GA	TX	NC	VA	MA	MI	PA	NC Average Rank = 4.91
	2-1	Percent Change in Number of Firms, 2001–02	MA	NC	VA	PA	TX	GA	MI	
	3-1	Percent of Jobs in Gazelle Firms, 2001	MA	TX	VA	GA	NC	PA	MI	
	3-2	Number of "Fast 500" Companies, 2002	MA	VA	TX	NC	PA	GA	MI	
	4-1	Annual Average Wages, Private Sector, 2002	MA	MI	TX	VA	GA	PA	NC	
	4-2	Percent Change in Real Wages, 1989 & 2000	MA	GA	VA	NC	TX	PA	MI	
	5-1	Growth in Real per Capita Income, 1991–02	MA	GA	TX	MI	VA	NC	PA	
	5-2	Median Household Income, 1999–01	VA	MA	MI	GA	PA	TX	NC	
	6-1	Change in Average Real Income, Bottom Fifth of Families, 1978–80 to 1998–00	VA	GA	PA	MI	NC	TX	MA	
	6-1	Change in Average Real Income, Top Fifth of Families, 1978–80 to 1998–00	VA	MA	PA	MI	NC	TX	GA	
	6-2	Percent Persons in Poverty, 1999–01	VA	PA	MI	MA	GA	NC	TX	
Economic Structure	7-1	Technology-Intensive Employment, Share of Private Sector Employment, 1989 & 2000	MI	MA	PA	VA	TX	NC	GA	NC Average Rank = 3.35
	7-2	Employment Growth, Technology-Intensive Industries, 1989–00	GA	NC	VA	TX	MI	PA	MA	
	7-3	Employment Growth, by Tech-Intensive Category, 1989–00 (Ranked by Very Tech-Intensive)	GA	NC	VA	TX	MI	PA	MA	
	9-1	Growth in International Exports, 1999–02	TX	MI	GA	MA	NC	PA	VA	
	9-2	Export Intensity, Ratio of Exports to Gross State Product, 2001	TX	MI	NC	MA	GA	PA	VA	
	10-1	Mass Layoff Actions per 10,000 Establishments, 1997–01	GA	VA	NC	TX	MA	PA	MI	
	10-1	Mass Layoff Actions per 1,000 Workers, 1997–01	GA	VA	NC	TX	PA	MA	MI	
	10-2	Growth/Decline Average Wage Index, 2000	GA	NC	VA	MA	TX	PA	MI	
Innovation Outcome	11-1	Utility Patents Granted per 100,000 Population, 2000	MA	MI	TX	PA	NC	VA	GA	NC Average Rank = 4.61
	11-2	Utility Patents Granted: Growth, 1989–00	NC	GA	TX	MA	VA	MI	PA	
	12-1	Number of Patents and Invention Disclosures, 2000	MA	PA	TX	NC	GA	VA	MI	
	12-2	Number of Licenses and Options Executed, 2000	MA	PA	TX	NC	VA	MI	GA	
	12-3	Ratio of License Income to Gross State Product, 2000	MA	MI	PA	GA	NC	TX	VA	
	13-1	Average Annual Venture Capital Growth Rate, 1996–01	TX	PA	MA	NC	GA	VA	MI	
	13-2	Ratio of Venture Capital to Gross State Product, 2001	MA	TX	VA	GA	NC	PA	MI	
	14-1	Value of Initial Public Offerings, Percent of U.S. Total, 1996–02	TX	MA	GA	PA	VA	MI	NC	
	14-2	Initial Public Offerings per Million Population, 1996–02	MA	VA	TX	GA	PA	NC	MI	
Innovation Input	15-2	R&D Spending as Share of Gross State Product, 2000	MI	MA	PA	NC	TX	VA	GA	NC Average Rank = 4.00
	15-3	Percent of University & College R&D Funding from State & Local Government, 2000	VA	TX	NC	GA	MI	PA	MA	
	16-1	R&D Expenditures per Tech Transfer Action, 2000	MA	VA	PA	NC	TX	MI	GA	
	17-1	Employed Ph.D. Scientists and Engineers per 1,000 Population, 2001	MA	VA	PA	NC	MI	TX	GA	
	18-1	Number of Graduate Science and Engineering Programs Rated in Top 50, 2002	MA	PA	TX	NC	MI	VA	GA	
	19-1	SBIR Funding per Capita, 2001	MA	VA	PA	MI	TX	NC	GA	
	19-2	STTR Funding per Capita, 2002	MA	VA	NC	PA	MI	TX	GA	
	20-1	NIH Award Amount, 2002	MA	PA	TX	NC	MI	GA	VA	
	20-2	Growth in NIH Awards, 1998–02	GA	TX	NC	PA	MA	VA	MI	
	20-3	NSF Award Amount, 2002	MA	VA	PA	TX	MI	NC	GA	
	20-4	Growth in NSF Awards, 1998–02	VA	GA	NC	TX	MA	PA	MI	
Preparation	21-1	Educational Attainment, Bachelor Degree or Higher, 2002	VA	MA	TX	PA	GA	MI	NC	NC Average Rank = 5.18
	21-1	Educational Attainment, Less than High School Diploma, 2002	VA	MA	MI	PA	GA	NC	TX	
	21-2	High School Dropout Rates, 1998–00	MA	MI	PA	VA	NC	GA	TX	
	23-1	Percent of Bachelors Degrees Awarded in Science & Engineering Disciplines, 2001–02	GA	MI	NC	VA	PA	MA	TX	
	23-2	Percent U.S. Science and Engineering Bachelors Degrees Awarded, 2001–02	PA	TX	MI	MA	NC	GA	VA	
	23-3	Science & Engineering Bachelors Degrees Awarded per Capita, 2001–02	MA	PA	MI	VA	NC	GA	TX	
	23-3	Science & Engineering Graduate Degrees Awarded per Capita, 2001–02	MA	MI	PA	VA	GA	TX	NC	
	24-1	Students per Instructional Multimedia Computer, 2002	TX	VA	PA	GA	MI	MA	NC	
	24-2	Percent of Classrooms with Internet Access, 2002	NC	TX	VA	GA	MI	PA	MA	
	25-1	Percent of Households with Internet Access, 2001	VA	MA	MI	PA	TX	GA	NC	
	25-2	Percent of Households & Businesses with Broadband Internet Access, 2002	MA	GA	NC	TX	VA	MI	PA	

[1] Six measures that could not be ranked meaningfully (7-5, 7-6, 8-1, 8-2, 15-1, and 22-1) are not included here.

Note: States that tied are denoted with a box and listed in alphabetical order. In the case of a tie, average ranks were computed by assigning the average value between ranks. For example, two states that tied between fifth and sixth were assigned a value of 5.5.

Contents

The key outcome of growing and expanding North Carolina's innovation economy is the positive impact it will have on jobs, wage levels, firm competitiveness, and standards of living. This section examines North Carolina's performance in creating new jobs, increasing worker wages, and improving the competitiveness of its companies and economy in general.

A state's economic structure is a key determinant of its ability to create and sustain technology-intensive industries and companies. This section examines North Carolina's economic structure in terms of the intensity of its technology activity, the performance of its technology-related industry sectors, the state's role in the global economy, and key employment and wage trends.

Contents

The ability of a state to translate its innovative ideas into commercially viable products is a key indicator of the success of its innovation economy. This section examines North Carolina's success in patenting and commercializing ideas and in attracting and generating investment in new companies.

Successful innovation outcomes require the proper innovation inputs. This section examines the level and quality of North Carolina's research and development activities, intellectual capital, entrepreneurial activities, and funding for small businesses.

Contents

Basic resources — human and physical — are essential to prepare North Carolina for innovation and economic growth. Resources critical to the innovation economy include a well-educated workforce and a robust technology infrastructure. This section looks at North Carolina's ability to maintain a highly educated workforce and access advances in technology.

What is innovation, and why is it important?

Innovation is the introduction of new ideas, methods, or devices, often in the form of new technologies. According to economic estimates, more than 50 percent of the growth in the U.S. economy since World War II, and as much as two-thirds of the U.S. economic growth during the 1990s, resulted from the introduction of new technologies.[1] Researchers at the Progressive Policy Institute refer to this new innovative economy as "the kind of profound transformation of all industries that happens perhaps twice in a century . . . equivalent in scope and depth to the rise of the manufacturing economy in the 1890s and the emergence of the mass-production, corporate economy in the 1940s and 1950s."[2] As part of this new economy, North Carolina is undergoing a major shift in employment from labor-intensive manufacturing industries such as textiles and furniture, to knowledge-based industries such as information technology, telecommunications, pharmaceuticals, and biotechnology.[3] Innovation is critical to North Carolina's ability to compete in this dynamic and fast-paced economic environment.

Why Tracking Innovation 2003?

A major impediment to the proper design and implementation of science and technology policy is a lack of up-to-date information on innovation rates, research and development (R&D) performance, and trends in technology-intensive industries. Nearly all states are grappling with the problem, including North Carolina. Critical questions concern whether North Carolina has the proper infrastructure and resources in place to support innovation. At a minimum, finding the answers requires timely baseline information on innovation and technology in the state.

What is Tracking Innovation 2003?

The goal of *Tracking Innovation 2003* is to provide that information in a systematic and accessible format, and therefore to help inform science and technology planning and policy at all levels throughout the state. As a follow-up to *Tracking Innovation 2000*,[4] this report enables North Carolina to join a growing number of states regularly monitoring innovation trends within their borders.[5] It assembles information from a wide variety of disparate sources to document technology-related activity in North Carolina, six comparison states, and the U.S. The fifty-plus measures are summarized under twenty-five broad indicators of innovation, technology, and economic growth. Each of the twenty-five indicators, in turn, falls into one of five general categories:

- ***Performance outcomes*** (e.g., gross state product, income distribution)
- ***Economic structure*** (e.g., technology intensity, industrial transition)
- ***Innovation outcomes*** (e.g., patents, initial public offerings)
- ***Innovation inputs*** (e.g., R&D spending, Ph.D. scientists and engineers)
- ***Preparation*** (e.g., educational attainment, technology infrastructure)

The report does not make normative judgments regarding which of its measures are most important for plotting the course of science and technology policy in North Carolina. Instead, the facts — as best they can be gathered from existing secondary sources — are presented as concisely as possible, leaving it to the reader to gauge the significance of specific trends. Though every measure is inadequate in isolation, together they lend useful insight into the status of science, technology, and innovation activity in North Carolina.

What is the methodology of Tracking Innovation 2003?

The report compares North Carolina's performance on each measure to that of six other states:

- Two leading *technology* states (Massachusetts and Texas)
- Two major *manufacturing* states (Pennsylvania and Michigan)
- Two *southeastern* states (Georgia and Virginia)[6]

Where possible, national rankings for the comparison states and North Carolina are also reported.

Following the practice established by other states (e.g., Massachusetts with its *Index of the Massachusetts Innovation*

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1. *Index of the Massachusetts Innovation Economy*. Massachusetts Technology Collaborative, 2002.
2. Atkinson, Robert D. *The 2002 New State Economy Index*, p. 3. Washington, D.C., Progressive Policy Institute, June 2002.
3. *We are Changing the Way We Do Business: North Carolina's 2002 Economic Development Strategic Plan*. North Carolina Economic Development Board, October 2002.
4. *Tracking Innovation 2000*, issued by the North Carolina Board of Science and Technology in 2000, was the first such report in North Carolina. An electronic copy is available at *http://www.ncscienceandtechnology.com*.
5. The same indicators appear in both *Tracking Innovation* reports, except in the small number of cases where data for indicators used in the 2000 report were unavailable.
6. Massachusetts and Texas typically rank high on several indicators of technology (e.g., venture capital, fast-growth firms, patents). Pennsylvania and Michigan are similar to North Carolina in terms of manufacturing base and population. Georgia and Virginia are typically regarded as leading southeastern technology states with which North Carolina competes.

Economy and Washington with its *Index of Innovation and Technology*), the report uses only existing secondary data sources (see detailed listing on page 53).[7] No surveys or other forms of primary data collection were undertaken to assemble measures. Further, all measures are:

- as current and accurate as possible,[8]
- derived from objective and reliable data sources,
- easy to understand and compare across states, and
- relevant and of interest to the public.

The measures included in this report are meant to serve as a baseline for decision-making and further inquiry.[9] To the extent possible, future updates of the report will include additional data and measures.[10]

Methodological Note: State Rankings

State-by-state economic rankings have become commonplace in recent years. The Progressive Policy Institute's *New State Economy Index* and the Corporation for Enterprise Development's *Development Report Card for the States* are widely cited and discussed when they are released each year.

A caveat to keep in mind when reading this report is that rankings can be misleading and therefore must be used cautiously. First, on some measures, there is very little statistically significant variation between states. Second, states may be tied in rankings. And third, rankings tend to divert attention from the absolute value of a given measure, which often is more important.

In this report, the actual value of each measure is reported in addition to the rank (which is revealed by default in each graphic), permitting careful interpretation of the findings. Only the measures that can be ranked meaningfully are included in *Table ES-2* of the Executive Summary.

7. The Massachusetts index is available at *http://www.mtpc.org/InnovationEconomy/the_index.htm*. The Washington index is available at *http://www.watechcenter.org*.
8. For some measures, the most current data are from as far back as 2000 and therefore may not reflect the change in economic conditions beginning that year.
9. Compared to similar reports for other states, this report includes a larger and more diverse set of measures.
10. The report will be updated biennially. In future years, data for some indicators may not be available or may be cost-prohibitive. In such cases, alternate data that will serve as effective proxies will be used.

Performance Outcome Indicators

The key outcome of growing and expanding North Carolina's innovation economy is the positive impact it will have on jobs, wage levels, firm competitiveness, and standards of living. This section examines North Carolina's performance in creating new jobs, increasing worker wages, and improving the competitiveness of its companies and economy in general.

INDICATOR 1: *Overall Performance*

Key Finding

- **Between 1990 and 2001, North Carolina's gross state product growth rate (43.7 percent) ranked above the U.S. average (30.6 percent) and the rates for most comparison states.**

Indicator Overview

There are many ways to measure a state's overall economic performance. One of the most common is to look at gross state product (GSP). The U.S. Bureau of Economic Analysis defines GSP as a measurement of a state's output — the value added in production by the labor and property located in a state.[1]

How does North Carolina perform?

In 2001, North Carolina's GSP was $275.6 billion, or 2.7 percent of U.S. gross product, up from 2.5 percent in 1990 (data not shown here). Between 1990 and 2001,[2] North Carolina's GSP grew by 43.7 percent, well above the U.S. average of 30.6 percent and third fastest among the seven comparison states *[1-1]*. Georgia and Texas had the biggest gain, with growth rates of 55.9 percent and 44.7 percent, respectively. The four southern states — Georgia, Texas, North Carolina, and Virginia — ranked one through four, respectively, among comparison states in terms of percentage growth in GSP.

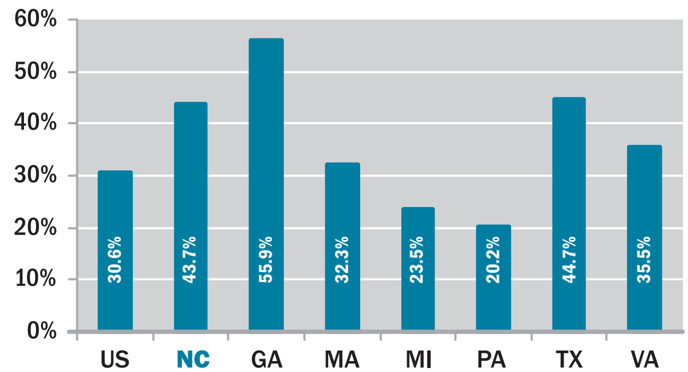
Because of the significant growth in North Carolina's economic output, employment growth has remained favorable into 2003. In April 2003, civilian employment in the state was 3.83 million, approximately 2.9 percent of the total U.S. civilian workforce (data not shown here). Between 1990 and 2002, employment in North Carolina expanded by 23.3 percent, faster than the U.S. employment growth rate for the same period, 19.5 percent. In 2002, unemployment in North Carolina averaged 6.7 percent, compared to 5.8 percent nationally.

What does this mean for North Carolina?

Despite continued restructuring of the state's economic base away from manufacturing and toward high technology, service, and knowledge-based industries, it performed well with respect to GSP over the last decade.

1-1 Percent Change in Gross State Product, 1990–2001

Adjusted for inflation



Source: Bureau of Economic Analysis, U.S. Department of Commerce.

1. Conceptually, an industry's gross product (GP), or its value added, is equivalent to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other U.S. industries or imported). GSP for a state is the sum of the GPs for all its industries.
2. 1990 and 2001 were chosen as comparison years due to their similar standing in the U.S. unemployment cycle (in terms of both cyclical relationship and value).

Performance Outcome

INDICATOR 2: *New Firms*

Key Finding

- **During 2001–2002, North Carolina's net firm creation rate (1.8 percent) ranked above the U.S. average (-0.6 percent) and the rates for most comparison states.**

Indicator Overview

Because many new business ventures fail within the first few years, a vibrant economy is typically characterized by a high rate of transition, including both firm openings and closings. Net firm creation is the overall change in the number of firms from one year to the next and takes into account start-ups, firm closings, locations and relocations, and reorganizations. Positive net firm growth generally reflects a healthy economy in which new business locations and start-ups are outpacing firm closings and relocations out-of-state.

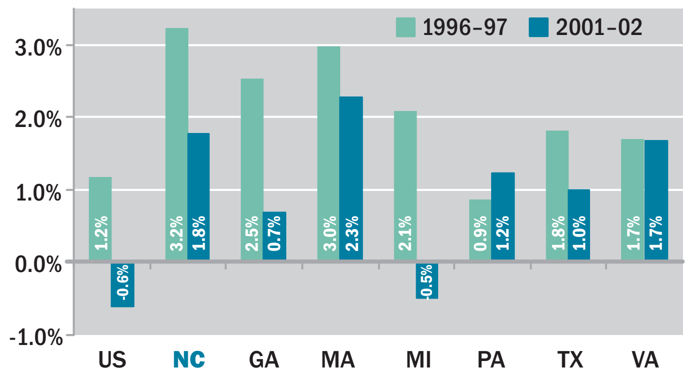
How does North Carolina perform?

Over the 2001–2002 period, North Carolina ranked second among comparison states and sixth among the 50 states and District of Columbia in terms of percentage change in number of firms (1.8 percent) *[2-1]*. Among comparison states, Massachusetts had the largest positive percentage change, at 2.3 percent (ranked fourth nationally); Michigan had the only negative change, at -0.5 percent (ranked forty-third nationally). The U.S. average was -0.6 percent over the same period. Compared to the 1996–1997 period, the overall trend was a decrease in the number of firms among comparison states and the nation as a whole. This decrease reflects the economic recession during 2001 and 2002.

What does this mean for North Carolina?

North Carolina remains very competitive in terms of firm growth, suggesting the presence of a dynamic and healthy economy. This is especially impressive considering the downturn in the economy and continued global pressure affecting manufacturing industries in the state.

2-1 Percent Change in Number of Firms, 1996–1997 & 2001–2002



Nat'l Rank 2001-02	US	NC	GA	MA	MI	PA	TX	VA
		6	26	4	43	11	16	7

Source: Office of Advocacy, U.S. Small Business Administration.

INDICATOR 3: *Fast-Growth Companies & Jobs*

Key Findings

- **In 2001, the percentage of North Carolina jobs in gazelle firms (13.5 percent) nearly equaled the U.S. average (13.8 percent) and ranked in the middle of the percentages for comparison states.**
- **Between 1998 and 2002, the number of Technology Fast 500 companies in North Carolina declined slightly (17 in 1998; 15 in 2002), consistent with the trend in comparison states.**

Indicator Overview

The term "gazelle," as defined by Cognetics, Inc., a Cambridge, Massachusetts consulting firm, describes young business enterprises posting annual sales growth of 20 percent or higher over a four-year period, starting from an initial sales base of at least $100,000. While most gazelle firms have fewer than 100 employees at the beginning of their growth phase, they are estimated to be responsible for more than 70 percent of all new jobs created in the U.S.

Deloitte and Touche's "Technology Fast 500" are North America's fastest-growing technology companies in terms of revenue over five years. To be eligible for the list, a company must meet several criteria, including ownership of proprietary technology, contribution of a significant portion of operating revenues toward research and development, operating revenues of at least one million dollars, and being operational for a minimum of five years.

How does North Carolina Perform?

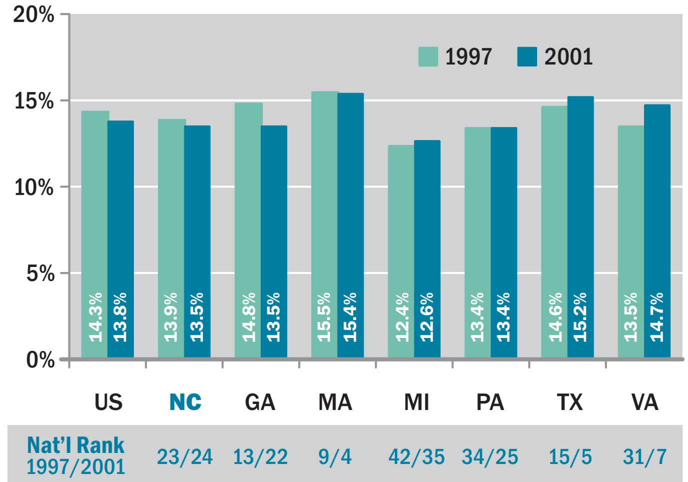
With respect to the percentage of jobs in gazelle firms, North Carolina performed slightly below the U.S. average, with 13.9 percent and 13.5 percent in 1997 and 2001, respectively *[3-1]*. The U.S. averages for the same years were 14.3 percent and 13.8 percent. Michigan, Texas, and Virginia were the only comparison states to experience an increase from 1997 to 2001. Overall, however, there is minimal variation across the 50 states and the District of Columbia in terms of the percentage of jobs in gazelle firms.

North Carolina was home to 15 Technology Fast 500 firms in 2002, ranking fourth among the comparison states *[3-2]*. Between 2000 and 2002, the number of such firms in North Carolina decreased by 16.7 percent. Massachusetts and Virginia experienced the largest declines, at 26 percent and 42 percent, respectively. Texas is the only comparison state to increase its numbers, growing by 40 percent over the same period. The size of a state's resident population had little influence on the number of Technology Fast 500 firms. Massachusetts, the least populated comparison state, had the greatest number of such firms. Michigan, a highly populated state, had only one.

What does this mean for North Carolina?

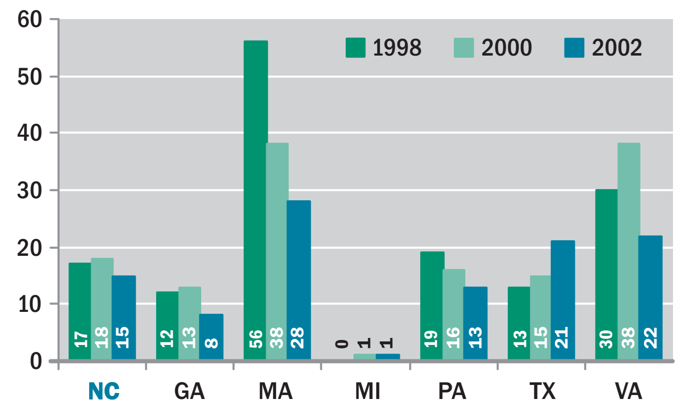
The presence of fast-growing firms indicates the degree to which the economy is dynamic, innovative, and a positive environment for firm expansion and job creation. While the presence of such companies in North Carolina has decreased slightly in recent years, similar trends hold for the comparison states. North Carolina remains strong in terms of fast-growth companies and jobs.

3-1 Percent of Jobs in Gazelle Firms, 1997 & 2001



Source: Cognetics, Inc. and Progressive Policy Institute.

3-2 Number of "Fast 500" Companies, 1998, 2000 & 2002



Source: Deloitte and Touche.

INDICATOR 4: *Worker Pay*

Key Findings

- In 2000, North Carolina's average private-sector wages ($30,937) ranked below the U.S. average ($35,305) and the averages for all comparison states.
- Between 1989 and 2000, North Carolina's real-wage growth rate (17 percent) ranked above the U.S. average (14 percent) and in the middle of the rates for comparison states.

Indicator Overview

A state's average wages and salaries reflect worker quality and productivity, industry mix, and the state's cost of living. Historically, North Carolina's average private-sector wage has been one of the lowest among the major manufacturing states. This low average wage reflects the state's heavy endowment of relatively low-technology and/or labor-intensive durable and non-durable goods industries (including textiles, apparel, household furniture, and packaged goods) and the comparatively low cost of living.

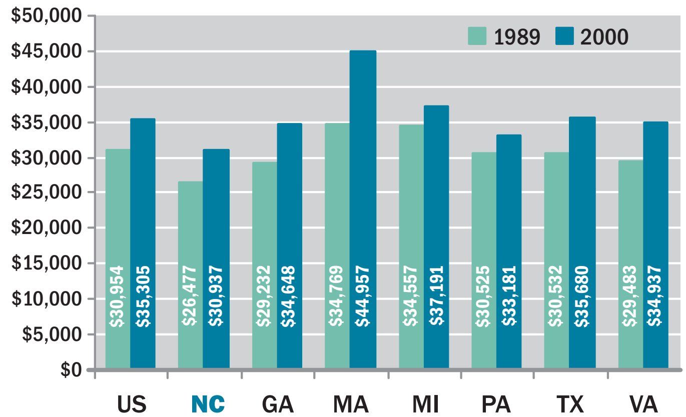
How does North Carolina Perform?

In 2000, U.S. private-sector workers earned, on average, $35,305 *[4-1]*. The typical worker in North Carolina earned $30,937 that year — 88 percent of the U.S. average. Driven by an industrial base dominated by low-technology industries that are sensitive to labor costs, North Carolina's average wage is below that of all its comparison states. Moreover, while the rate of real-wage growth in North Carolina (17 percent) was above the U.S. average (14 percent) between 1989 and 2000, it lagged growth in Georgia (19 percent), Massachusetts (29 percent), and Virginia (18 percent) *[4-2]*. Among comparison states, only Michigan and Pennsylvania had lower wage-rate growth. Like North Carolina, Michigan and Pennsylvania are manufacturing-intensive states with relatively moderate complements of technology-intensive industry.

What does this mean for North Carolina?

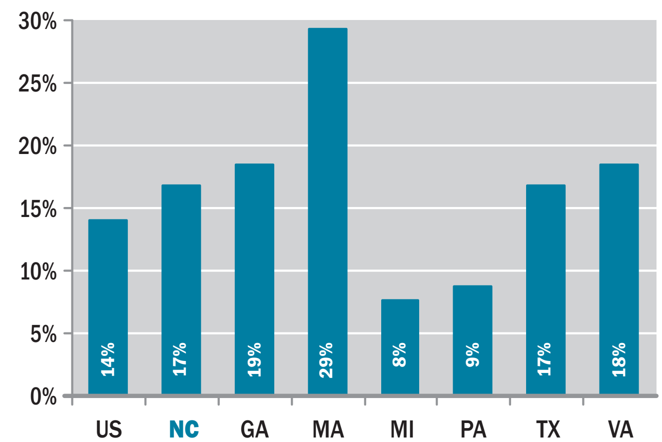
North Carolina is transitioning from a traditional manufacturing-based economy to a new knowledge-based economy. Over time, with the growth of higher-wage knowledge- and technology-intensive industries, real wages earned by North Carolina workers will increase, allowing for greater consumer spending and resultant economic growth in the state.

4-1 Annual Average Wages, Private Sector, 1989 & 2000
Adjusted for inflation



Source: Minnesota IMPLAN Group, Inc.

4-2 Percent Change in Real Wages, 1989 & 2000
Adjusted for inflation



Source: Minnesota IMPLAN Group, Inc.

INDICATOR 5: *Personal Income*

Key Findings

- In 2002, per capita income in North Carolina ($27,711) ranked below the U.S. average ($30,941) and the per capita incomes for all comparison states.
- Between 1991 and 2002, the per capita income growth rate in North Carolina (18 percent) ranked above the U.S. average (17.1 percent) but behind the rates in most comparison states.
- During 1999–2001,
  - North Carolina's median household income ($39,040) ranked below the U.S. average ($42,873) and the medians for all comparison states.
  - North Carolina's median household income growth rate (11.5 percent) ranked above the U.S. average (9.6 percent) and in the middle of the rates for comparison states.

Indicator Overview

Personal income, which includes wages and salaries, transfer payments, dividends, interest, rents, and proprietor's income, is a key indicator of the overall health of a state's economy. Technology-oriented economic development strategies aim to increase the number of high-wage jobs, expand investment opportunities in fast-growth, innovative companies, and raise productivity by diffusing advanced technologies and best practices. Per capita personal income is calculated as the personal income of an area's residents divided by the area's population. As an indicator, however, per capita personal income can obscure significant differences in the income distribution of various states. For example, a few individuals with very high incomes can elevate the level of per capita income of a given state, yielding a misleading picture of the level of prosperity enjoyed by the majority of residents. An alternate indicator — median household income — is based on the income distribution itself: it is the level at which half of all families (head of household and all other persons 15 years old and over in the household) report higher incomes and half of all families report lower incomes.

How does North Carolina Perform?

Per capita personal income in North Carolina was $27,711 in 2002, 90 percent of the U.S. level ($30,941) *[5-1]*. Unadjusted for cost of living, per capita income in North Carolina ranked last among comparison states. Between 1991 and 2002, incomes in the state rose by 18.0 percent, ahead of the U.S. growth rate (17.1 percent) but behind all comparison states except Pennsylvania.

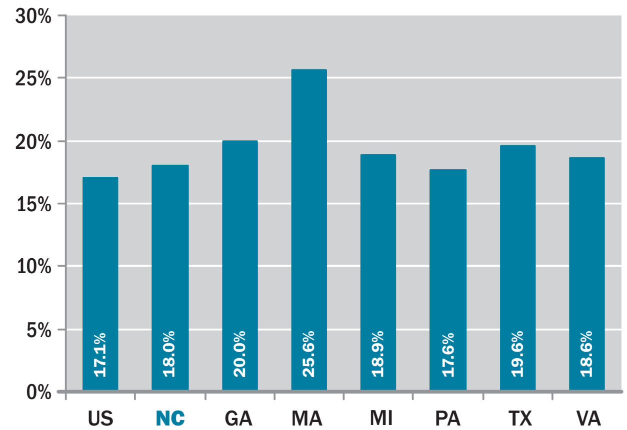
Unadjusted for cost of living differences, the median household income in North Carolina for the 1999–2001 period ($39,040) was 91 percent of the national average ($42,873) and last among the seven comparison states *[5-2]*. However, between the 1989–1991 period and the 1999–2001 period, North Carolina's growth rate was 11.5 percent, ahead of the U.S. average (9.6 percent) and greater than Massachusetts, Pennsylvania, and Virginia among comparison states.

What does this mean for North Carolina?

Healthy economies generate opportunities for households to increase incomes. Given that, on average, the highest incomes flow to individuals with the most advanced skill set and highest educational attainment, focusing on high-wage industries and dedicating resources toward improving educational levels in the labor force may enable more workers to enter the ranks of the innovation economy.

5-1 *Growth in Real per Capita Income, 1991–2002*

Adjusted for inflation

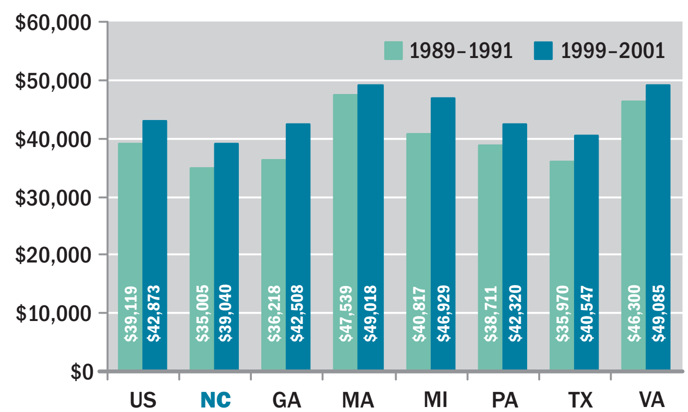


	US	NC	GA	MA	MI	PA	TX	VA
'02 Per Cap Inc	$30,941	$27,711	$28,821	$39,244	$30,296	$31,727	$28,551	$32,922
Nat'l Rank		28	16	3	22	31	17	25

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

5-2 *Median Household Income, 1989–1991 & 1999-2001*

Three-year average (adjusted for inflation), percent growth at bottom



	US	NC	GA	MA	MI	PA	TX	VA
Growth	9.6%	11.5%	17.4%	3.1%	15.0%	9.3%	12.7%	6.0%

Source: U.S. Census Bureau, U.S. Department of Commerce.

Performance Outcome

INDICATOR 6: *Income Distribution & Poverty*

Key Findings

- Between the late 1970s and late 1990s,
  - Incomes of the poorest North Carolina households increased by 5.9 percent, slower than the U.S. average (7.1 percent) and the increases in most comparison states.
  - Incomes of the wealthiest North Carolina households increased by 47.5 percent, faster than the U.S. average (44 percent) but slower than the increases in most comparison states.
- Between 1999 and 2001, North Carolina's poverty rate (12.9 percent) ranked above the U.S. average (11.6 percent) and the rates for most comparison states.

Indicator Overview

Ensuring economic opportunities for all North Carolinians, regardless of income level, is an essential goal of economic development policy.[1] As North Carolina transitions from a manufacturing-based economy to a knowledge-based economy, workers with insufficient education or skills and residents of areas that are distant from growing technology centers in the state will become increasingly isolated and unable to obtain the quality jobs that knowledge-based industries typically provide. In addition, the "digital divide"[2] threatens to limit some North Carolinians' access to the broader innovation economy and its associated investment opportunities and higher wage jobs. Income distribution and poverty level are important measures for monitoring the degree to which the emerging knowledge-based economy is yielding gains for all residents in the state.

How does North Carolina perform?

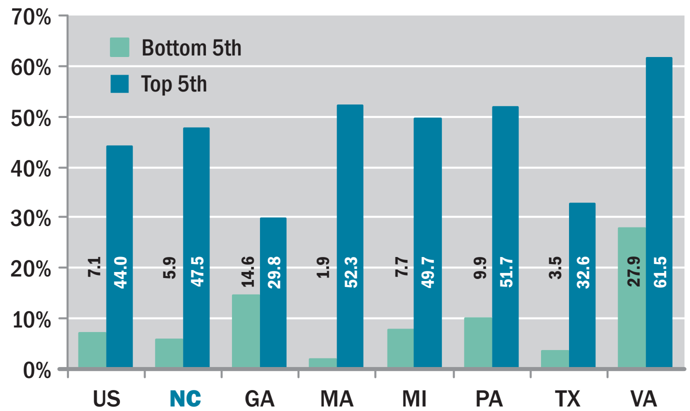
Reversing a trend toward greater income equality that prevailed between World War II and the 1970s, the last two decades have seen the incomes of poor and middle class families rise only modestly, whereas the incomes of the wealthiest families grew dramatically.[3] In the late 1970s, the average income of the wealthiest fifth of households in the U.S. was 7.4 times that of the poorest fifth of households (data not shown here). By the late 1990s, the average incomes of the wealthiest households had risen to 10 times that of the poorest *[6-1]*. Trends in North Carolina mirrored the national pattern. Between the 1978–1980 and 1998–2000 periods, North Carolina ranked third from the bottom among comparison states, ahead of Georgia and Texas, in terms of income growth for the poorest fifth of households (5.9 percent). In contrast, North Carolina's wealthiest fifth of households kept pace with most of the other states, at just under 50 percent growth.

Although there was a slight decrease in the percentage of persons in poverty in North Carolina between the 1986–1988 period and the 1999–2001 period, the state performed better than only one comparison state, Texas *[6-2]*. During the 1999–2001 period, 12.9 percent of families were in poverty, compared to 11.6 percent nationally. Among comparison states, Virginia had the lowest percentage in poverty, at 8.0.

What does this mean for North Carolina?

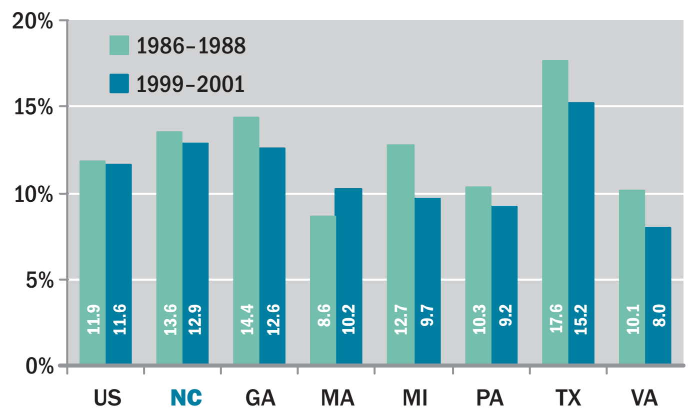
North Carolina's rapidly growing technology and service industry clusters (located in its largest metropolitan areas) and its struggling manufacturing and agriculture industry clusters (located primarily in rural counties and towns) are on divergent paths. This divergence is increasing North Carolina's income gap and isolating many poor and rural families from the innovation economy.

6-1 *Percent Change in Average Real Income, Top and Bottom Fifth of Families, 1978–1980 & 1998–2000*



Source: Center on Budget and Policy Priorities, Economic Policy Institute.

6-2 *Percent Persons in Poverty, 1986–1988 & 1999–2001*
Three-year average



Source: Center on Budget and Policy Priorities, Economic Policy Institute.

1. North Carolina Economic Development Board, *We are Changing the Way We Do Business: North Carolina's 2002 Economic Development Strategic Plan* (Raleigh, NC, North Carolina Department of Commerce, October 2002).
2. The gap in access to information technologies between higher and lower income households, or between urban and rural households and businesses.
3. Bernstein et al. *Pulling Apart: A State-by-State Analysis of Income Trends*, April 2002.

Economic Structure Indicators

A state's economic structure is a key determinant of its ability to create and sustain technology-intensive industries and companies. This section examines North Carolina's economic structure in terms of the intensity of its technology activity, the performance of its technology-related industry sectors, the state's role in the global economy, and key employment and wage trends.

INDICATOR 7: *Technology-Intensive Activities*

Key Findings

- In 2000, the share of North Carolina's private sector workers employed in technology-intensive industries (11.5 percent) ranked below the U.S. average (12.8 percent) and the shares for most comparison states.
- Between 1989 and 2000 in North Carolina,
  - The growth rate in technology-intensive employment (3.7 percent) ranked above the U.S. average (1.4 percent) and the rates for most comparison states.
  - The growth rate in very technology-intensive employment (4.8 percent) ranked above the U.S. average (2.3 percent) and the rates for most comparison states.
- Within North Carolina,
  - Nearly half (48 percent) of the growth in technology-intensive jobs occurred in the Research Triangle region between 1989 and 2002, far exceeding the growth in other regions of the state.
  - More than half of the very technology-intensive jobs (53.0 percent) were located in the Research Triangle region in 2002.

Indicator Overview

As a group, technology-intensive industries — distinguished here by three categories (very technology-intensive, moderately technology-intensive, and somewhat technology-intensive) — are one of the principal sources of new, higher wage jobs in the U.S. Technology-intensive industries require access to pools of skilled labor, advanced infrastructure, and quality living conditions for employees. Those are the assets that North Carolina and the rest of the U.S. must develop as traditional industries that are sensitive to labor costs migrate to low-cost locations in other countries.

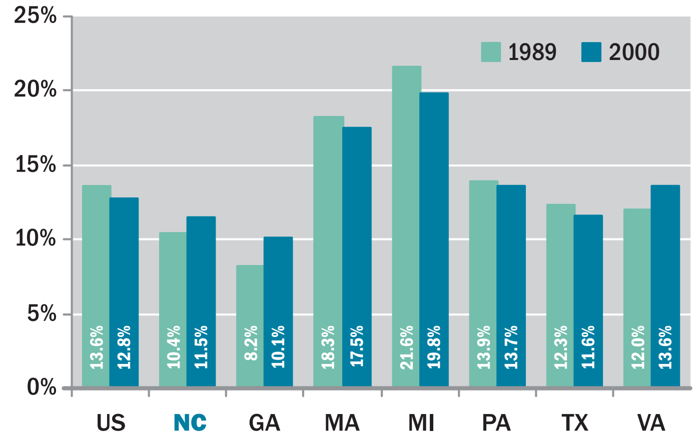
How does North Carolina perform?

In 2000, 11.5 percent of private sector workers in North Carolina were employed in technology-intensive industries *[7-1]*, ranking below the U.S average (12.8 percent) and the average among the comparison states (14.4 percent).[1] North Carolina ranked behind all comparison states except Georgia in overall technology intensity. In addition, within the technology sector, a greater proportion of North Carolina high-technology workers were employed in somewhat technology-intensive industries (as opposed to moderately or very technology-intensive) than is the case for the U.S. or the comparison states (data not shown here). Between 1989 and 2000, however, North Carolina was one of only three comparison states (NC, GA, VA) to increase its share of technology-intensive employment.

This increase in technology-intensive employment resulted from a high rate of growth in North Carolina's technology sector. Technology-intensive jobs in the state grew by 3.7 percent between 1989 and 2000, tying with Virginia for second behind Georgia among comparison states *[7-2]*. Those states also were the only three among the comparison states to have their technology sector growth rates surpass their overall private sector growth rates. The fastest growth in North Carolina occurred among very technology-intensive industries, such as pharmaceuticals, computers, and software and

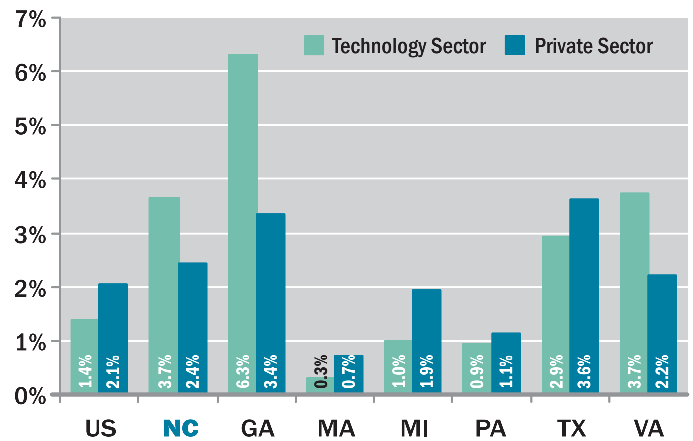
7-1 Technology-Intensive Employment, 1989 & 2000

Percent share of all private sector employment



Source: Minnesota IMPLAN Group, Inc.

7-2 Annual Percent Employment Growth, Technology-Intensive Industries, 1989–2000



Source: Minnesota IMPLAN Group, Inc.

1. 2000 is the latest year for which data for the U.S. and the comparison states are available.

Examples of Technology-Intensive Industries

(See Appendix 1 for complete list.)

Somewhat Technology-Intensive

- household chemicals and paints
- industrial machinery
- electrical equipment
- car, truck, and bus bodies

Moderately Technology-Intensive

- industrial chemicals
- electronics components
- motor vehicles
- medical instruments
- hospitals and labs

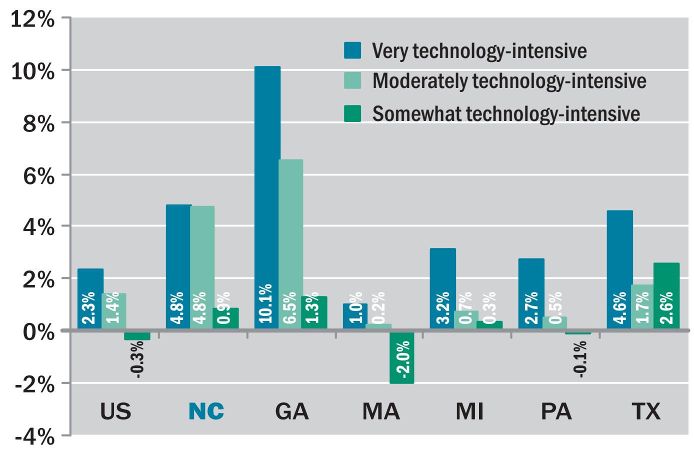
Very Technology-Intensive

- pharmaceuticals
- computers
- aircraft and space equipment
- process controls
- sensors and instruments
- software and information services
- testing and research labs

information services *[7-3]*. North Carolina's 4.8 percent growth rate in these industries ranked above the U.S. average (2.3 percent) and most comparison states.

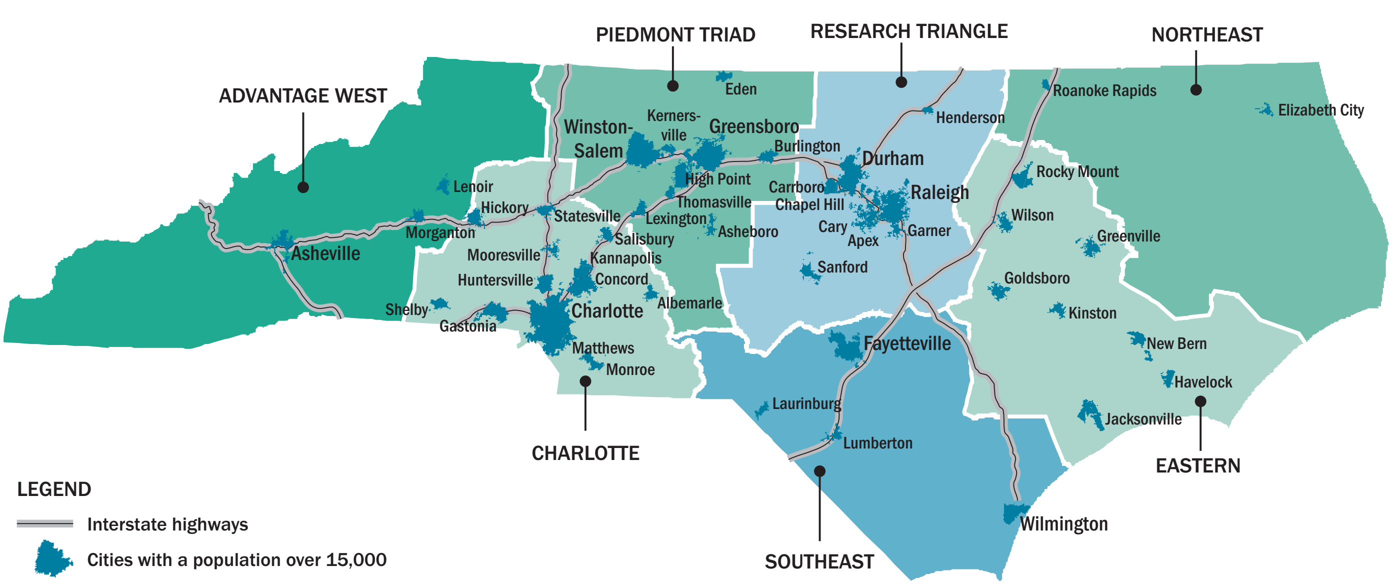
Within North Carolina, the Research Triangle continues to garner the lion's share of new technology jobs. In 1989, 27 percent of all of North Carolina's technology-intensive jobs were located in the Research Triangle, the highest share of any region *[7-5a]*. Between 1998 and 2002, the Research Triangle

7-3 Annual Percent Employment Growth by Technology-Intensive Category, 1989–2000



Source: Minnesota IMPLAN Group, Inc.

7-4 Economic Development Partnership Regions in North Carolina

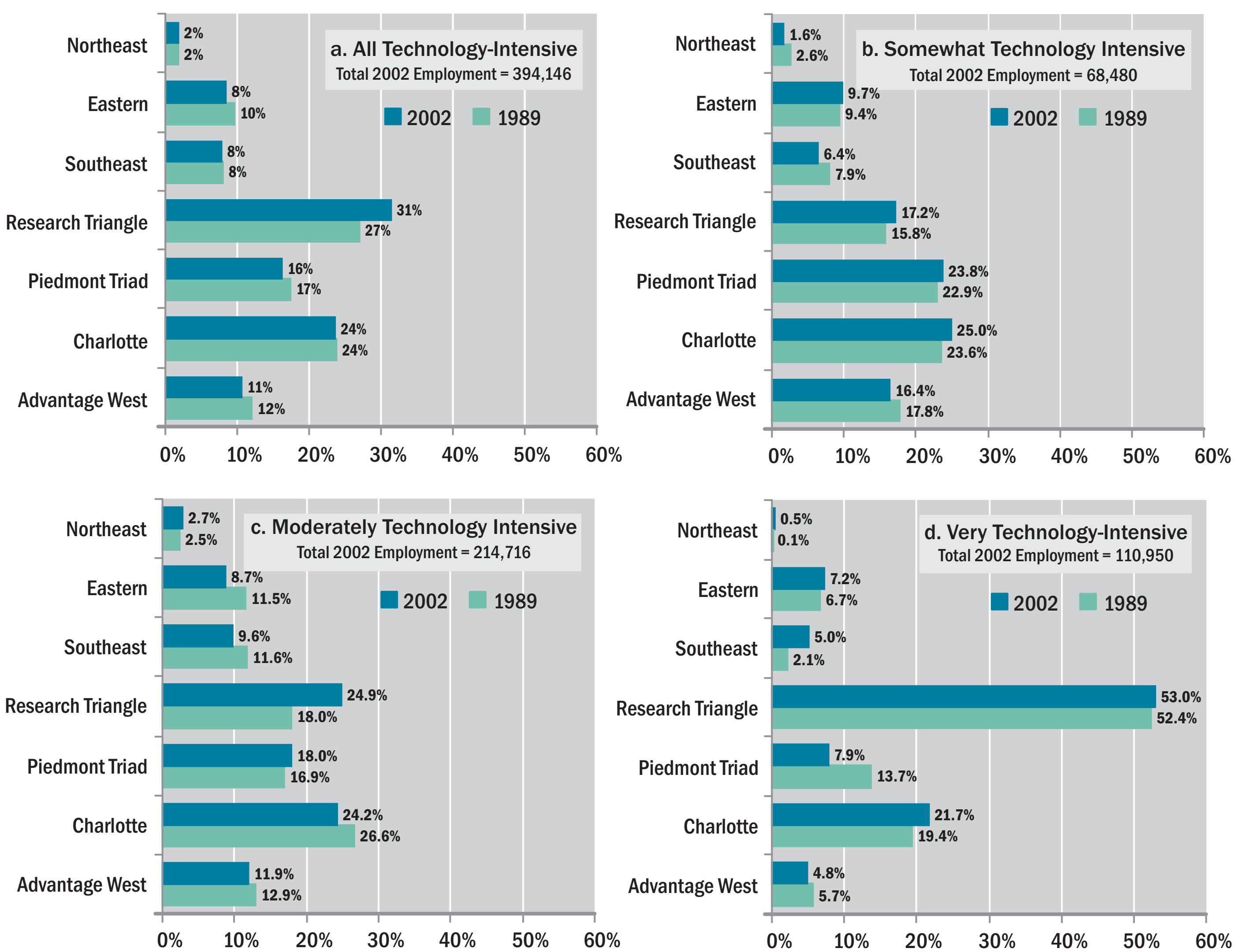


gained 48 percent of all new technology-intensive jobs created in North Carolina, increasing its overall share of the state's technology-intensive jobs to 31 percent *[7-5a and 7-6]*. Although the absolute number of technology-intensive jobs increased in every region over the period, the Research Triangle region is the only one whose statewide share of technology-intensive jobs increased. The trend toward concentration of technology-intensive industries and jobs in the Research Triangle is strongest for the moderately technology-intensive sectors *[7-5c]*. That region's largest share of jobs is in the very technology-intensive category, in which it accounts for 53 percent of the jobs *[7-5d]*.

What does this mean for North Carolina?

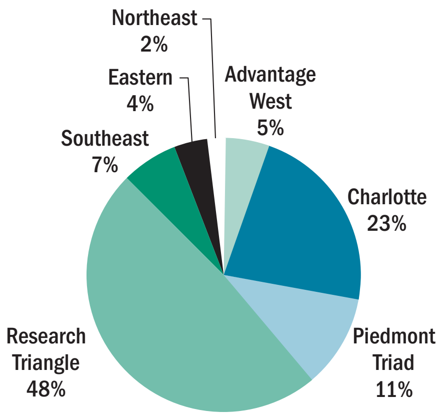
North Carolina's high rate of growth in technology-intensive industries indicates that it is gaining relative to other states, but it currently is not a leader in high-technology industries. The state's technology-intensive gains, however, are accruing disproportionately to the Research Triangle region. For economic growth to continue and yield benefits throughout the state, regions other than the Research Triangle must gain increasing shares of technology-intensive jobs.

7-5 Share of Statewide Technology Jobs by Region and Technology-Intensive Category, 1989 & 2002



Source: North Carolina Employment Security Commission.

7-6 Distribution of Growth in Technology-Intensive Jobs in North Carolina by Region, 1989–2002



Source: North Carolina Employment Security Commission.

INDICATOR 8: *High-Technology Industry Clusters*

Key Findings

- In 2000,
  - Among seven core high-technology industry clusters in the U.S., two in North Carolina (chemicals/plastics and pharmaceuticals/medical technologies) had higher employment than would be expected based on national trends.
  - Average wages in the seven core high-technology industry clusters in North Carolina ranked above the average private sector wages for North Carolina and the U.S. as a whole.
- Between 1989 and 2002, real wages grew faster in North Carolina's high-technology clusters than in either the North Carolina or U.S. private sectors as a whole.

Indicator Overview

A business enterprise's success depends in part on the competitiveness of its key suppliers, service providers, sources of capital equipment, and even its direct competitors. Industry clusters are groups of businesses and industries that are related through presence in a common product chain, dependence on similar labor skills, or utilization of similar or complementary technologies. Whereas an *industry* is a group of businesses that produce a similar product, a *cluster* includes final market producers, suppliers, related producer services, and other linked enterprises. Oft-cited examples of clusters are the vehicle manufacturing complex in Detroit, computers, software, and telecommunications in the Silicon Valley, and the many industries involved in commercial aircraft production in Seattle.

The critical feature of an industry cluster is shared benefits associated with the cluster's size and scope; such returns grant individual member businesses a competitive edge relative to their counterparts in regions with less extensive clusters. Businesses in large, well-developed industry clusters enjoy ready access to specialized supplies and equipment, skilled labor, specialized infrastructure, and top-quality technical and scientific personnel. Businesses in such clusters often work jointly to solve collective problems while also engaging in direct competition.[1]

To focus on high-technology industries, we analyzed relationships among strictly high-technology industry sectors (see Indicator 7) to identify seven technology clusters in the U.S. economy and North Carolina.[2] Examining the relative presence of the clusters in North Carolina provides some sense of the major technology strengths in the state.[3] The core technology clusters are not mutually exclusive, since they are based on interdependence between technology-intensive industries.

How does North Carolina perform?

Classified with respect to location quotient, the core technology clusters with the strongest relative presence in North Carolina include chemicals/plastics and pharmaceuticals/medical technologies *[8-1 and 8-2]*.[4] For each cluster, the location quotient is the ratio of the cluster's share of employment in North Carolina to its share of employment in the U.S. as a whole.[5] A location quotient equal to 1.0 indicates that the cluster's share in North Carolina matches the comparable share for the U.S. as a whole. A location quotient significantly above 1.0 signifies state specialization, i.e., the state has a larger share of activity in the cluster than we would expect based on national trends. By this measure, industrial machinery and motor vehicle manufacturing are also beginning to attain critical mass, but information technology/instruments, communications services/software, and aerospace have a less significant presence in the state relative to national patterns.

In terms of number of employees, North Carolina's strongest relative gains between 1989 and 2002 came in the communications software/services cluster, while its only loss was in the industrial machinery cluster. All other clusters had positive, but small, employment gains. In terms of average wages, the information technology/instruments cluster had both the highest value and highest real growth rate between 1989 and 2002. Communication services/software and pharmaceuticals/medi-

Key Features of North Carolina High-Technology Industry Clusters:

- They are based on a detailed analysis of inter-industry trade and labor usage patterns.
- Every cluster includes end-market and supplier industries.
- They are not mutually exclusive. Many industries supply or purchase from — or are technologically similar to — many other industries, and therefore appear in multiple clusters.

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1. See *Boosting Innovation—The Cluster Approach,* edited by T.J.A. Roelandt and P. den Hertog (Paris, Organization for Economic Co-operation and Development, 1999).
2. The complete list of high-technology clusters is available in Appendix 2.
3. This cluster analysis builds on a more comprehensive analysis conducted in 2000. See *High Tech Clusters in North Carolina,* available at *http://www.ncscienceandtechnology.com*.
4. With the exception of wage information, the table and figure present identical information but in different formats.
5. The formula for computing a location quotient is as follows:

$$\frac{\text{Employment, cluster i, NC}}{\text{Total employment, NC}} \div \frac{\text{Employment, cluster i, US}}{\text{Total employment, US}}$$

8-1 *Core U.S. Technology Clusters in North Carolina*

***Size** (2002), **location quotient (i.e., concentration, 2000), wages** (2002), **and growth** (1989–2002)*

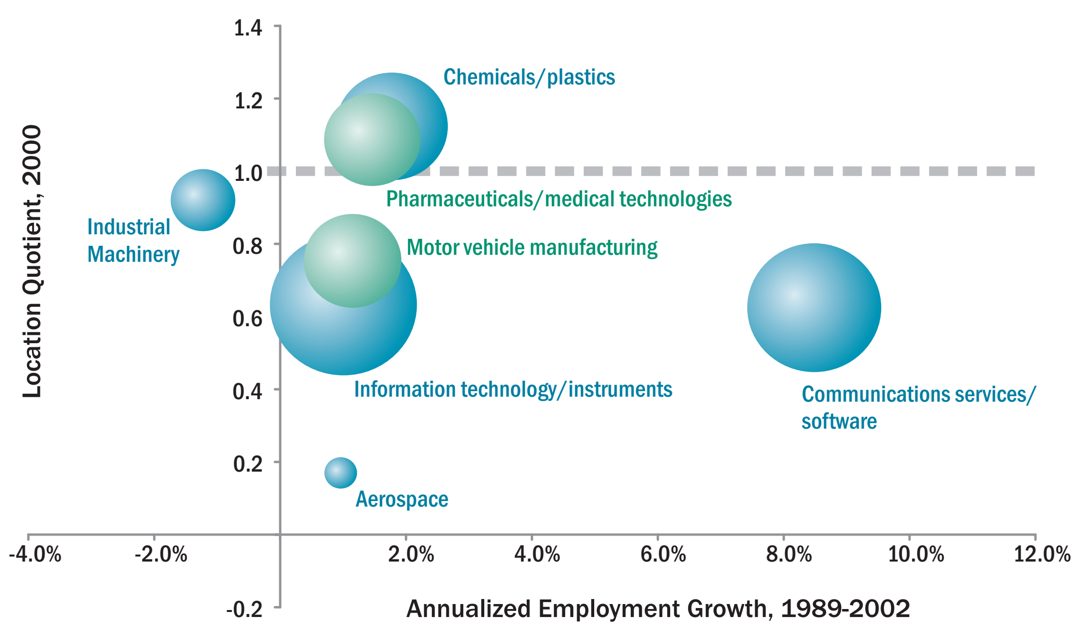
Clusters (sorted in descending order based on location quotient)	Employment 2002	Employment Annual Change 1989–2002	Location Quotient 2000*	Average Wages 2002	Real Wage Growth 1989–2002
Chemicals/plastics	48,789	1.8%	1.12	45,038	12.8%
Pharmaceuticals/medical technologies	36,120	1.5%	1.09	59,387	54.4%
Industrial machinery	16,210	-1.2%	0.92	43,870	20.6%
Motor vehicle manufacturing	37,078	1.2%	0.75	44,661	28.6%
Information technology/instruments	84,113	1.0%	0.63	71,639	59.7%
Communication services/software	69,768	8.5%	0.62	61,917	54.5%
Aerospace	4,146	1.0%	0.17	50,091	31.2%

Source: N.C. Employment Security Commission, U.S. Bureau of Labor Statistics.

** U.S. data used in calculating the location quotients is for year 2000. SIC-based industry data were not available at the national Level after year 2000. The dotted line designates the point above which clusters in North Carolina have a larger share of employment activity than would be expected based on national trends.*

8-2 *Core U.S. Technology Clusters in North Carolina*

***Size** (2002), **location quotient (i.e., concentration, 2000), and growth** (1989–2002)*



Note: The dotted line at 1.0 designates the point above which clusters in North Carolina have a larger share of employment activity than would be expected based on national trends.

Source: N.C. Employment Security Commission, U.S. Bureau of Labor Statistics.

INDICATOR 8: *High-Tech Clusters, continued*

cal technologies also had high average wages and growth in real wages. The other clusters had positive, but lower, wages and growth rates.[6] The average wage values and wage growth rates in most of these clusters are higher than the comparable values and rates for the North Carolina private sector and the U.S. private sector (see Indicator 4).

What does this mean for North Carolina?

Relative to the U.S. as a whole, North Carolina's share of employment in high-technology clusters ranks below average and is concentrated in a small number of clusters. Because such high-technology clusters have higher-than-average wages and high rates of wage growth, North Carolina should continue its efforts to create, grow, and recruit a broad base of high-technology clusters in the state.

6. U.S. and comparison-state data for employment, employment growth, average wages, and real wage growth were not available for the high-technology clusters analyzed here.

Economic Structure

INDICATOR 9: *International Exports*

Key Findings

- **Between 1999 and 2002, the value of North Carolina's international commodity exports decreased by 1.9 percent, ranking slightly below average among the rates for comparison states.**
- **In 2001, North Carolina's export intensity (6.1 percent) ranked below the U.S. average (9.9 percent) but above the intensities for most comparison states.**

Indicator Overview

International exports are an important indicator of a state's potential for generating income and increasing the competitiveness of businesses in the state.[1] Money brought into the state from export businesses allows for the purchase of local goods and services and thus improves the state's local economy.[2] Export-based companies also are frequently required to adapt products in unique ways for foreign consumers. They may be called upon to negotiate trade restrictions and certification requirements, to work with foreign suppliers, and/or to manage expansive distribution channels — all of which create the flexibility and determination that result in greater competitiveness in home markets.

How does North Carolina perform?

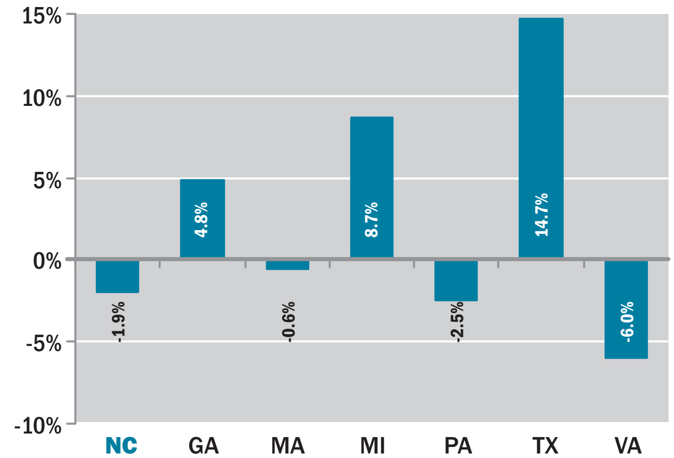
Between 1999 and 2002, North Carolina experienced a decrease in the value of its international commodity exports, from approximately $15 billion down to $14.7 billion (-1.9 percent), placing it third from the bottom in terms of percent growth among comparison states (ahead of Pennsylvania and Virginia) *[9-1]*. Texas, which showed the largest gain, experienced growth of 14.7 percent. North Carolina exports constituted 2.1 percent of the U.S. total in 2002, down from 2.6 and 2.4 percent in 2000 and 2001, respectively (data not shown here).

In 2001, North Carolina's export intensity — the ratio of commodity exports (value) to gross state product — was 6.1 percent, ranking behind the U.S average (9.9 percent). North Carolina ranked third highest among the comparison states *[9-2]*. Texas had the largest export intensity ratio, at 12.4 percent; Virginia and Pennsylvania tied for the lowest ratio at 4.3 percent.

What does this mean for North Carolina?

While the economic downturn in 2000 and 2001 played the biggest role in North Carolina's decrease in export value, the globalization of the manufacturing industry most likely also contributed to the decline.[3] As North Carolina transitions into a knowledge-based economy, one in which services make up a larger percent of total output, the state's commodity exports likely will continue to decrease over time.

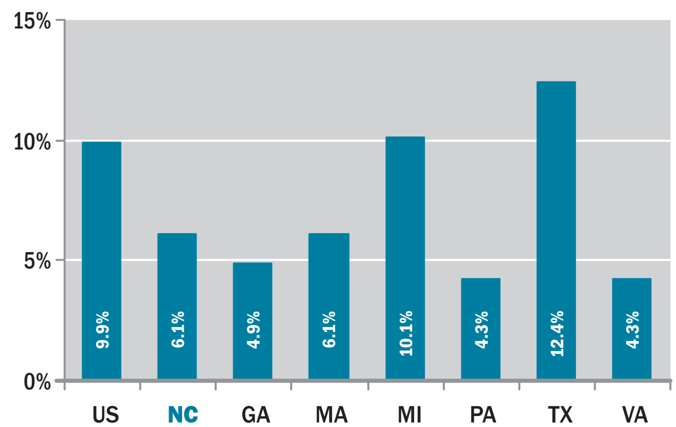
9-1 Growth in International Exports, 1999–2002



2002 Exports (in millions)	NC	GA	MA	MI	PA	TX	VA
	$14,719	$14,413	$16,708	$33,775	$15,768	$95,396	$10,796

Source: U.S. Census Bureau, U.S. Department of Commerce.

9-2 Export Intensity, Ratio of Exports to Gross State Product, 2001



Source: U.S. Census Bureau, U.S. Department of Commerce; Bureau of Economic Analysis, U.S. Department of Commerce.

1. The data in this section come from the Origin of Movement series, available since 1987 from the U.S. Census Bureau, Foreign Trade Division. This series provides export statistics based on the state from which the merchandise starts its journey to the port of export; that is, the data reflect the transportation origin of exports.
2. Export income is considered "new" money introduced into a local economy (in this case a state's economy). This "new" money can be spent on local goods and services, resulting in an income multiplier effect.
3. For all the states, the value of exports for the 1999-2002 period is much lower than for the 1993-1999 period, which was featured in the *Tracking Innovation 2000* report.

INDICATOR 10: *Industrial Transition*

Key Findings

- **Between 1997 and 2001, North Carolina's layoff actions per establishment (5.47 per 10,000) and layoffs per worker (7.16 per 1,000) ranked below the U.S. average (8.06 per 10,000 establishments; 10.20 per 1,000 workers) and the rates for most comparison states.**
- **In 2000, North Carolina's growth/decline wage ratio (105.7) ranked above the U.S. average (90.9) and the ratios for most comparison states.**

Indicator Overview

The shift from traditional manufacturing to knowledge-based manufacturing and services is occurring throughout the United States. With its high relative concentration of traditional manufacturing sectors, North Carolina is currently facing considerable industry restructuring. Two measures of industrial restructuring are mass layoff actions and the ratio of wages in major growth sectors to wages in major decline sectors. The first indicates the relative size and extent of plant declines and closures. The second characterizes the relative wage effects of the transition, i.e., whether the average wage of the sectors adding the most new jobs in the state is higher than the average wage of the sectors eliminating the most jobs.

How does North Carolina perform?

Between 1997 and 2001, North Carolina averaged 116 layoff actions annually; an average of 27,000 workers lost their jobs each year in such actions (data not shown here). In relative terms, mass layoff activity in the state was modest. The state averaged 5.47 layoff actions per 10,000 establishments, compared to 8.06 layoffs per 10,000 establishments nationwide *[10-1]*. Among comparison states, North Carolina ranked third behind Georgia and Virginia in the fewest layoff actions per establishment. Similarly, in terms of layoffs per worker, North Carolina's 7.16 per 1,000 workers ranked third among comparison states and below the U.S. average (10.2 per 1,000 workers).

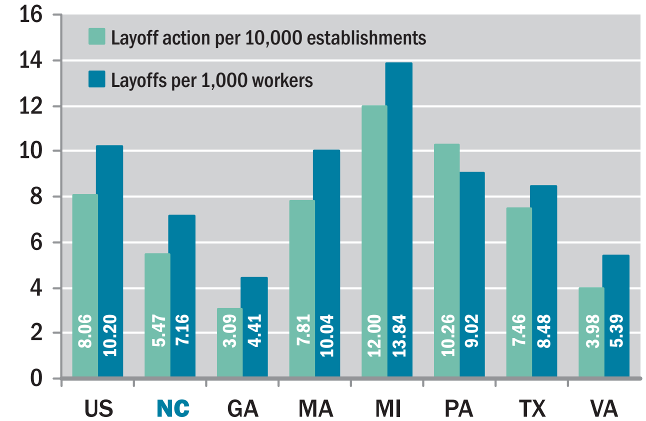
In 2000, the industry sectors accounting for the most net job gains in North Carolina paid a slightly higher wage, on average, than sectors accounting for the most net job declines. This is a reversal from 1997, when growth industries in North Carolina paid lower average wages than decline industries. North Carolina's 2000 ratio, 105.7, is second among comparison states and well above the U.S. average of 90.9 *[10-2]*. In North Carolina, wages in growth industries are 105.7 percent of wages for declining industries. Unlike the U.S. overall, the industrial transition underway in the North Carolina involves a shift toward higher wage sectors.

What does this mean for North Carolina?

Although North Carolina's traditional manufacturing base has experienced a sharp decline in employment over the last decade, its job losses have been modest when compared to similar trends in other states. Over the same period, its targeted industry base — high-skilled, higher-wage industries — has grown significantly. It is essential that North Carolina continue to create new jobs in growing industry sectors with the potential for income growth.

10-1 Mass Layoff Actions, 1997–2001

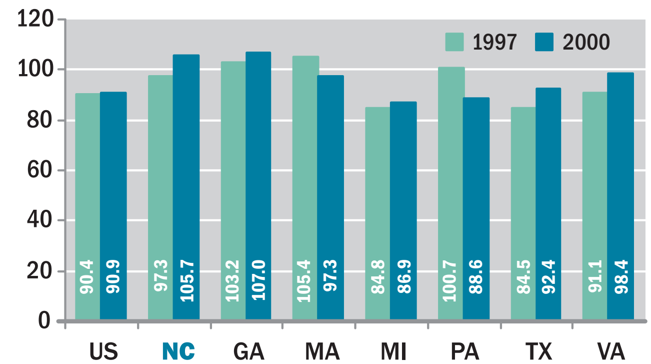
Annual figures averaged for three-year period



Source: Bureau of Labor Statitics, U.S. Department of Commerce.

10-2 Growth/Decline Average Wage Index, 1997 & 2000

Ratio of average wage for major growth sectors to average wage for major declining sectors



Source: Minnesota IMPLAN Group, Inc.; Bureau of Labor Statistics, U.S. Department of Commerce.

Methodological Note

The mass layoff data reported here are based on quarterly data from the U.S. Bureau of Labor Statistics, which reports actions for establishments that have at least 50 initial claims filed against them during a five-week period and where the employer indicates that 50 or more people were separated from their jobs for at least 31 days. Thus small layoffs — those involving fewer than 50 workers (or where fewer than 50 workers apply for unemployment benefits) — are not included in the data.

We developed the growth/decline average wage index as follows: For a given state, we identified the industry sectors that added the most net new jobs between 1997 and 2000 (sorting sectors in descending order according to job creation and using the first 80 percent of net new jobs as the cut-off point). We also identified the sectors that eliminated the most net jobs over the period (also using an 80 percent cut-off). We then took the mean of the top growth sectors' average wage in 1997 and 2000 and the mean of the major declining sectors' average wage in those years. The ratio of the two means is the growth/decline index. A ratio higher than 100 indicates that jobs in the state's principal growth industries pay a higher wage than the jobs in the principal declining industries.

Innovation Outcome Indicators

The ability of a state to translate its innovative ideas into commercially viable products is a key indicator of the success of its innovation economy. This section examines North Carolina's success in patenting and commercializing ideas and in attracting and generating investment in new companies.

INDICATOR 11: *Utility Patents*

Key Findings

- In 2000, the number of utility patents granted per capita in North Carolina (22.9 per 100,000 population) ranked below the U.S. average (30.2 per 100,000 population) and the numbers for most comparison states.
- Between 1989 and 2000, North Carolina's utility patent growth rate (132 percent) ranked above the U.S. average (70 percent) and the rates for all comparison states.

Indicator Overview

Utility patents are patents for inventions. The number of utility patents generated by North Carolina universities, companies, and research institutions reflects the magnitude of initial discovery and protection of innovative ideas. These new ideas are often the catalyst for future products and marketable commodities, resulting in commercially relevant research and development. Because strong patent activity measures attempts by inventors to fully and exclusively appropriate returns from their innovations, it is a broad indicator of innovative activity within a state. There are considerable differences in the propensity of different industries to patent new ideas, and thus industry mix partially explains differences in patenting rates across states.[1]

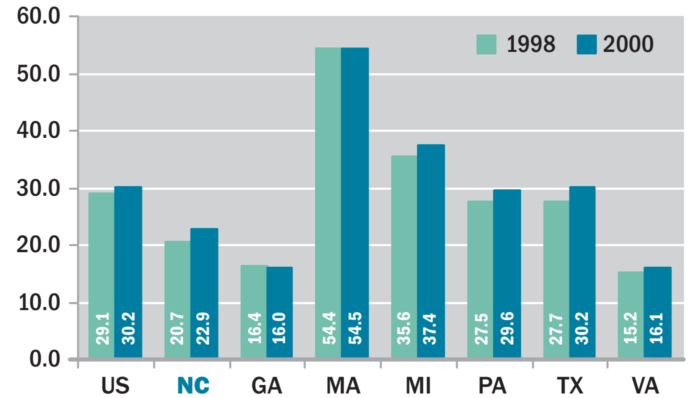
How does North Carolina perform?

While experiencing considerable growth from 1998 to 2000, North Carolina still lags the nation and all comparison states, except for Georgia and Virginia, in the number of utility patents granted per capita *[11-1]*. In 2000, 22.9 utility patents were awarded in North Carolina for every 100,000 people, compared to the national rate of 30.2 patents. Massachusetts significantly out-performed the nation and all comparison states with a rate of 54.5 patents granted per 100,000 people in 2000. At the same time, however, North Carolina utility patents grew by 132 percent, faster than the U.S. average (70 percent) and all comparison states in terms of patent growth from 1989 to 2000 *[11-2]*.

What does this mean for North Carolina?

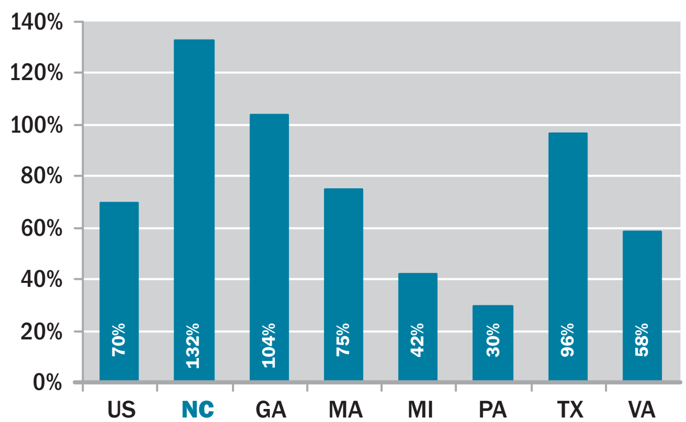
North Carolina is in a strong competitive position in terms of innovative activity. If the growth trend continues, the state will increasingly improve on the number of utility patents granted per capita.

11-1 Utility Patents Granted per 100,000 Population, 1990 & 2000



Source: U.S. Patent and Trademark Office; Bureau of Economic Analysis, U.S. Department of Commerce.

11-2 Utility Patents Granted: Growth, 1989–2000



Source: U.S. Patent and Trademark Office.

1. Works consulted: *Index of Innovation and Technology*, Washington State, 2003; Index *of the Massachusetts Innovation Economy*, 2002.

Innovation Outcome

INDICATOR 12: *Technology Transfer Activity*

Key Findings

- Between 1997 and 2000,
  - North Carolina's number (803) and growth rate (46 percent) of patent applications and invention disclosures ranked in the middle of the numbers and rates for comparison states.
  - North Carolina's number (161) and growth rate (13 percent) of licenses and options executed ranked below the numbers and rates for most comparison states.
- In 2000, North Carolina's ratio of license income to gross state product (0.004 percent) ranked below the U.S. average (0.011 percent) and the ratios for most comparison states.

Indicator Overview

Broadly defined, the phrase "technology transfer" describes the movement of ideas, tools, and people among institutions of higher learning, the commercial sector, and the public.[1] Specifically, technology transfer is the process whereby intellectual property derived from research at major universities and research institutions is licensed and conveyed to industry. There are several measures of the ability of research institutions to connect with business in bringing the results of academic research to market. Invention disclosures and patent applications indicate the number of inventions and intellectual properties created through academic or institutional research. Licensing agreements transfer innovations of commercial interest and value to industry. The number of licenses and options executed and incomes generated from licensing are indicators of the value of those intellectual properties.

How does North Carolina perform?

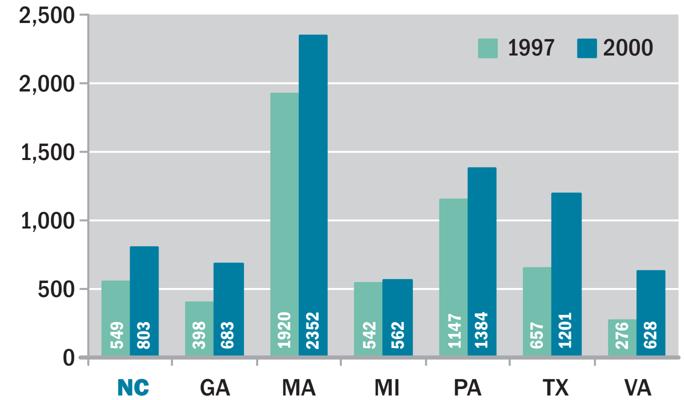
North Carolina's major universities generated 803 patent applications and invention disclosures in 2000, up from 549 in 1997, a growth rate of 46 percent. The number of patent application and invention disclosures generated in North Carolina exceeded similar technology transfer activity in Georgia, Michigan, and Virginia, although Massachusetts nearly tripled, and Pennsylvania almost doubled, North Carolina's volume *[12-1]*. In terms of licenses and options executed in 2000, among comparison states, North Carolina (161 licenses and options executed) lagged Massachusetts, Pennsylvania, and Texas. Except for Georgia, the only comparison state to decrease in its number of license options executed from 1997 to 2000, North Carolina experienced the smallest growth rate (13 percent) *[12-2]*.

In absolute terms, gross license income earned by North Carolina universities remains modest. In 2000, North Carolina research universities generated a total of $10.8 million in licensing income, up from $6.4 million in 1997, but ahead of only Virginia among comparison states (data not shown here). Massachusetts led all comparison states in generating approximately $53.5 million in licensing income in 2000, whereas Pennsylvania, Texas, and Michigan each generated approximately $30 million. In 2000, North Carolina's ratio of licensing income to gross state product (0.004 percent) was 36 percent of the U.S. average, down from 38 percent in 1997, and ahead of only Virginia *[12-3]*.

What does this mean for North Carolina?

Between 1997 and 2000, the volume growth rates of patent applications, invention disclosures, and license and options

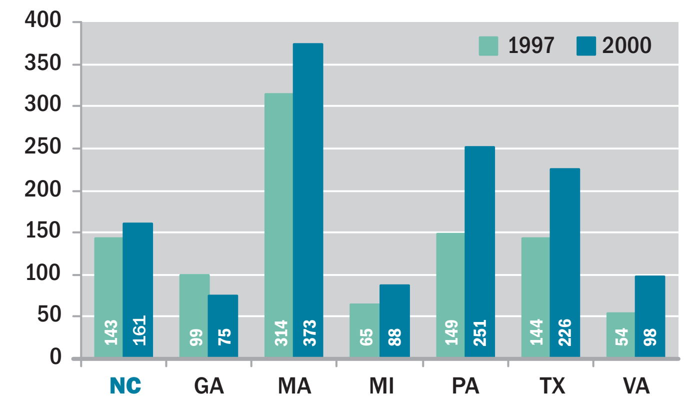
12-1 Number of Patents and Invention Disclosures, 1997 & 2000



	NC	GA	MA	MI	PA	TX	VA
% Change 1997-00	46%	72%	23%	4%	21%	83%	128%

Source: Association of University Technology Managers, Inc.

12-2 Number of Licenses and Options Executed, 1997 & 2000



	NC	GA	MA	MI	PA	TX	VA
% Change 1997-00	13%	-24%	19%	35%	68%	57%	81%

Source: Association of University Technology Managers, Inc.

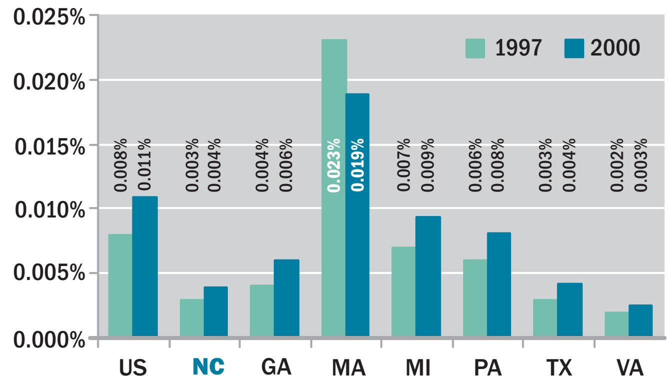
1. Source: Association of University Technology Managers, Inc. *AUTM Licensing Survey: Fiscal Year 2000.*

executed in North Carolina remained modest. North Carolina must improve its ability to enhance and sustain intellectual property in the marketplace. Connecting research institutions to the market is a key component of the state's ability to benefit from its higher education system.

Note

Technology transfer activity is tied to the number of institutions conducting research subject to transfer. In North Carolina, only the University of North Carolina at Chapel Hill, North Carolina State University, East Carolina University, Duke University, and Wake Forest University submitted patent and license disclosures for fiscal year 2000. The most active state in the comparison group, Massachusetts, had the most institutions conducting transferable research.

12-3 Ratio of License Income to Gross State Product, 1997 & 2000, License income received by universities



Source: Association of University Technology Managers, Inc.; Bureau of Economic Analysis, U.S. Department of Commerce.

Innovation Outcome

INDICATOR 13: *Venture Capital*

Key Findings

- **Between 1996 and 2001, the average annual venture capital growth rate in North Carolina (47 percent) equaled the U.S. average and ranked in the middle of the rates for comparison states.**
- **In 2001, the ratio of venture capital to gross state product in North Carolina (0.22 percent) ranked below the U.S. average (0.40 percent) and the ratios for most comparison states.**

Indicator Overview

Venture capital is a critical source of funding for technology-based start-ups and expansions and is most commonly used to stimulate the flow of equity capital to emerging growth companies. The amount of venture capital funding available to companies and the industries supported by it are predictors of potential new products and services, job creation, and revenue growth in a region.

How does North Carolina perform?

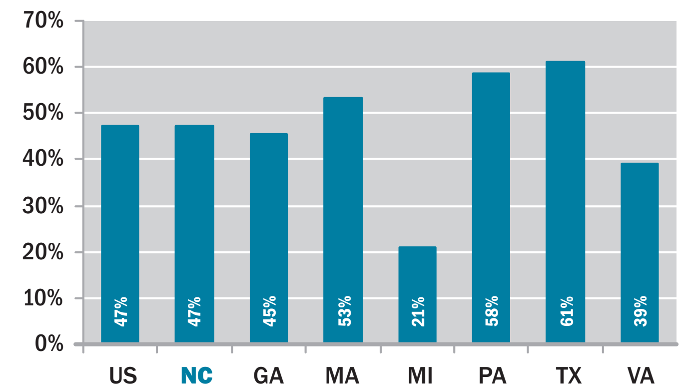
In 2001, North Carolina businesses attracted approximately $615.7 million in venture capital funding. Between 1996 and 2001, the average annual growth rate for the state was equal to the U.S. average, 47 percent *[13-1]*. Among the comparison states, only Massachusetts, Pennsylvania, and Texas had higher average annual growth rates. North Carolina's share of the national venture capital investment pool fell slightly, from 1.7 percent in 1996 to 1.5 percent in 2001. Among comparison states, Massachusetts continued its dominance, garnering 12 percent in 2001, up from 9.4 percent in 1996.

Overall, and consistent with the comparison states, venture capital activity is a small part of the North Carolina economy. In 2001, the ratio of venture capital investments to gross state product was 0.22 percent, below the U.S. average of 0.40 percent and below rates in Georgia (0.25 percent), Massachusetts (0.55 percent), Texas (0.42 percent), and Virginia (0.35 percent) *[13-2]*.

What does this mean for North Carolina?

Without venture capital, many innovative companies in North Carolina will not realize their growth potential. Research indicates that venture capital is highly concentrated in a few regions in the U.S.: Silicon Valley, New England (Boston), and New York Metro being the three largest recipients in 2001.[1] Entrepreneurs with venture capital needs often have little choice but to locate in those areas. The current market concentration raises the prospect that North Carolina businesses, universities, and research institutions will spin off technology companies that may leave the state to obtain the financing required to develop and expand. To the extent that this occurs, North Carolina will not fully capture the gains, in terms of research, innovation, and downstream jobs and income.

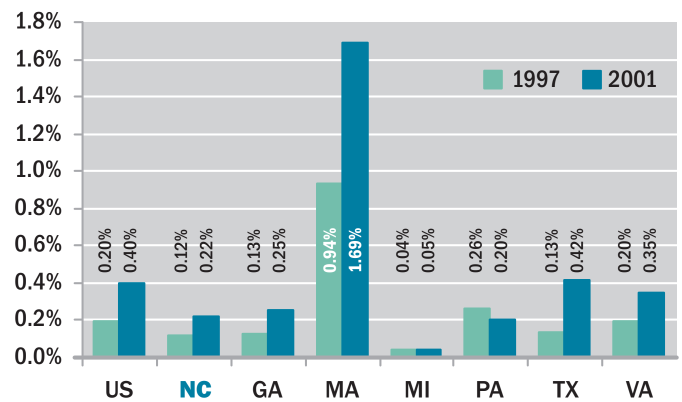
13-1 Average Annual Venture Capital Growth Rate, 1996–2001, Adjusted for inflation



	US	NC	GA	MA	MI	PA	TX	VA
Share of Nat'l Venture Capital 2001		1.5%	1.9%	12.0%	0.4%	2.0%	7.9%	2.3%

Source: National Venture Capital Association.

13-2 Ratio of Venture Capital to Gross State Product, 1990 and 2001



Source: National Venture Capital Association; Bureau of Economic Analysis, U.S. Department of Commerce.

1. Source: *Index of Innovation and Technology*, Washington State, 2003.

INDICATOR 14: *Initial Public Offerings (IPOs)*

Key Findings

Between 1996 and 2002,

- **North Carolina's number of IPOs (31), value of IPOs ($1.57 billion), and share of total U.S. IPO value (0.6 percent) ranked behind those for all comparison states.**
- **North Carolina's per capita number of IPOs (3.7 per million population) and value ($189 per capita) ranked below the U.S. averages (8.9 per million population and $934 per capita) and the numbers and values for most comparison states.**

Indicator Overview

An initial public offering (IPO) represents the first time a firm offers general stock to the public. The number and value of IPOs within a state are indicators of the potential for high-growth companies. "Going public" raises significant investor capital, stimulates next-stage growth in a company, and reflects investor confidence that a company can generate increases in value, sustain growth, and produce satisfactory returns on investment.

How does North Carolina perform?

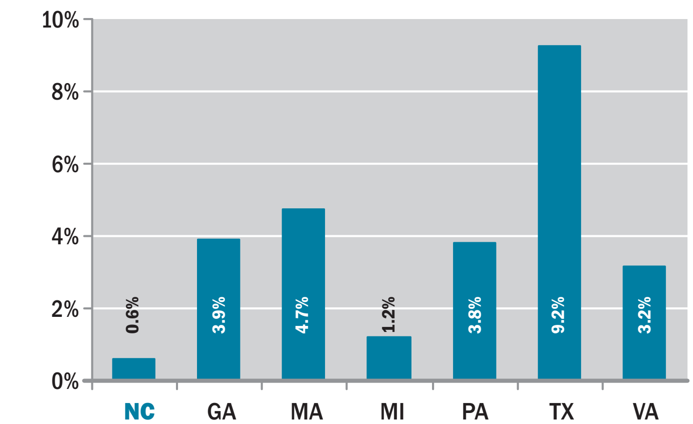
Between 1996 and 2002, 31 North Carolina firms successfully completed IPOs, ranking it last among comparison states in number of IPOs *[14-1]*. The total value of the 31 IPOs was $1.57 billion, or 0.6 percent of the total U.S. IPO value for that period, placing North Carolina last among comparison states. Its 0.6 percent share was half that of the next lowest state, Michigan (1.2 percent). Texas led all comparison states, with 209 IPOs valued at $24.8 billion, a 9.2 percent share of the U.S. total.[1]

Between 1996 and 2002, North Carolina's 3.7 IPOs per million population (based on estimated population for 2002) ranks well below the U.S. rate of 8.9 and second lowest among comparison states, ahead of only Michigan *[14-2]*. Massachusetts more than doubled the second place comparison state, Virginia (10.4), with 23.6 IPOs per million population. The value of North Carolina's IPOs per capita ($189) ranked below all comparison states.

What does this mean for North Carolina?

Because IPOs signify to the global capital market the entry of young companies with proven business concepts and management, they are influential in creating jobs, promoting innovation, and stimulating the economy through investment. North Carolina's low ranking in terms of both the number and value of IPOs suggests that future young-firm growth in the state may be limited.

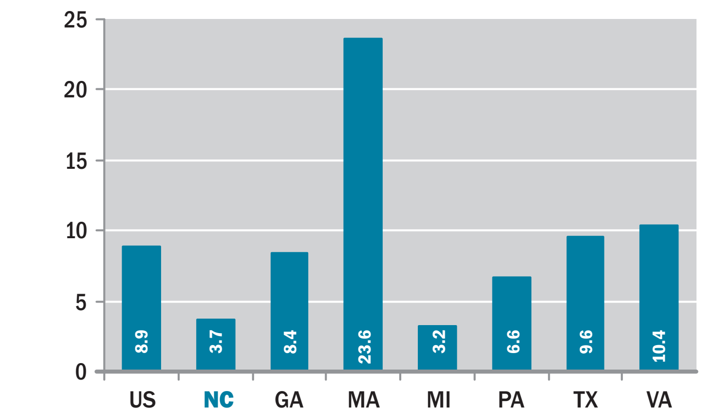
14-1 Value of Initial Public Offerings, Percent of U.S. Total, 1996–2002



	NC	GA	MA	MI	PA	TX	VA
IPOs	31	72	152	32	82	209	76
Value (in millions)	$1,569	$10,530	$12,770	$3,279	$10,230	$24,884	$8,509

Source: Hale and Dorr, LLP.

14-2 Initial Public Offerings per Million Population, 1996–2002, based on 2002 population estimates



	US	NC	GA	MA	MI	PA	TX	VA
IPO Value Per Capita	$934	$189	$1,230	$1,987	$326	$829	$1,142	$1,167

Source: Hale and Dorr, LLP; U.S. Census Bureau, U.S. Department of Commerce.

1. The 2000 and 2003 editions of this report use different data sources and IPO definitions. Data on IPOs in the more reliable 2003 edition are not comparable to the data presented in 2000.

Innovation Outcome

Innovation Input Indicators

Successful innovation outcomes require the proper innovation inputs. This section examines the level and quality of North Carolina's research and development activities, intellectual capital, entrepreneurial activities, and funding for small businesses.

INDICATOR 15: *Research & Development*

Key Findings

In 2000,

- The share of North Carolina's R&D performed by universities and colleges (21 percent) ranked nearly twice as high as the U.S. average (12 percent).
- North Carolina's total R&D spending as a share of gross state product (1.8 percent) ranked below the U.S. average (2.7 percent) and in the middle of the shares for comparison states.
- The share of North Carolina's university and college R&D expenditures accounted for by state and local governments (10.9 percent) ranked above the shares for most comparison states.

Indicator Overview

Research and development (R&D) is the driving force behind innovation and sustained economic growth. Companies, universities, and research institutions performing R&D create new product innovations, thus expanding markets and sales, stimulating investment, and ultimately creating jobs. Firms located near R&D centers benefit from knowledge and expertise shared between businesses, universities, and government and non-profit research institutions. Such firms are often the first to adopt new product technologies.

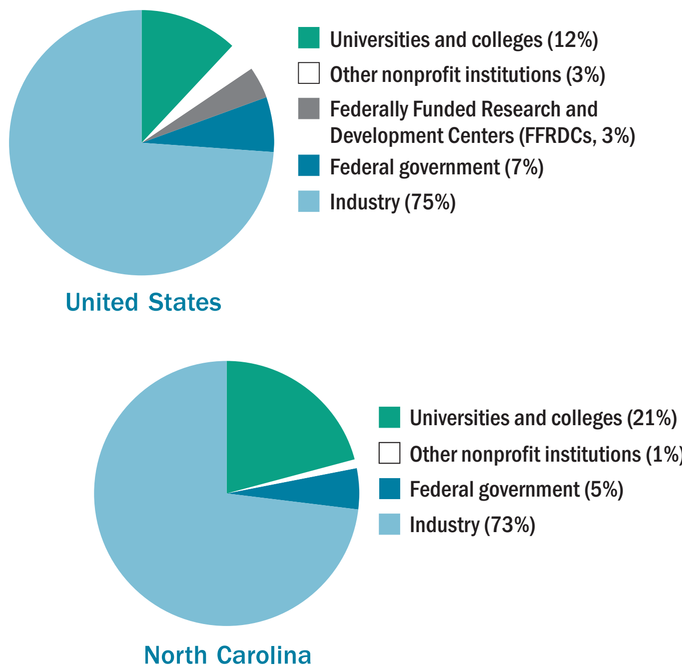
How does North Carolina perform?

A variety of institutions — industry, universities, government agencies, and nonprofit research institutes — actively participate in R&D. Nationally, industry performs the overwhelming majority of R&D (75 percent), while universities and colleges perform a much smaller share (12 percent) *[15-1]*. North Carolina's industry R&D share is consistent with the national average, yet the share performed by its universities and colleges (21 percent) is nearly twice as high as the national average. North Carolina's strength is its university-based R&D.

North Carolina's R&D spending as a share of gross state product lags the national average and places the state in the middle of its comparison states. Industry spending accounts for a large majority of the activity in most states, and Massachusetts' and Michigan's industrial R&D intensity dwarfs that in all other states. Virginia's extraordinarily large amount of federal R&D spending results from its proximity to Washington D.C.; Virginia, Maryland, and the District of Columbia alone are home to nearly half of the federal government's R&D efforts. Compared to the U.S. and other peer states, North Carolina's university-based R&D intensity (0.38 percent) ranks above the national average and is third highest among comparison states, below Pennsylvania (0.39 percent) and Massachusetts (0.52 percent) *[15-2]*.

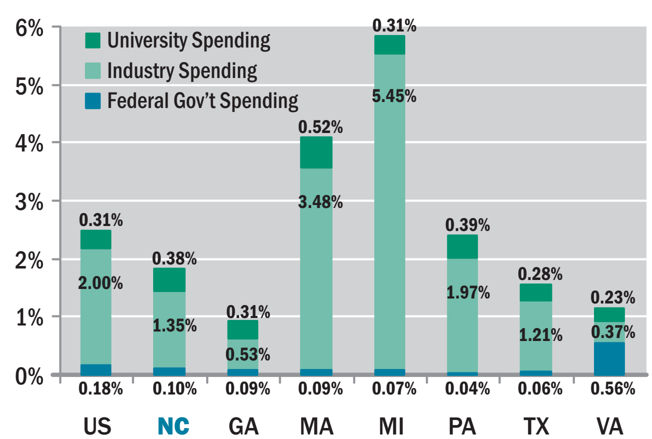
Traditionally, state and local governments have played a minor role in directly supporting research and development efforts, though they have played a critical indirect role in developing universities, infrastructure, related agencies, and institutions. Relative to the comparison states, state and local governments in North Carolina provide a higher percentage of university-based R&D funding. In 2000, North Carolina state and local governments accounted for 10.9 percent of

15-1 Distribution of R&D by Performer, 2000



Source: National Science Foundation.

15-2 R&D Spending as Share of Gross State Product by Performer, 2000



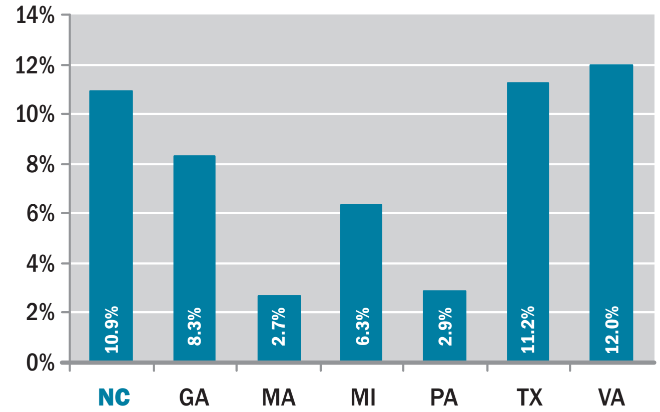
Source: National Science Foundation; Bureau of Economic Analysis, U.S. Department of Commerce.

university and college R&D expenditures *[15-3]*. Among the comparison states, only Texas and Virginia universities and colleges received a higher percentage of state and local government support than North Carolina, with 11.2 and 12.0 percent, respectively.

What does this mean for North Carolina?

The relative strength of North Carolina's R&D activity is its universities and colleges. The University of North Carolina system and North Carolina's private universities are key drivers of the state's innovation economy. Emphasis on R&D, regardless of performing sector, is critical to the economic success of North Carolina and its ability to attract and retain innovative companies.

15-3 Percent of University & College R&D Funding that Comes from State & Local Government, 2000



	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2000	16	21	48	29	47	14	13

Source: National Science Foundation.

INDICATOR 16: *R&D per Tech Transfer Action*

Key Findings

In 2000,

- North Carolina's ability to yield patentable inventions (1 per $1.30 million in R&D expenditures) ranked above the U.S. average (1 per $1.60 million in R&D expenditures) and in the middle of the rates for comparison states.
- North Carolina's ability to yield licensed innovations (1 per $6.46 million in R&D expenditures) ranked above the U.S. average (1 per $8.59 million in R&D expenditures) and in the middle of the rates for comparison states.

Indicator Overview

The ratio of patents and license options to research expenditures by academic institutions reflects the ability of university researchers to generate innovations that are available for commercial use. This indicator must be interpreted carefully, however. Basic research plays an important role in yielding marketable innovations, but its influence is often difficult to detect in the short run.[1] A low number of technology transfer actions per R&D dollar expended does not necessarily indicate an inefficient or inappropriate research effort by the state's universities and research institutions.

How does North Carolina perform?

In 2000, North Carolina research institutions produced one patent application or invention disclosure for every $1.30 million in R&D, ahead of the national average ($1.60 million) and fourth among comparison states *[16-1]*. This is a two-state gain from its sixth-place 1997 ranking of one patent application or invention disclosure per every $1.76 million in R&D (data not shown here). Massachusetts' universities and research institutions generated significantly more marketable ideas per dollar according to this measure, with one patent application or invention disclosure per $0.63 million in R&D. Pennsylvania and Virginia produced one patent application or invention disclosure per $1.12 million and $0.94 million in R&D, respectively.

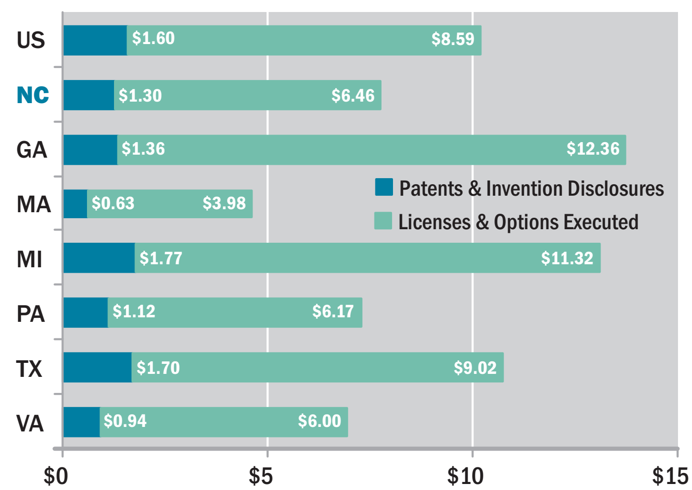
North Carolina ranks similarly for executing licenses and options per R&D expenditure. In 2000, North Carolina executed one license or option per $6.46 million, ahead of the national average ($8.59 million) and down from one per $6.75 million in 1997 (1997 data not shown here). Massachusetts, Pennsylvania, and Virginia each produced more licenses and options for R&D expenditure, at $3.98 million, $6.17 million, and $6.00 million, respectively.

What does this mean for North Carolina?

The ability of North Carolina's academic institutions to generate innovations that can be patented and licensed for commercial use remains average when compared to peer states. The more efficiently North Carolina is able to generate patentable and licensed innovations, the greater the chances its innovative ideas will enter the marketplace and the greater the opportunities for industry expansion within the state.

16-1 R&D Expenditures per Tech Transfer Action, 2000

In millions of dollars, R&D and tech transfer conducted by universities



Source: Association of University Technology Managers.

1. See "Industry Technology Has Strong Roots in Public Science," *CHI Research Newsletter*, Vol. V, No. 1., March 1997.

Innovation Input

INDICATOR 17: *Ph.D. Scientists & Engineers*

Key Finding

- **In 2001, North Carolina's number of employed Ph.D. scientists and engineers per 1,000 population (2.0) equaled the U.S. average (2.0) and ranked in the middle of the shares for comparison states.**

Indicator Overview

Scientists, engineers, and innovators who generate breakthroughs in process and product technologies drive the technology economy. The availability of scientists and engineers for technology-related industries is an important indicator of accessible workforce resources and a key component considered by potential business when considering firm relocation. The number of Ph.D. scientists and engineers, as a share of the U.S. total and per capita, is an indicator of the relative size of the overall scientific and technical existence in the state, an input measure of innovation activity similar to R&D expenditures.

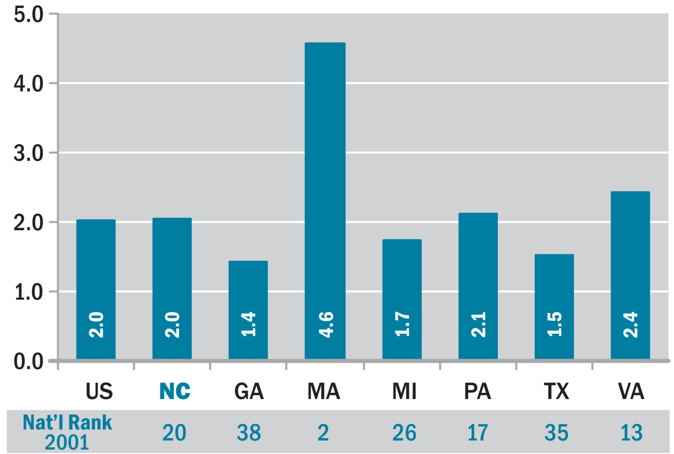
How does North Carolina perform?

In 2001, North Carolina employed approximately 2.9 percent of Ph.D. scientists and engineers in the United States, up from 2.6 percent and above Georgia's 2.1 percent but below all other comparison states (data not shown here). The comparison states with the largest share of Ph.D. scientists and engineers were Texas (5.7 percent), Massachusetts (5.1 percent), and Pennsylvania (4.6 percent). Standardizing for population differences among states, North Carolina ranked twentieth out of all 50 states and the District of Columbia, with 2.0 Ph.D. scientists and engineers per 1,000 population, tied with the United States rate and ranked ahead of Georgia, Michigan, and Texas *[17-1]*. Massachusetts had the highest relative complement of scientists, at 4.6 per 1,000 people.

What does this mean for North Carolina?

States with higher concentrations of Ph.D. scientists and engineers are more attractive to relocating companies. Relocating technology firms often cite specialized employment clusters as a key criterion determining their relocation. Furthermore, a competitive concentration of Ph.D. scientists and engineers is essential to provide the human capital foundation required by technology-related start-up firms. The ability of North Carolina to attract potential Ph.D. scientists and engineers to existing doctoral programs (see Indicator 23) and the ability to attract out-of-state or retain in-state science and engineering students upon graduation enhances the state's ability to establish a strong technology-related human capital foundation.

17-1 Employed Ph.D. Scientists and Engineers per 1,000 Population, 2001



Source: National Science Foundation; Bureau of Economic Analysis, U.S. Department of Commerce.

INDICATOR 18: *Perceived Academic Science Strength*

Key Finding

- In 2002, North Carolina had 16 science engineering graduate programs ranked in the top 50, placing it above average relative to comparison states.

Indicator Overview

Graduate program rankings in science and technology are one indicator of a university's academic science strength. *The rankings presented here provide a broad picture of the leading programs in various U.S. universities.*[1] Strong reputations tend to draw premier scientific talent, top graduate students, research dollars, and other resources to the state. Graduate students in top programs may go on to staff North Carolina companies. The total number of highly ranked programs in particular areas also provides an indication of the state's principal research specialties.

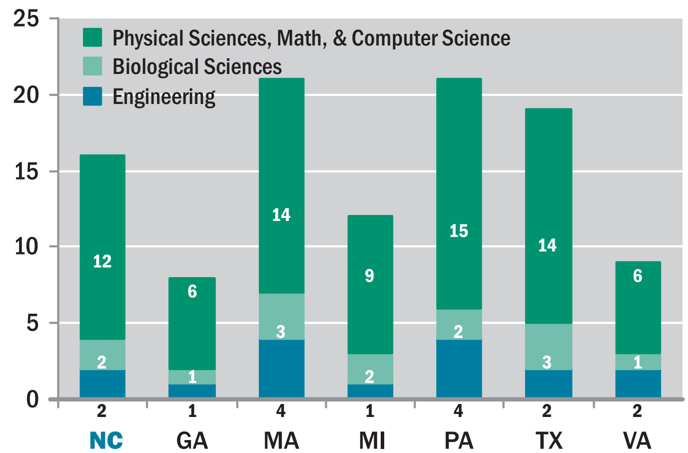
How does North Carolina perform?

In rankings made by *U.S. News and World Report*, 16 North Carolina graduate programs in engineering, biological sciences, physical sciences, mathematics, and computer science appear among the top 50 graduate programs *[18-1]*. North Carolina outperformed Georgia, Michigan, and Virginia both in the number of graduate programs available in science and mathematics and in the number of these programs ranked among the top 50. Massachusetts and Pennsylvania were at the top of the rankings, each with 21 programs among the top 50.[2]

What does this mean for North Carolina?

In order for North Carolina to remain competitive in the innovation economy, highly ranked graduate programs in science and technology are critical in attracting top-ranked talent, in terms of professors, students, and research dollars to the state. While subjective in nature, the reputation of North Carolina's science and engineering graduate programs has the potential to lead to increased research funding, a specialized science and engineering employment pool, and enhanced technology related resources. Highly ranked graduate programs in science and technology are critical if North Carolina is to remain economically competitive. Talented professors and students drawn to the top-ranked programs will generate an increase in research funds. As a result, a positive impact on the state's economy is likely, given the potential for a specialized science and engineering employment pool and enhanced technology-related resources.[3]

18-1 Number of Graduate Science and Engineering Programs Rated in Top 50, 2002



Source: *U.S. News and World Report*.

1. Such rankings are an important, though imperfect and sometimes controversial, indicator of a university's academic strength. The *U.S. News and World Report* rankings presented here are the most current and widely used nationally. The National Research Council (NRC) last released similar rankings of graduate programs in September 1995. Researchers Evan Rogers and Sharon J. Rogers have compared rankings produced by the 1995 NRC study with those *U.S. News* has developed, looking specifically at the *U.S. News* rankings based on peer assessment data only. They concluded that there was "a very high positive association between *U.S. News* peer assessment scores and rankings and those reported by the NRC." Their article in the May 1997 issue of the *American Association of Higher Education Bulletin* provides further discussion of this topic.

2. For each state, the number of highly ranked programs is likely to be positively related to the number of universities. No analysis was conducted here to determine the extent of that relationship.

3. For an extensive discussion of how universities can impact states in the knowledge economy, see: Tornatzky, Louis G., Paul G. Waugaman, and Denis O. Gray. 2002. *Innovation U.: New University Roles in a Knowledge Economy*. Southern Growth Policies Board, Research Triangle Park, North Carolina.

Methodological Note[4]

The *U.S. News and World Report* engineering rankings are based on two types of data: expert opinion about program quality and statistical indicators that measure the quality of a school's faculty, research, and students. To gather the opinion data, *U.S. News and World Report* asked deans, program directors, and senior faculty to judge the overall academic quality of programs in their field on a scale of 1 ("Marginal") to 5 ("Outstanding"). Professionals in the field who are part of the industry hiring process were also surveyed. The statistical indicators used in the rankings fall into two broad categories: *inputs*, or measures of the qualities that students and faculty bring to the educational experience; and *outputs*, measures of graduates' achievements that can be credited to their educational experience.

To arrive at a school's rank, *U.S. News and World Report* examined the distribution of the data for each quality indicator. Where the data deviated significantly from the normal distribution, standard statistical techniques were used to make the distribution of the values closer to that of a normal curve. The value of these indicators was then standardized relative to the curve's mean. The weights applied to the indicators reflect the relative importance of the indicators, as developed in consultation with experts in each field. The highest-scoring school was assigned 100, and the other schools' scores were recalculated as a percentage of that top score. The scores were then rounded to the nearest whole number and schools were placed in descending order of rank. Every school's performance is presented relative to the other schools with which it is being compared. Thus, a school with an overall score of 100 was not necessarily superlative on every indicator; rather it accumulated the highest composite score. A school's rank reflects the number of schools that are rated above it; if three schools are tied at 1, the next school will be numbered 4, not 2.

Rankings of doctoral programs in the sciences are based on the results of surveys sent to academics in each discipline during the fall of 2001. The questionnaires asked individuals to rate the quality of the program at each institution on a five-point scale: Outstanding (5), Strong (4), Good (3), Adequate (2), or Marginal (1). Individuals who were unfamiliar with a particular school's programs were asked to select "Don't Know." Scores for each institution were totaled and divided by the number of respondents who rated that school. In the biological sciences, chemistry, computer science, and physics, survey respondents also were asked to nominate programs that had excellent offerings in certain specialty areas. Those programs that received seven or more nominations are published, ranked by the number of nominations received.

Surveys in the biological sciences, chemistry, computer science, mathematics, applied mathematics, and physics were conducted by T. E. Systems, Inc. The National Science Foundation report, "Science and Engineering Doctorate Awards: 1999," was the source for the lists of programs surveyed in each of these disciplines. Questionnaires were sent to the department heads and deans or directors of graduate studies at each program in each discipline.

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4. Source: *U.S. News and World Report*; http://www.usnews.com/usnews/rankguide/rghome.htm.

INDICATOR 19: *SBIR & STTR Awards*

Key Findings

- **In 2001, per capita SBIR funding in North Carolina ($1.67 per person) ranked below the U.S. average ($4.06 per person) and the funding levels in most comparison states.**
- **In 2002, per capita STTR funding in North Carolina ($.57 per person) ranked above the U.S. average ($.33 per person) and the funding levels in most comparison states.**

Indicator Overview

The Small Business Innovation Research (SBIR) Program provides competitive grants to entrepreneurs to help finance Research and Development (R&D), start-up, and commercialization of innovative business ideas.[1] Phase I SBIR funding helps entrepreneurs conduct research on the technical merit and feasibility of an idea; entrepreneurs use Phase II funding for implementation and prototype development.[2] Success in the SBIR program also attracts additional outside capital investment. Nationally, companies that receive SBIR Phase II funding have significantly out-performed similar companies that do not receive such support.

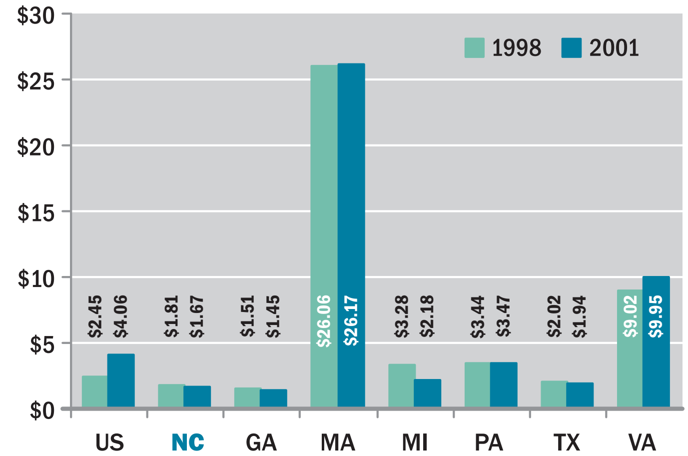
The Small Business Technology Transfer (STTR) Program facilitates partnerships between small businesses and non-profit research institutions, including universities.[3] Tracking STTR funds provides an indication of how well the state's universities are collaborating with small businesses on R&D efforts. Similar to the SBIR Program, the STTR Program follows a dual-phased approach.

How does North Carolina perform?

North Carolina falls well below the U.S. average in terms of SBIR funding per capita *[19-1]*. In 2001, the state's per capita funding was $1.67, down from $1.81 in 1998 and a higher than only Georgia among comparison states. The U.S. average in 2001 was $4.06. Massachusetts and Virginia both garnered a disproportionate share of SBIR awards in 2001, with $26.17 and $9.95, respectively. Only Massachusetts among comparison states and the U.S. overall realized an increase in per capita funding between 1998 and 2001.

North Carolina fared much better in terms of STTR funding than SBIR funding *[19-2]*. In FY 2002, North Carolina ranked fourth

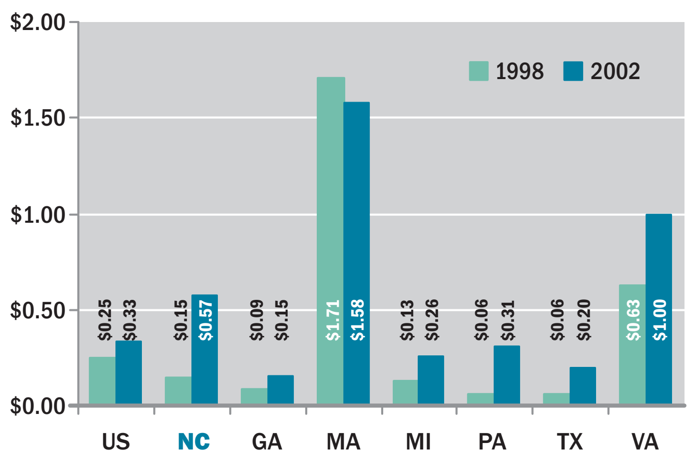
19-1 SBIR Funding per Capita, 1998 & 2001



	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2001	34	36	1	28	21	32	6

Source: U.S. Small Business Administration; Bureau of Economic Analysis, U.S. Department of Commerce.

19-2 STTR Funding per Capita, 1998 & 2002



	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2002	10	37	1	28	22	33	4

Source: U.S. Small Business Administration; Bureau of Economic Analysis, U.S. Department of Commerce.

1. Source: *Index of the Massachusetts Innovation Economy, 2002*. The federal SBIR program is reputed to be the world's largest seed capital fund for development of new products and processes. The U.S. Department of Defense, National Institutes of Health (NIH), and National Science Foundation (NSF) are recognized as some of the top funding sources for the SBIR program.
2. Source: Small Business Administration. Phase I is the startup phase. Awards support exploration of the technical merit or feasibility of an idea or technology. Phase II awards expand Phase I results. During this time, the R&D work is performed and the developer evaluates commercialization potential. Only Phase I award winners are considered for Phase II.
3. Source: Small Business Administration. The five federal departments and agencies required to provide these funds are as follows: Department of Defense, Department of Energy, Department of Health and Human Services, National Aeronautics and Space Administration, and National Science Foundation.

in the nation in the total amount of dollars received for both Phase I and Phase II awards (data not shown here). North Carolina's per capita STTR funding was $0.57, up from $0.15 in 1998, an increase of 283 percent. Only Pennsylvania had a greater increase among comparison states, at 415 percent. The U.S. per capita average in 2002 was $0.33.

What does this mean for North Carolina?

North Carolina's funding under the SBIR and STTR programs indicates both how aggressive the state's small businesses are in pursuing federal support for innovation activity as well as their competitiveness in developing and commercializing innovative ideas, technologies, and products. The state's relative success in obtaining STTR funding compared to SBIR is not surprising considering the synergistic relationship between North Carolina industry and institutions of higher education. Given the importance of SBIR funding and North Carolina's relatively low performance in obtaining it, emphasis should be placed on improving the state's position in this category.

INDICATOR 20: *NIH & NSF Awards*

Key Findings

- **In 2002,**
  - **North Carolina's level of NIH funding ($781 million) ranked seventh highest in the U.S. and in the middle of the levels for comparison states.**
  - **North Carolina's level of NSF funding ($95 million) ranked sixteenth highest in the U.S. and below the levels for most comparison states.**
- **Between 1998 and 2002,**
  - **North Carolina's growth rate in NIH funding (77.2 percent) ranked above the U.S. average (70.2 percent) and the rates for most comparison states.**
  - **North Carolina's growth rate in NSF funding (67 percent) ranked above the U.S. average (40.9 percent) and the rates for most comparison states.**

Indicator Overview

The National Institutes of Health (NIH) is one of eight health agencies of the Public Health Service, part of the U.S. Department of Health and Human Services. The primary mission of NIH is to invest public funds wisely for the support and further enhancement of the biomedical industry. NIH supports basic or clinical biomedical, behavioral, and bioengineering research at universities and other research institutions.

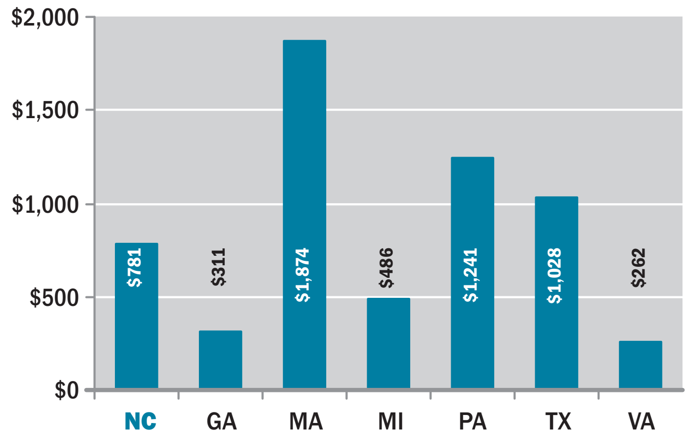
The National Science Foundation (NSF) is an independent agency of the U.S. government. The primary mission of NSF is to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense. NSF initiates and supports, through grants and contracts, scientific and engineering research and programs to strengthen scientific and engineering research potential, and education programs at all levels.

How does North Carolina perform?

In 2002, North Carolina received $781 million in funding from NIH, the seventh highest amount nationally and behind only Massachusetts ($1.9 billion), Pennsylvania ($1.2 billion), and Texas ($1 billion) among comparison states *[20-1]*. Between 1998 and 2002, North Carolina's growth rate in NIH funding (77.2 percent) ranked above the U.S. average (70.2 percent) and twenty-sixth out of the 50 states and the District of Columbia *[20-2]*. Over the same period, Georgia led all comparison states, with a growth rate of 87.3 percent.

In 2002, North Carolina received $95 million in funding from NSF, the sixteenth highest amount nationally and behind most comparison states, of which four (Massachusetts, Pennsylvania, Texas, and Virginia) ranked in the top ten *[20-3]*. Between 1998 and 2002, North Carolina's growth rate in NSF funding (67 percent) ranked above the U.S. average (40.9 percent) and nineteenth out of the 50 states and the District of Columbia *[20-4]*. Over the same period, Virginia led all comparison states, with a growth rate of 231.6 percent. A majority of Virginia's growth resulted from a series of awards to a single service commission, which performed operations support for a program out of state.[1]

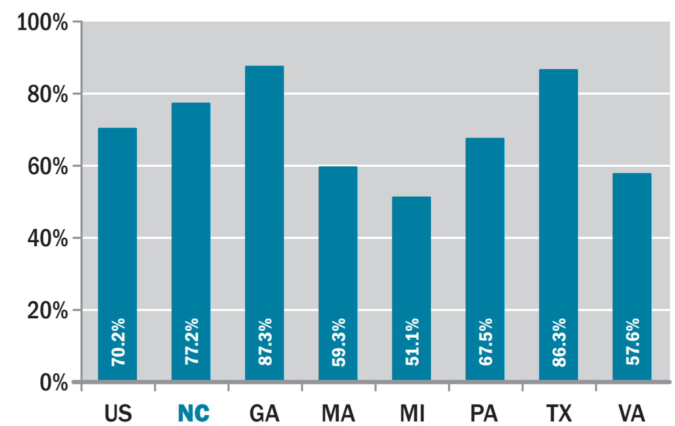
20-1 NIH Award Amount (in millions of dollars), 2002



	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2002	7	17	2	11	4	6	20

Source: National Institutes of Health.

20-2 Growth in NIH Awards, 1998–2002



	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 1998-02		26	22	42	51	37	24	44

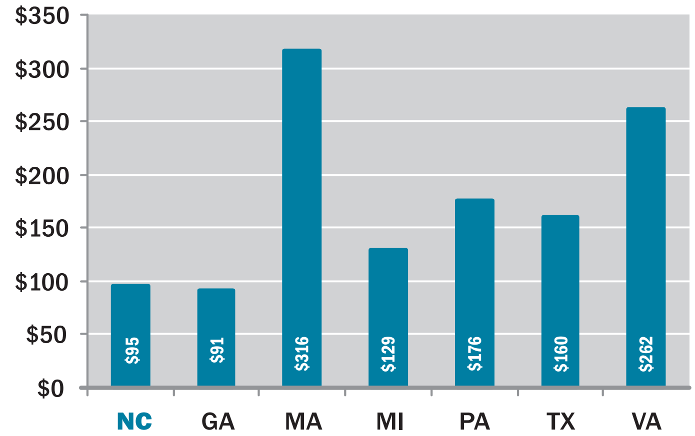
Source: National Institutes of Health.

1. The awards, amounting to $141,719 million, accounted for 54 percent of Virginia's NSF awards in 2002 and supported operations for the U.S. Antarctic Program. Minus that set of awards, Virginia's 2002 NSF awards were $121,241 million, making Virginia's NSF award growth rate 77.2 percent between 1998 and 2002.

What does this mean for North Carolina?

NIH and NSF funding plays a critical role in supporting cutting-edge research, education, and training. This support is increasingly important due to recent cost-cutting pressures faced by universities and teaching and research hospitals. The success of North Carolina in securing NIH and NSF dollars will help mitigate against funding reductions from other sources and will enable the state to attract the most capable, research professionals, medical professionals, and students. Continued support by the NIH and NSF will be crucial if North Carolina is to maintain its position as national leader in research and teaching.

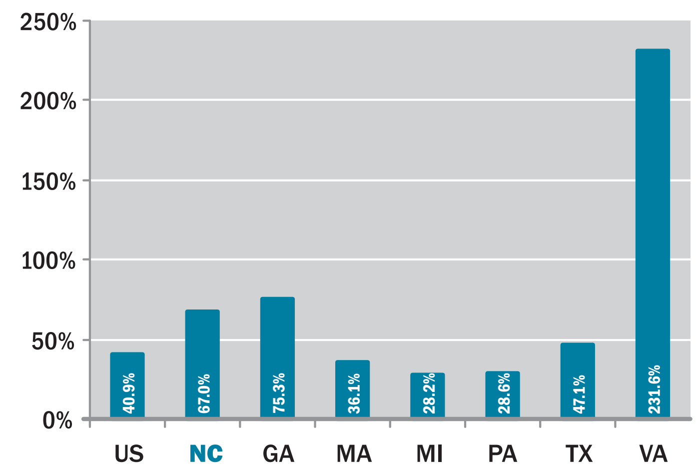
20-3 NSF Award Amount (in millions of dollars), 2002



	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2002	16	18	3	12	8	9	4

Source: National Science Foundation.

20-4 Growth in NSF Awards, 1998–2002



	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 1998-02		19	11	36	44	42	28	2

Source: National Science Foundation.

Preparation Indicators

Basic resources — human and physical — are essential to prepare North Carolina for innovation and economic growth. Resources critical to the innovation economy include a well-educated workforce and a robust technology infrastructure. This section looks at North Carolina's ability to maintain a highly educated workforce and access advances in technology.

INDICATOR 21: *Educational Attainment*

Key Findings

- In 2002,
  - The percentage of North Carolina's adult population with a bachelor's degree or higher (22.4 percent) ranked below the U.S. average (26.7 percent) and the percentages for all comparison states.
  - The percentage of North Carolina's adult population without a high school diploma (19.9 percent) ranked above the U.S. average (15.9 percent) and the percentages for most comparison states.
- Between 1995–1997 and 1998–2000, North Carolina's high school dropout rate decreased 0.8 percentage points, faster than the U.S average (which increased by 0.1 percentage point) and the decreases for all comparison states.
- During 1998–2000, North Carolina's dropout rate (13.9 percent) ranked below the U.S. average (14.3 percent) but above the rates for most comparison states.

Indicator Overview

A well-educated and skilled workforce is a prerequisite for success in the knowledge-based economy. The educational attainment levels of the workforce are a fundamental indicator of how well a state can generate and support economic growth centered on innovation, science, and technology. Two measures in particular — educational attainment and high school dropout rates — provide insight into the ability of a state's workforce to be competitive. The innovation economy is dynamic and constantly in flux; college-educated workers are in a better position to adjust to economic changes over their lifetimes, including inevitable cycles of industry growth, decline, and restructuring. Similarly, almost all jobs now require at least a high school diploma. The high school dropout rate serves as a risk indicator that warns of a potential workforce not qualified for even the most basic jobs.

How does North Carolina perform?

In 2002, 22.4 percent of the North Carolina adult population (residents 25 years and older) was college-educated *[21-1]*. This figure places North Carolina last among comparison states and below the U.S. average of 26.7 percent. In addition, 19.9 percent of North Carolina adults have never earned a high school diploma, a percentage that is well above the U.S. average of 15.9 percent and higher than all but one comparison state, Texas.

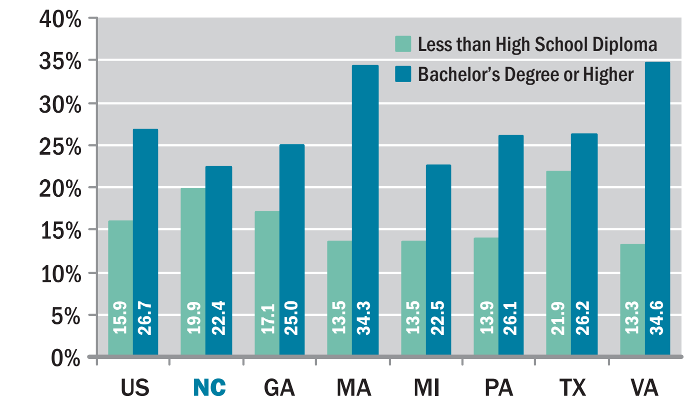
North Carolina's performance on the provision of basic education to its future workforce is improving. High school completion rates are higher now than for previous generations (data not shown here) and, in comparing the 1995–1997 period to the 1998–2000 period, the North Carolina high school dropout rate fell from 14.7 percent to 13.9 percent *[21-2]*. The U.S. average high school dropout rate for the 1998–2000 period was 14.3 percent. Texas had the highest dropout rate at 20.6 percent, whereas Massachusetts had the lowest at 9.1 percent.

What does this mean for North Carolina?

The economic prospects of workers with limited formal education grow dimmer each year as higher skilled and technology-oriented jobs replace well-paid, lower-skill jobs in manufacturing. The availability of a highly educated workforce is required for many companies to realize their full potential and to compete in the technology-driven industries. Without a highly educated workforce, North Carolina will be limited in its ability to provide the human capital resources necessary to support a growing knowledge-based economy.

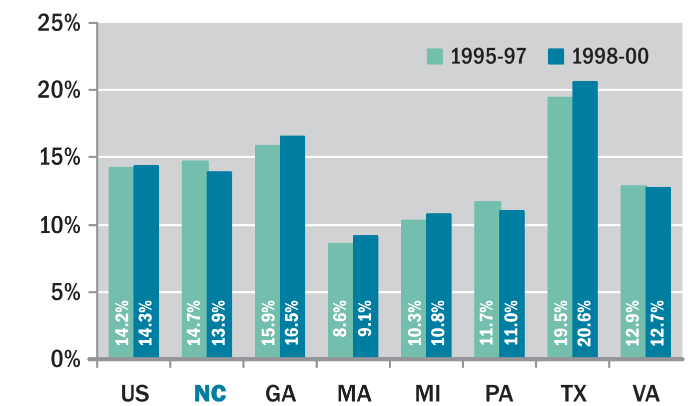
21-1 Educational Attainment, 2002

Percent persons 25 years and older



Source: U.S. Bureau of the Census, U.S. Department of Commerce.

21-2 High School Dropout Rates, 1995-1997 & 1998-2000



	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 1998–00		34	40	12	21	22	48	28
Change 1995–97 to 1998–00	+0.1%	-0.8%	+0.6%	+0.5%	+0.5%	-0.7%	+1.1%	-0.2%

Source: U.S. Department of Education.

INDICATOR 22: *Test Scores*

Key Findings

In 2002,

- North Carolina's average math SAT score (505) ranked in the middle of the scores for comparison states and improved significantly from 1998.
- North Carolina's average verbal SAT score (493) lagged the scores for comparison states and improved slightly from 1998.

Indicator Overview

As a comparative measure, Scholastic Aptitude Test (SAT) scores partially reflect the quality of a state's primary and secondary education systems.[1] SAT scores have long been the educational standard in measuring a student's readiness for continuing on to college. High SAT scores indicate that the state's young people are well prepared for the post-secondary education required by entrepreneurial and technology-driven companies.

How does North Carolina perform?

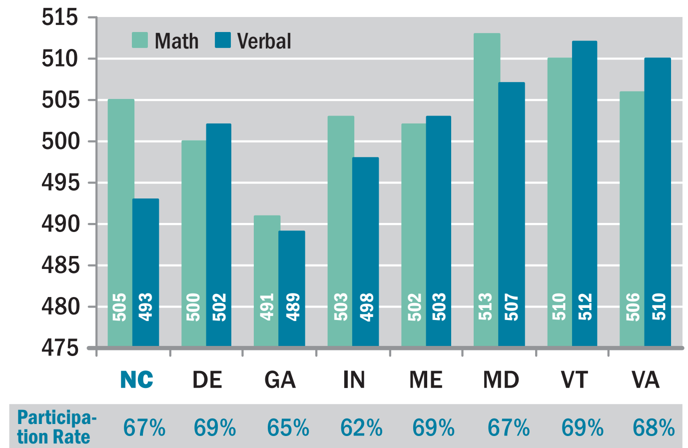
On the math SAT, North Carolina students performed moderately well when compared to peer states *[22-1]*. In 2002, the average math SAT score in the state was 505, significantly up from 492 in 1998 (data not shown here). Maryland posted the highest average among comparison states, with 513, and Georgia had the lowest, with 491. North Carolina's verbal SAT scores portray a different picture. Among comparison states, only Georgia had a lower average verbal SAT score. North Carolina's average verbal SAT score rose slightly from 490 in 1998 (data not shown here) to 493 in 2002. Vermont posted the highest average verbal SAT score with 512.

What does this mean for North Carolina?

Innovative firms look for locations with high-quality primary, secondary, and post-secondary educational institutions for three reasons. First, the basic skill needs of technology companies are greater than in many sectors. Second, retraining typically occurs on a near-continuous basis in firms that are constantly developing new products and penetrating new markets. Local sources of education and training are critical to that process. Third, technology companies are sensitive to the locational preferences of their workers, particularly those with specialties that are in high demand. Technology workers, who tend to be less tied to place than workers in other industries, seek quality schools for their children and are often prepared to change jobs and locations to access them. Improving average SAT scores is essential for North Carolina to remain competitive in the innovation economy, attract technology-based companies and workers, and prepare its youth for higher education.

22-1 Average SAT Scores, 2002

States with comparable test participation rates



Source: The College Board.

1. There is a high negative correlation between average SAT scores and the share of students who take the exam; students likely to perform poorly are less likely to take it. Thus, North Carolina's SAT scores are compared here only with those states having roughly the same rates of student participation.

INDICATOR 23: *Science & Engineering Education*

Key Findings

During 2001-2002,

- The share of North Carolina's undergraduate students majoring in science and engineering (17.1 percent) ranked above the U.S. average (16 percent) and the shares for most comparison states.
- The share of U.S. science and engineering bachelor's degrees awarded by North Carolina colleges and universities (2.2 percent in computer and information science; 3.2 percent in math, physical sciences, and engineering; 3.3 percent in biological and life sciences) ranked lower than the shares for most comparison states.
- North Carolina's number of science and engineering bachelor's degrees (7.89 per 10,000 population) ranked above the U.S. average (7.55 per 10,000 population) but below the numbers for most comparison states.
- North Carolina's number of science and engineering graduate degrees (2.13 per 10,000 population) ranked below the U.S. average (2.54 per 10,000 population) and the numbers for all comparison states.

Indicator Overview

Individuals with university training in the fields of math, science, and engineering are in demand among private sector technology companies. When it comes to the creation of new products and ideas, states that have a robust science and engineering workforce have a competitive advantage over states that do not. The potential pool of well-trained science and engineering workers is an important indicator of the future innovation economy workforce.

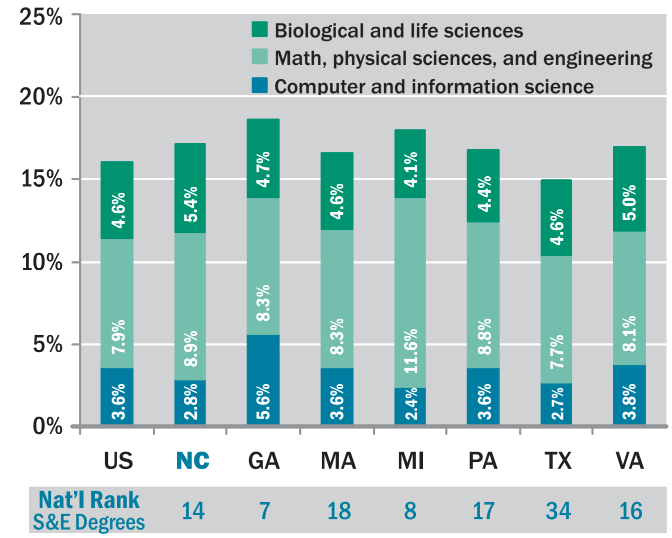
How does North Carolina perform?

During the 2001-2002 academic year, 17.1 percent of all bachelor's degrees in North Carolina were awarded in computer and information sciences; math, physical sciences, and engineering; and biological and life sciences *[23-1]*. That is higher than the U.S. average (16 percent) and all comparison states except Michigan and Georgia. North Carolina's percentage in 2002 is down from 18.8 percent during the 1996-1997 academic year. A similar downward trend affected the U.S. average and all comparison states except Georgia (data not shown here). North Carolina ranked fourteenth among the 50 states and the District of Columbia in terms of science and engineering degrees as a share of total bachelor's degrees awarded. Specifically, North Carolina ranked twenty-ninth in computer and information sciences; ninth in the share of students earning degrees in math, physical sciences, and engineering; and eleventh in the percentage of students earning degrees in the biological and life sciences (the composite rank is shown in 23-1).[1]

Colleges and universities in North Carolina granted 3.0 percent of all science and engineering bachelor's degrees in the U.S. during 2001-2002 (figures cited here are averages for the combined fields) *[23-2]*.[2] In comparison, Texas granted 5.7 percent,

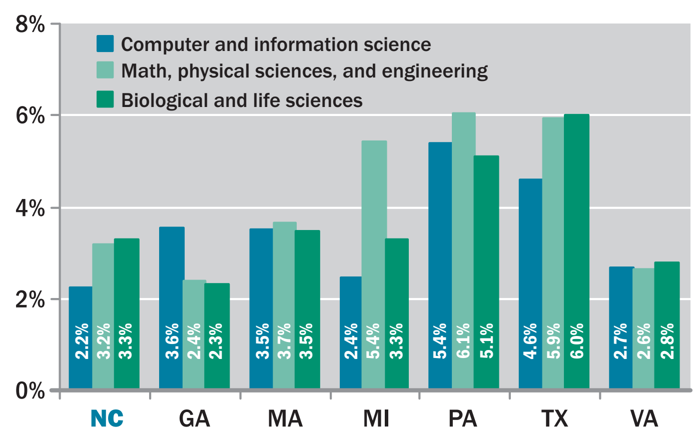
1. The comparison states and their comparable rankings are as follows: *Computer and information science*—Georgia (3rd), Massachusetts (19th), Michigan (38th), Pennsylvania (21st), Texas (32nd), and Virginia (17th); *math, physical sciences, and engineering* — Georgia (16th), Massachusetts (13th), Michigan (3rd), Pennsylvania (10th), Texas (28th), and Virginia (17th); *biological and life sciences* — Georgia (20th), Massachusetts (24th), Michigan (38th), Pennsylvania (32nd), Texas (25th), and Virginia (15th).
2. Due to a calculation error, the 2000 edition of this report cited inaccurate figures regarding each state's share of science and engineering bachelor's degrees. The error has been corrected in this edition.

23-1 Percent of Each State's Total Bachelor's Degrees Awarded in Science & Engineering Disciplines, 2001–2002



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

23-2 Percent of all U.S. Science and Engineering Bachelor's Degrees Awarded in each Discipline, 2001-2002



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

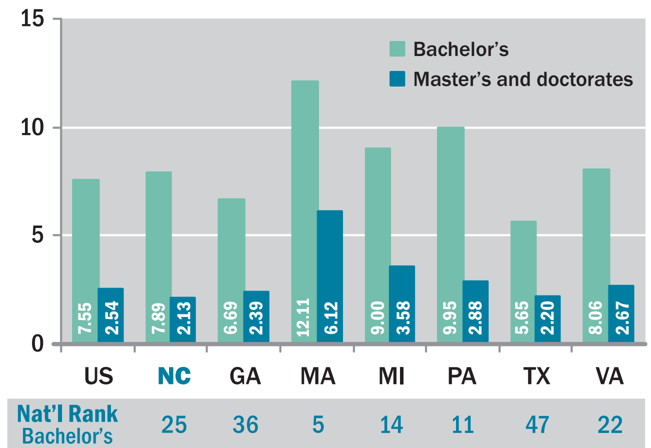
Pennsylvania, 5.6 percent; Michigan, 4.2 percent; Massachusetts, 3.6 percent; Virginia, 2.7 percent; and Georgia, 2.6 percent. North Carolina institutions granted 3.3 percent of all biological and life sciences bachelor's degrees in the U.S., down from 3.6 percent in 1996-1997, but still more than all peer states except, Massachusetts, Pennsylvania, and Texas.[3]

North Carolina ranked twenty-fifth nationally in science and engineering bachelor's degrees awarded (7.89 degrees granted per 10,000 residents) in academic year 2001-2002 *[23-3]*.[4] This rate is above the national average of 7.55 and ahead of Georgia and Texas. Massachusetts, Michigan, and Pennsylvania all rank within the top 15 nationally. With a national ranking of twenty-sixth, the number of graduate degrees awarded per 10,000 population in North Carolina is below all peer states and the national average. During 2001-2002, North Carolina colleges and universities awarded 2.13 graduate degrees in the sciences and engineering per 10,000 residents. Massachusetts significantly exceeded all comparison states with 6.12 science and engineering master's and doctoral degrees per 10,000 population.

What does this mean for North Carolina?

Science and engineering play a critical role in the growth of the innovation economy, and an inadequate supply of suitably trained workers can limit the growth of science and technology industries. North Carolina, like many states and regions, relies heavily on technically competent workers who relocate from other regions to staff technology companies. The number of bachelor's degrees granted in math, science, and engineering fields is an important measure of whether the skills of the typical North Carolina graduates meet the needs of the state's growing innovation economy. Because many companies seek individuals with graduate-level education for key research and leadership positions, graduate degrees awarded in math, science, and engineering is another important measure of the emerging skill set in the state and of the potential for specialized academic research. The greater the percentage of science and technology workers that come from within the state, the less North Carolina is forced to rely on other states and countries to sustain its pool of future workers. In addition, relocating companies are likely to gravitate toward states that have the required workforce pool already available.

23-3 Science & Engineering Degrees Awarded, 2001–2002
(per 10,000 population)



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

3. The seven states with higher percentages of biological and life sciences bachelor's degrees are California, Illinois, Massachusetts, New York, Ohio, Pennsylvania, and Texas.

4. Due to a calculation error, the 2000 edition of this report reported figures that were inaccurate regarding per capita science and engineering degrees. The error has been corrected in this edition. In addition, the per capita measure was changed from "degrees per *1,000* population" to "degrees per *10,000* population."

INDICATOR 24: *Computers & Internet Access in Schools*

Key Findings

- **Between 1999 and 2002, the number of students per multimedia computer in North Carolina decreased by 50 percent, improving the state's national ranking from forty-seventh to thirty-second.**
- **In 2002,**
  - **The number of students per instructional multimedia computer in North Carolina (6.2) ranked above the U.S. average (5.9 percent) and the numbers for all comparison states.**
  - **The percentage of classrooms with Internet access in North Carolina (91 percent) ranked above the U.S. average (89 percent) and ranked first with two other states among the comparison states.**

Indicator Overview

Access to computers and the Internet in classrooms allows children to develop technical skills at an early age. Students who have access to computers are more likely to acquire important technical expertise, an understanding of the tools driving the innovation economy, and better preparation for the demands of higher education and future employment. The ratio of students per multimedia computer is a good measure of the accessibility of computers to elementary and secondary school students. Multimedia computers reflect a more advanced generation of interactive personal computer technology and are a necessity for making full use of today's advanced software and the Internet. Internet access allows students to locate, analyze, and exchange information from global sources, and it is increasingly used to supplement in-class training. Teachers and students in classrooms lacking Internet access are less able to utilize the growing number of learning tools on the World Wide Web.

How does North Carolina perform?

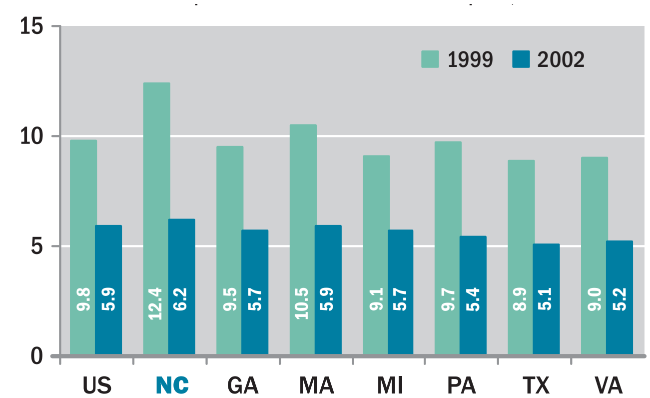
In 2002, with a rate of 6.2 students per instructional multimedia computer, North Carolina ranked above the U.S. average (5.9) and last among comparison states *[24-1]*. However, between 1999 and 2002, North Carolina decreased its number of students per multimedia computer by 50 percent (down from 12.4 in 1999), the largest decrease among comparison states. This decrease improved its national ranking from forty-seventh to thirty-second.

Ninety-one percent of classrooms in North Carolina had Internet access in 2002, above the U.S. average (89 percent) and up from 31 percent in 1998 *[24-2]*. The 2002 rankings placed North Carolina seventeenth nationally and tied with two states for first among the comparison states.

What does this mean for North Carolina?

In addition to having a strong foundation in traditional subject areas, tomorrow's workforce must be comfortable in carrying out tasks required of the developing digital environment. North Carolina's schools are moving to the forefront of the digital revolution so that its children have the opportunity to learn from and with information technology.

24-1 Students per Instructional Multimedia Computer, 1999 & 2002

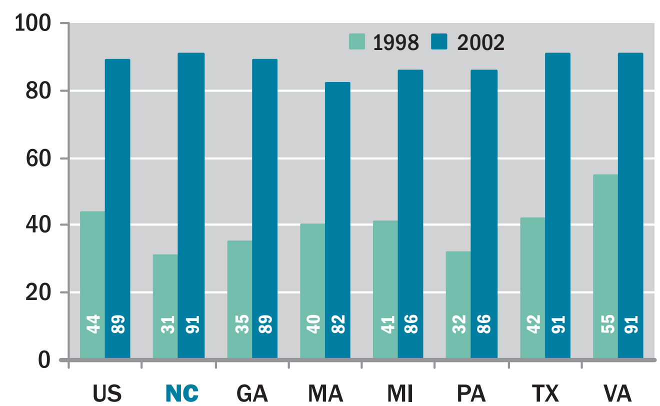


	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2002		32	23*	26*	23*	18*	13*	16

* Tied with other states.

Source: Education Week on the Web.

24-2 Percent of Classrooms with Internet Access, 1998 & 2002



	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank 2002		17*	28*	47	38*	38*	17*	17*

* Tied with other states.

Source: Education Week on the Web.

INDICATOR 25: *Internet Access*

Key Findings

- **In 2001, the share of households with Internet access in North Carolina (44.5 percent) ranked below the U.S. average (50.5 percent) and the shares for all comparison states.**
- **In 2002, the share of households and businesses with high-speed Internet access in North Carolina (16.0 percent) ranked below the U.S. average (16.4 percent) but above the shares for most comparison states.**

Indicator Overview

Households with Internet connectivity have access to an increasing amount of information and are better able to conduct day-to-day activities at work, school, and home. The percentage of households and businesses with Internet access, particularly high-speed access, is a measure of a state's level of Internet connectivity, its information infrastructure, and its citizens' familiarity with the Internet.

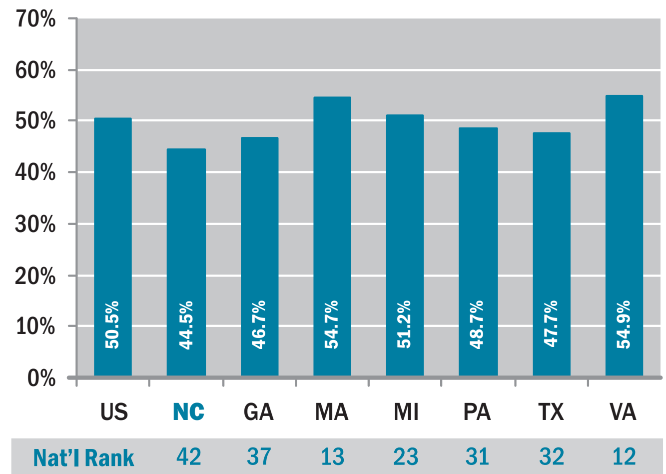
How does North Carolina perform?

In 2001, 44.5 percent of North Carolina households had Internet access, placing the state last among its comparison states and forty-second in the nation in the percentage of households with Internet access *[25-1]*. With respect to high-speed Internet access, North Carolina fares better. In 2002, it ranked fourteenth in the nation and third among its comparison states in the percentage of households and businesses with high-speed Internet access *[25-2]*.[1] North Carolina's 16.0 percent of households and businesses with high-speed Internet access ranked slightly below the national average of 16.4 percent.[2] Nationally, New York had the highest share (26.8 percent) of households and businesses with high-speed Internet access (data not shown here).

What does this mean for North Carolina?

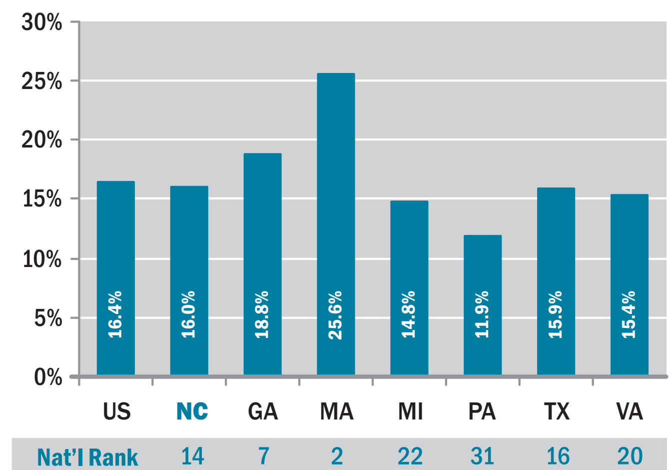
The Internet is becoming an increasingly vital tool in the information society. More Americans are going online to conduct day-to-day activities including education, business transactions, personal correspondence, research, and job searches. Each year, connection to the Internet becomes ever more critical to economic and educational advancement and community participation. People who lack access to the Internet are at a growing disadvantage. Raising the level of digital inclusion by increasing the number of households and businesses using the Internet, particularly through high-speed connections, is vitally important the state. In order for North Carolina households and businesses to purchase high-speed Internet access, the information infrastructure first must be available. It is essential that North Carolina work to ensure that all of its residents — regardless of age, income, race, ethnicity, disability, gender, or geography — have access to the technological tools and skills needed in the new economy.[3]

25-1 Percent of Households with Internet Access, 2001



Source: National Telecommunications and Information Administration, U.S. Department of Commerce.

25-2 Percent of Households & Businesses with Broadband Internet Access, 2002



Source: Federal Communications Commission.

1. Data for Hawaii were unavailable.
2. The percentages for households and businesses combined are lower than the percentages for businesses alone and higher than for households alone. Data analyzing households and businesses separately were unavailable.
3. The North Carolina Rural Internet Access authority, which began operations in 2001, works to collaborate with technology providers to make high-speed information infrastructure facilities available throughout North Carolina and to train citizens to use computers and the Internet.

Sources (by Indicator)

Indicators for *Tracking Innovation 2003* were compiled using existing secondary data sources. The specific measures within the various indicators typically required reconfiguration of existing data sets. Because the measures were derived from a wide range of sources, there are variations in the time frames used and in the specific data that define the indicators being measured. The information below provides detailed notes on data sources used for each indicator.[1] When available, Web site addresses are provided.[2]

1. Overall Performance

Gross state product data are from *Regional Economic Accounts*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (adjusted for inflation using the Bureau of Labor Statistics' inflation calculator). Employment and unemployment data are from *Employment and Unemployment*, Bureau of Labor Statistics (*http://www.bls.gov*), U.S. Department of Labor.

2. New Firms

Data on new firms are from *Small Business Economic Indicators for 2002,* Office of Advocacy, U.S. Small Business Administration (SBA, *http://www.sba.gov/advo/stats*). Raw data are compiled by the SBA from the Employment & Training Administration (*http://www.doleta.gov*), U.S. Department of Labor, and the U.S. Census Bureau (*http://www.census.gov*), U.S. Department of Commerce.

3. Fast-Growth Companies & Jobs

Data for the percentage of jobs in gazelle firms in 2001 are from the 2002 *State New Economy Index*, published by the Progressive Policy Institute (*http://www.neweconomyindex.org*). Data for percentage of jobs in gazelle firms in 1997 are from the 1998 *State New Economy* Index, as cited in the *Tracking Innovation 2000* report. Raw gazelle data are from Cognetics, Inc. (*http://www.cogonline.com*). Data on Fast 500 companies are from the 2002 *Technology Fast 500 Report*, published by Deloitte and Touche (*http://www.public.deloitte.com/fast500*).

4. Worker Pay

Wage data are from Minnesota IMPLAN Group, Inc. (*http://www.implan.com*), enhanced ES-202 files.

5. Personal Income

Annual state per capita personal income data are from *Regional Economic Accounts*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (adjusted for inflation using the Bureau of Labor Statistics' inflation calculator). Median household income data are from *Population and Household Economic Topics*, U.S. Census Bureau (*http://www.census.gov*), U.S. Department of Commerce. Population data are from *Population and Household Economic Topics*, U.S. Census Bureau (as cited above), U.S. Department of Commerce.

6. Income Distribution & Poverty

Data for 1996-1998 are from *Pulling Apart: A State-by-State Analysis of Income Trends*, by J. Bernstein, E.C. McNichol, L. Mishel, and R. Zahradnik. Center on Budget and Policy Priorities, Economic Policy Institute, January 2000, as cited in the *Tracking Innovation 2000* report. Data for 1999–2001 are from *Pulling Apart: A State-by-State Analysis of Income Trends*, by Jared Berstein, Heather Boushey, Elizabeth McNichol, and Robert Zahradnik. Center on Budget and Policy Priorities, Economic Policy Institute, Washington, DC, April 2002. Population data are from the *March Current Population Survey*, averaged for 1976–1980 and 1998–2000, U.S. Census Bureau (*http://www.census.gov*), U.S. Department of Commerce.

7. Technology-Intensive Activities

Four-digit SIC state employment data for 1989 and 2000 are from Minnesota IMPLAN Group, Inc. (*http://www.implan.com*), available with a two- to three-year lag. The data are based on the U.S. ES-202 (Covered Wages and Employment Program, Bureau of Labor Statistics (*http://www.bls.gov*), and are adjusted to estimate cells suppressed for confidentiality reasons. North Carolina Employment data for 1989 and 2002 are from the North Carolina Employment Security Commission (*http://www.ncesc.com*), obtained with special permission and available after, approximately, a one-year lag.

8. High-Technology Industry Clusters

Employment and wage data for 1989 and 2002 are from the North Carolina Employment Security Commission (*http://www.ncesc.com*), obtained with special permission, and the Bureau of Labor Statistics (*http://www.bls.gov*), U.S. Department of Labor. High-technology industry cluster definitions are available in Appendix 2.

9. International Exports

Data on state and national exports are from *Foreign Trade Statistics*, U.S. Census Bureau (*http://www.census.gov/foreign-trade/www/index.html*), U.S. Department of Commerce. Gross state product data are from, *Regional Economic Accounts,* Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce.

10. Industrial Transition

Data on mass layoffs are from *Mass Layoff Statistics*, Bureau of Labor Statistics (*http://www.bls.gov*), U.S. Department of Commerce. Four-digit Standard Industrial Classification (SIC) employment and wage data for 1989 and 1997, which underlie the growth/decline wage index, are from Minnesota IMPLAN Group, Inc. (*http://www.implan.com*), enhanced ES-202 files. Employment and wage data for 2000 are from the Bureau of Labor Statistics (*http://www.bls.gov*), U.S. Department of Commerce, modified ES-202 files.

1. The data used in this report were collected during July 2003.
2. Web site addresses provided here link to the relevant organizations, not to their specific reports or data tables, whose links may change after publication of this report.

Sources (by Indicator)

11. Utility Patents

Total patents by state are from the U.S. Patent and Trademark Office (*http://www.uspto.gov*). Raw data are from the National Bureau of Economic Research (*http://www.nber.org*). Population data are from *Regional Economic Accounts: Population Estimates*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (based on U.S. Census Bureau data).

12. Technology Transfer Activity

Data for 1997 are from the *AUTM Licensing Survey: Fiscal Year 1997*, published by the Association of University Technology Managers, Inc., as cited in the *Tracking Innovation 2000* report. Data for 2000 are from the *AUTM Licensing Survey: Fiscal Year 2000*, published by the Association of University Technology Managers, Inc. (*http://www.autm.net/index_ie.html*). Gross state product data are from *Regional Economic Accounts,* Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (adjusted for inflation using the Bureau of Labor Statistics' inflation calculator).

13. Venture Capital

Venture capital data are from *2002 Yearbook,* published by the National Venture Capital Association (http://www.nvca.org). Gross state product data are from *Regional Economic Accounts,* Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (adjusted for inflation using the Bureau of Labor Statistics' inflation calculator).

14. Initial Public Offerings (IPOs)

Data on initial public offerings are from *2002 IPO Report*, published by Hale and Dorr, LLP (*http://www.haledorr.com*). Population data are from *Population and Household Economic Topics*, U.S. Census Bureau, (*http://www.census.gov*), U.S. Department of Commerce.

15. Research & Development (R&D)

R&D data are from the Division of Science Resources Statistics; Directorate for Social, Behavioral and Economic Sciences; National Science Foundation (NSF, *http://www.nsf.gov/sbe/srs*). Raw data are from four NSF surveys: *Survey of Industrial R&D*, *Survey of R&D Expenditures at Universities and Colleges*, *Survey of Federal Funds for R&D*, and *Survey of R&D Funding and Performance by Nonprofit Organizations*. Gross state product data are from, *Regional Economic Accounts*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce.

16. R&D per Tech Transfer Action

R&D data are from the Division of Science Resources Statistics; Directorate for Social, Behavioral and Economic Sciences; National Science Foundation (NSF) (*http://www.nsf.gov/sbe/srs*). Raw data are from four NSF surveys: *Survey of Industrial R&D*, *Survey of R&D Expenditures at Universities and Colleges*, *Survey of Federal Funds for R&D*, and *Survey of R&D Funding and Performance by Nonprofit Organizations*. Technology transfer data are from *AUTM Licensing Survey: Fiscal Year 2000,* published by the Association of University Technology Managers, Inc. (*http://www.autm.net/index_ie.html*).

17. Ph.D. Scientists & Engineers

Data on employed doctoral scientists and engineers are from *Characteristics of Doctoral Scientists and Engineers in the US: 2001*, published by the Division of Science Resources Statistics; Directorate for Social, Behavioral and Economic Sciences; National Science Foundation (*http://www.nsf.gov/sbe/srs*). Raw data are from the *2001 Survey of Doctorate Recipients*, published by the National Science Foundation (same Web site as previous). Population data are from *Regional Economic Accounts: Population Estimates*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (based on U.S. Census Bureau data).

18. Perceived Academic Science Strength

Science and engineering program rankings data are from *Best Graduate Schools Index,* published by U.S. News and World Report (*http://www.usnews.com*).

19. SBIR & STTR Awards

SBIR and STTR awards and dollar values for 1998 are from the Office of Technology, U.S. Small Business Administration, as cited in the *Tracking Innovation 2000* report. SBIR and STTR awards and dollar values for 2001 and 2002 are from the Office of Technology, U.S. Small Business Administration (*http://www.sba.gov/index.html*). Population data are from *Regional Economic Accounts: Population Estimates*, Bureau of Economic Analysis (*http://www.bea.doc.gov*), U.S. Department of Commerce (based on U.S. Census Bureau data).

20. NIH & NSF Awards

NIH awards and dollar values are from the Office of Extramural Research (*http://grants1.nih.gov/grants/OER.htm*), National Institutes of Health. NSF awards and dollar values are from the Budget Internet Information System (*http://dellweb.bfa.nsf.gov*), Office of Budget, Finance & Award Management, National Science Foundation.

21. Educational Attainment

Educational attainment data are from *Educational Attainment in the United States: March 2002*, published by the U.S. Census Bureau (*http://www.census.gov*). Drop-out rates are from *Drop-out Rates in the United States: 2000,* published by the National Center for Education Statistics (*http://nces.ed.gov*), U.S. Department of Education.

22. Test Scores

Data for average SAT scores and percentage of students taking the SAT are from the College Board (*http://www.collegeboard.com*).

23. Science & Engineering Education

Data on the number of science and engineering undergraduate and graduate students are from the Integrated Postsecondary Education Data System (*http://nces.ed.gov/ipeds*), National Center for Education Statistics, U.S. Department of Education.

24. Computers & Internet Access in Schools

Data on multimedia computer intensity for 1999 are from *Technology Counts 1999: State Data Tables*, published by Education Week on the Web (*http://www.edweek.org*). Data on the percentage of classrooms with Internet access in 1998 were obtained from *Do Students and Teachers Have Adequate Access to Education Technology,* published by Education Week on the Web, as cited in the *Tracking Innovation 2000* report. Data for 2002 on multimedia computer intensity and percentage of classrooms with Internet access are from *Technology Counts 2003: State Data Tables*, published by Education Week on the Web (as cited above).

25. Internet Access

Data on percent of households with Internet access are from *A Nation Online: How Americans Are Expanding Their Use of the Internet (2002)*, National Telecommunications and Information Administration (*http://www.ntia.doc.gov*), U.S. Department of Commerce. Data on high-speed Internet access are from *High-Speed Services for Internet Access: Status as of December 31, 2002*, Federal Communications Commission (*http://www.fcc.gov/wcb/stats*).

SIC-Technology Classification[1]

(Adjusted from classification from North Carolina Alliance for Competitive Technologies.)

Very Technology-Intensive Industries

SIC	Description
2830	Drugs
3570	Computer and office equipment
3660	Communications equipment
3720	Aircraft and parts
3760	Guided missiles, space vehicles, parts
3812	Search and navigation equipment
3820	Measuring and controlling devices
7371	Computer programming services
7372	Prepackaged software
7373	Computer integrated systems design
7374	Data processing and preparation
7375	Information retrieval services
7379	Computer related services, n.e.c.
8711	Engineering services
8731	Commercial physical research
8733	Noncommercial research organizations
8734	Testing laboratories

Moderately Technology-Intensive Industries

SIC	Description
2810	Industrial inorganic chemicals
2820	Plastics materials and synthetics
2860	Industrial organic chemicals
3670	Electronic components and accessories
3711	Motor vehicles and car bodies
3714	Motor vehicle parts and accessories
3716	Motor homes
3841	Surgical and medical instruments
3844	X-ray apparatus and tubes
3845	Electromedical equipment
3851	Ophthalmic goods
3861	Photographic equipment and supplies
8062	General medical and surgical hospitals
8071	Medical laboratories
8072	Dental laboratories
8090	Health and allied services, n.e.c.

Somewhat Technology-Intensive Industries

SIC	Description
2840	Soap, cleaners and toilet goods
2851	Paints, varnishes, lacquers, etc.
2873	Agricultural chemicals
2890	Misc. chemical products
3510	Engines and turbines
3530	Construction and related machinery
3540	Metalworking machinery
3550	Special industry machinery
3560	General industrial machinery
3610	Electrical distribution equipment
3620	Electrical industrial apparatus
3630	Household appliances
3640	Electric lighting and wiring equipment
3650	Household audio and video equipment
3690	Misc. electrical equipment and supplies
3713	Truck and bus bodies
3715	Truck trailers
3821	Laboratory apparatus and furniture
3842	Surgical appliances and supplies
3843	Dental equipment and supplies
4899	Communications services, n.e.c.

1. SIC is the abbreviation for the U.S. Standard Industrial Classification System.

Component Industries, U.S. Benchmark Technology-Intensive Clusters

(Note: Clustering based on analysis of technology-intensive industries only. Clusters are not mutually exclusive.)

Chemicals and Plastics

SIC	Description
2812	Alkalies and chlorine
2813	Industrial gases
2816	Inorganic pigments
2821	Plastics materials and resins
2822	Synthetic rubber
2823	Cellulosic manmade fibers
2824	Organic fibers, noncellulosic
2841	Soap and other detergents
2842	Polishes and sanitation goods
2843	Surface active agents
2844	Toilet preparations
2851	Paints, varnishes, lacquers, enamels, etc.
2865	Cyclic crudes and intermediates
2869	Industrial organic chemicals, n.e.c.
2873	Nitrogenous fertilizers
2874	Phosphatic fertilizers
2875	Fertilizers, mixing only
2879	Agricultural chemicals, n.e.c.
2891	Adhesives and sealants
2893	Printing ink
2899	Chemical preparations, n.e.c.
3559	Special industry machinery, n.e.c.
3624	Carbon and graphite products
3692	Primary batteries, dry and wet
3843	Dental equipment and supplies
8071	Medical laboratories
8072	Dental laboratories
8092	Kidney dialysis centers
8093	Specialty outpatient facilities, n.e.c.
8099	Health and allied services, n.e.c.

Information Technology and Instruments

SIC	Description
3571	Electronic computers
3572	Computer storage devices
3575	Computer terminals
3577	Computer peripheral equipment, n.e.c.
3578	Calculating and accounting equipment
3579	Office machines, n.e.c.
3625	Relays and industrial controls
3629	Electrical industrial apparatus, n.e.c.
3631	Household cooking equipment
3643	Current-carrying wiring devices
3644	Noncurrent-carrying wiring devices
3661	Telephone and telegraph apparatus
3663	Radio & TV communications equipment
3669	Communications equipment, n.e.c.
3672	Printed circuit boards
3674	Semiconductors and related devices
3675	Electronic capacitors
3676	Electronic resistors
3677	Electronic coils and transformers
3678	Electronic connectors
3679	Electronic components, n.e.c.
3694	Engine electrical equipment
3699	Electrical equipment & supplies, n.e.c.
3812	Search and navigation equipment
3821	Laboratory apparatus and furniture
3822	Environmental controls
3823	Process control instruments
3824	Fluid meters and counting devices
3825	Instruments to measure electricity
3826	Analytical instruments
3827	Optical instruments and lenses
3829	Measuring & controlling devices, n.e.c.
3844	X-ray apparatus and tubes
3845	Electromedical equipment
7371	Computer programming services
7372	Prepackaged software
7373	Computer integrated systems design
7374	Data processing and preparation
7375	Information retrieval services
7379	Computer related services, n.e.c.

Industrial Machinery

SIC	Description
3511	Turbines and turbine generator sets
3532	Mining machinery
3535	Conveyors and conveying equipment
3536	Hoists, cranes, and monorails
3541	Machine tools, metal cutting types
3542	Machine tools, metal forming types
3546	Power-driven handtools
3547	Rolling mill machinery

Component Industries, U.S. Benchmark Technology-Intensive Clusters

(Note: Clustering based on analysis of technology-intensive industries only. Clusters are not mutually exclusive.)

3549	Metalworking machinery, n.e.c.
3553	Woodworking machinery
3555	Printing trades machinery
3556	Food products machinery
3559	Special industry machinery, n.e.c.
3561	Pumps and pumping equipment
3563	Air and gas compressors
3564	Blowers and fans
3565	Packaging machinery
3612	Transformers, except electronic
3621	Motors and generators

Motor Vehicle Manufacturing

SIC	Description
2851	Paints, varnishes, lacquers, enamels, etc.
2893	Printing ink
3519	Internal combustion engines, n.e.c.
3531	Construction machinery
3534	Elevators and moving stairways
3537	Industrial trucks and tractors
3548	Welding apparatus
3641	Electric lamps
3645	Residential lighting fixtures
3646	Commercial lighting fixtures
3647	Vehicular lighting equipment
3648	Lighting equipment, n.e.c.
3651	Household audio and video equipment
3691	Storage batteries
3694	Engine electrical equipment
3711	Motor vehicles and car bodies
3713	Truck and bus bodies
3714	Motor vehicle parts and accessories
3715	Truck trailers

Aerospace

SIC	Description
3544	Special dies, tools, jigs & fixtures
3545	Machine tool accessories
3721	Aircraft
3724	Aircraft engines and engine parts
3728	Aircraft parts and equipment, n.e.c.
3761	Guided missiles and space vehicles
3764	Space propulsion units and parts
3769	Space vehicle equipment, n.e.c.

Communications Services and Software

SIC	Description
4899	Communications services, n.e.c.
7371	Computer programming services
7372	Prepackaged software
7373	Computer integrated systems design
7374	Data processing and preparation
7375	Information retrieval services
7379	Computer related services, n.e.c.
8711	Engineering services
8712	Architectural services
8713	Surveying services
8731	Commercial physical research
8732	Commercial nonphysical research
8734	Testing laboratories

Pharmaceuticals and Medical Technologies

SIC	Description
2833	Medicinals and botanicals
2834	Pharmaceutical preparations
2835	Diagnostic substances
2836	Biological products exc. diagnostic
3634	Electric housewares and fans
3841	Surgical and medical instruments
3842	Surgical appliances and supplies
8731	Commercial physical research
8732	Commercial nonphysical research
8734	Testing laboratories

THE NORTH CAROLINA BOARD OF SCIENCE AND TECHNOLOGY

The mission of the North Carolina Board of Science and Technology is to advance science and technology throughout North Carolina. As a division of the North Carolina Department of Commerce, the board advises and makes recommendations to the North Carolina Governor, General Assembly, Secretary of Commerce, and Economic Development Board on the role of science and technology in the economic growth and development of North Carolina.

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