Tracking Innovation

North Carolina Innovation Index 2000

VISION 2030
DRIVING THE NEW ECONOMY
SCIENCE & TECHNOLOGY

This report prepared for the
North Carolina Board of Science and Technology
by

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Executive Summary

Industries that have been North Carolina's bread and butter for generations are no longer creating enough job opportunities to meet the needs of the current generation of North Carolina workers, much less the next one. To be sure, the textiles, apparel, tobacco products, lumber, and furniture industries remain economic powers. After more than two decades of intensifying foreign competition, they are comprised of companies that are highly efficient and competitive. However, using automation to go head to head with overseas producers buying labor for one-tenth the price or less, many of those companies are raising production even as they let workers go. It is either that or fail.

The result is transition: for companies attempting to replace labor-intensive methods with advanced production practices and machinery; for displaced workers that must re-skill to meet the needs of the state's new job generators; for universities and community colleges as skill and training needs change with shifts in the industrial base; and for the public sector, as it faces decisions about where to target resources and investments in an economy where job growth is occurring along two paths — low wage, low skill service industries and high wage, high skill knowledge-intensive industries.

Much has been written about the increasing role of knowledge and innovation in industrialized economies. As the argument goes, global trade, the Internet, and spectacular advances in general information technology have altered the playing field. Researchers at the Progressive Policy Institute argue that while "low costs; abundant, basically skilled labor; and good transportation and other physical infrastructures" defined economic success in the old economy, "the rules of the game have changed in the New Economy."[1] According to the Kentucky Science and

Technology Corporation: "In the future, there will be two kinds of economies: smart and dead! A smart economy is one that is entrepreneurial and therefore driven by knowledge, innovation, and speed."[2]

There is little doubt that North Carolina's traditional comparative advantage in low-cost but industrious labor is fading fast.[3] And advanced technology and knowledge-based industries are indeed expanding in the state. But many former manufacturing workers have also shifted into low-wage service jobs that offer little job security and few opportunities for advancement.[4] The modest presence of high technology industry in most regions of the state, the dominance of branch plants over headquarters and R&D facilities, the poor performance of North Carolina students on standardized exams, and deteriorating infrastructure in the schools—from primary schools to the community colleges and universities—are not particularly sturdy building blocks for an economy in which knowledge creation and innovation drive growth. There is simply no guarantee that knowledge-intensive industries—and the higher wages and prosperity they promise—will command North Carolina's future.

Why Tracking Innovation?

A critical question in North Carolina is whether the proper infrastructure and resources—human and physical—are in place to ensure that a vibrant, high wage, knowledge-based economy emerges as the state's traditional growth engines wane. At a minimum, finding the answer requires timely baseline information on innovation and technology-related activity in the state. It is the goal of *Tracking Innovation: The North Carolina Innovation Index 2000* to provide that information in a systematic and accessible format, and therefore to help inform technology planning and policy at all levels.

The report assembles information from a wide variety of disparate sources to document trends on over fifty specific measures of technology-related activity in North Carolina, six comparison states (Georgia, Massachusetts, Michigan, Pennsylvania, Texas and Virginia), and the U.S. The fifty-plus measures are summarized under twenty-six broad indicators of innovation, technology, and economic growth. Each of the twenty-six indicators, in turn, falls into one of five general categories: performance outcomes, economic structure, innovation outcomes, innovation inputs, and preparation.

With *Tracking Innovation*, North Carolina joins a growing number of states that are monitoring innovation trends within their borders, from technology leaders such as Massachusetts to agricultural states like Kansas.

Findings

Together, the many trends documented in this report tell a story about North Carolina that is both optimistic and pessimistic. Figure 1 summarizes the state's ranking versus the comparison states on selected measures. The following are some specific findings:

- North Carolina is one of the fastest growing states in the U.S. It leads many of its peers in growth of gross state product, employment, and total firms. Despite considerable restructuring in the manufacturing sector, the incidence and scale of mass layoffs in North Carolina have been modest in comparison to trends in other peer states.

- The state has also enjoyed significant growth in venture capital investments over the 1996 to 1999 period and patent activity between 1989 and 1998.

FIGURE 1

Innovation index summary, selected indicators

Fig.	Measure	-1-	-2-	-3-	-4-	-5-	-6-	-7-	Rank, benchmark group
2	Gross state product growth, 1989-97	GA	TX	NC	VA	MI	PA	MA	Performance Outcome Avg. Rank = 4.22
3	Total firm growth, 1996-97	NC	MA	GA	MI	TX	VA	PA	
11	Employment growth, 1989-97	TX	GA	NC	MI	VA	PA	MA	
5	Adjusted average wages, 1998	TX	GA	MI	VA	MA	PA	NC	
*	Per capita income, 1997	VA	MA	PA	MI	GA	TX	NC	
6	Real per capita income growth, 1989-97	VA	MI	TX	GA	NC	PA	MA	
7	Adjusted median household income, 1996-7	MA	MI	VA	PA	TX	NC	GA	
8	Income growth, bottom fifth of families, '78-'80, '96-'98	NC	VA	MA	PA	GA	MI	TX	
9	Poverty rate, 1996-98	MA	MI	VA	PA	NC	GA	TX	
10	Technology intensity (employment), 1997	MI	MA	PA	VA	TX	NC	GA	
11	Technology intensive employment growth, 1989-97	GA	NC	TX	VA	PA	MI	MA	Economic Structure Avg. Rank = 3.38
12	Employment growth, very high tech industries, 1989-97	GA	VA	NC	TX	MI	PA	MA	
18	Export growth, 1993-99	GA	TX	NC	MI	PA	MA	VA	
19	Export intensity, 1997	MI	TX	MA	NC	PA	VA	GA	
20	Ratio of layoff actions to establishments, 1997-99	GA	VA	NC	MA	TX	MI	PA	
20	Ratio of layoffs to employment, 1997-99 (1)	GA	NC	TX	MA	PA	MI	VA	
21	Growth/decline average wage index, 1997	MA	GA	PA	NC	VA	MI	TX	
22	Patents per capita, 1998	MA	MI	PA	TX	NC	GA	VA	Innovation Outcome Avg. Rank = 4.56
23	Patent growth, 1989-98	GA	NC	TX	MA	VA	MI	PA	
24	Invention disclosures and patents, 1997	MA	PA	TX	NC	MI	GA	VA	
24	Licenses and options executed, 1997	MA	PA	TX	NC	GA	MI	VA	
25	Ratio of license income to GSP, 1997 (2)	MA	MI	PA	GA	TX	NC	VA	
26	Venture capital growth, 1996-99	MI	NC	MA	TX	VA	GA	PA	
27	Ratio of venture capital to GSP, 1997	MA	GA	TX	VA	NC	PA	MI	
28	IPOs filed, 1996-99 (3)	TX	MA	GA	PA	VA	MI	NC	
29	IPOSs per capita, 1996-99	MA	GA	TX	VA	PA	NC	MI	
31	Overall R&D intensity, 1995	MI	MA	PA	VA	NC	TX	GA	Innovation Input Avg. Rank = 4.38
31	Industry R&D intensity, 1995	MI	MA	PA	TX	NC	VA	GA	
32	State government R&D spending to GSP, 1995	GA	PA	TX	NC	VA	MI	MA	
33	R&D spending per invention disclosure/patent, 1997 (4)	MA	PA	VA	MI	GA	NC	TX	
33	R&D spending per license/option, 1997	GA	NC	MA	VA	TX	PA	MI	
34	Ph.D. scientists and engineers per capita, 1997 (5)	MA	VA	PA	NC	MI	TX	GA	
36	SBIR funding per capita, 1998 (6)	MA	VA	PA	MI	TX	NC	GA	
37	STTR funding per capita, 1998	MA	VA	NC	MI	GA	PA	TX	
38	ISO compliance, 1999 (7)	MI	TX	PA	MA	NC	GA	VA	Preparation Avg. Rank = 5.11
39	College educational attainment, 1998 (8)	MI	MA	PA	NC	TX	GA	VA	
40	High school drop-out rate, 1995-97	MA	VA	TX	NC	PA	MI	GA	
42	Share of science and engineering degrees in total	MI	NC	VA	GA	MA	PA	TX	
43	Science & engineering graduate degrees, 1996-7	MA	PA	NC	VA	MI	TX	GA	
43	Science & engineering bachelors degrees, 1996-7	MA	MI	PA	VA	GA	TX	NC	
44	Students per multimedia computer, 1999	TX	VA	MI	GA	PA	MA	NC	
45	Classroom Internet access, 1998	VA	TX	MI	MA	GA	PA	NC	
46	Internet connections per capita, 1999	VA	MA	PA	GA	MI	TX	NC	

[1] Rank tie: TX & MA. [1] Rank Tie: NC & TX. [2] Rank tie: NC & MI, GA & PA. [3] Rank tie: MI & TX. [4] Rank tie: TX & NC, MI & VA. [5] Rank tie: MI & TX. [6] Rank tie: PA & TX. [7] Rank tie: NC & PA. [8] Rank tie: NC & PA. * From text (no figure).

- North Carolina's public university system is among the top in the U.S., particularly in biological and health sciences, and it boasts two leading private universities: Duke and Wake Forest, also leaders in biological and health sciences research.

- Pharmaceuticals is a leading industry cluster in the state, and, though difficult to define based on traditional industrial categories, biotechnology and related health sciences sectors are expanding fast. Coupled with university strengths, health sciences represents one of North Carolina's most competitive and dynamic knowledge-based industries.

- Median household income in North Carolina, even adjusted for cost of living differences, is among the lowest in the U.S. and exceeds only Georgia's among peer states. Cost-of-living adjusted average wages fall below all peer states.

- North Carolina's economy is not yet particularly technology-intensive. The share of technology related employment in the private sector is low, though growth of technology sectors has been strong during the 1990s.

- The regional distribution of high tech activity in the state is highly skewed toward the Research Triangle region. During the 1990s, the Triangle increased its share of the state's high tech activity while five of the remaining six regions saw their shares decline.

- On the whole, North Carolina industry conducts less R&D than the national average and several peer states, reflecting its traditional industry base and the dominance of branch plant manufacturing operations.

- On measures of preparedness for the innovation economy (e.g., education, training, technology infrastructure in the schools), North Carolina ranks either in the middle of the pack or near the bottom of peer states.

- While a high share of bachelors degrees awarded by all universities and colleges in the state are in the sciences and engineering, the share of North Carolina residents with such degrees remains comparatively low, suggesting that the state may not be retaining its graduates or that it is still playing catch-up from an era when science and technology was not emphasized.

- The state ranks last among peer states in three common information technology indicators: students per multimedia computer, classroom Internet access, and Internet connections among the general population.

- Research and development spending as a share of gross state product (a measure of the R&D intensity of the economy) is comparatively low, though STTR funding is relatively high. Venture capital remains limited in volume.

- By way of summary, average rankings among peer states for five general categories of indicators finds North Carolina faring best on measures of performance (employment, GSP, income) and economic structure (export activity and technology intensity).

- The state fares worst on preparation indicators (education, Internet access) and innovation outcomes indicators (patenting, IPOs, and university technology transfer).

Implications and the Role of Policy

The 1990s have clearly been good to North Carolina. The sustained national economic expansion, coupled with key investments in infrastructure and technology made in earlier decades, have helped the state weather considerable industrial restructuring, including tens of thousands of layoffs in traditional manufacturing industries and the rapid growth of higher skill, knowledge-based sectors. Although difficult to quantify, major initiatives such as the Industrial Extension Service, customized industry training in the community colleges, the NC School of Science and Mathematics, the NC Biotechnology Center, MCNC, the NC Technological Development Authority, Centennial Campus, and the North Carolina Information Highway—not to mention Research Triangle Park—have all played important roles in growing the state's high technology industrial base.

But not all regions in the state are gaining higher wage technology jobs. Overall, knowledge-based industries remain comparatively small segment of the North Carolina economy. Real prosperity eludes many in the state as incomes and wages remain among the lowest in the U.S. Venture capital is still limited and evidence suggests that industrial R&D activity is modest at best. If test scores are an indicator, North Carolina students are not well-prepared for knowledge-based jobs. Without a skilled, well-educated workforce, North Carolina cannot expect to attract significant technology-related investment.

The findings in this report raise important questions. Are the investments noted above—all of which were initiated between

1950 and the mid 1980s—appropriate and/or sufficient to form the foundation for knowledge-based economic growth? The state's technology investments have slowed during the 1990s. What is the relationship between the slow-down in the state's activities and North Carolina's poor performance on some of the indicators? Are considerable new investments needed or is a laissez faire approach more appropriate?

Also relevant is whether the state's current means of technology policymaking is adequate. The North Carolina Board of Science and Technology has played a key role in initiating and coordinating many of the state's technology initiatives to date. But the Board's mandate is primarily an advisory one. Some states have established autonomous science and technology programs in an effort to elevate the importance of technology policy and increase flexibility in policymaking. Should North Carolina consider a similar arrangement, or are science and technology issues already a sufficient element of the state's economic policy?

This report is not intended to answer such questions. However, hopefully it will inspire others to ask them.

Future Editions

No agency or organization in the state presently monitors technology trends, although many assemble data on an ad hoc basis as their own needs arise. That leads to duplicated effort, confusion over the availability and quality of alternative data sources, and the use of outdated information. The latter is a particularly vexing problem for policymakers, as the high tech sector is undergoing extremely rapid quantitative and qualitative changes. Levels and rates of innovation and R&D in industry, universities, public agencies, and other organizations can vary significantly from year to year.

Tracking Innovation attempts to address the problem. Unfortunately, by assembling only *published* data on technology trends, it does so only partially. Existing data on technology trends are deficient at best. Many available sources of statistics on innovation, R&D, and technology suffer from one or more of the following limitations: 1) significant time lags, including up to seven years for some indicators; 2) data suppression; 3) unsuitable variables for technology planning; 4) high margin of error due to small or inappropriate samples; and 5) unsystematic and unreliable data collection procedures. Some of the most important measures of technology-related activity are simply not available at the state level at all, or on anything approaching a timely basis. The result is an incomplete picture of innovation and technology trends in the state, one that is determined as much by data availability as legitimate policy needs or a sensible conception of the role of innovation in economic development.

For example, at present we know nothing about the volume of R&D conducted in different industries, the degree to which various industries have adopted advanced technologies, the extent to which schools are utilizing computers and the Internet in teaching, the technology infrastructure needs of peripheral areas of the state, and the number and types of business spin-offs from universities. All of that information would inform major policy issues in North Carolina, debates on the "digital divide," rural prosperity, school quality, and the economic role of universities.

To properly monitor technology trends, future editions of *Tracking Innovation* must be based on a careful assessment—with the involvement of relevant agencies and stakeholders—of the most important measures of innovation activity, irrespective of existing data sources. Much of the most useful information will require surveys or other forms of raw data collection. Some indicators will surely prove too expensive or burdensome to collect. But others may not with the cooperation of current data gathering agencies in the state. The alternative is to do nothing and allow limited existing information to influence both the questions asked and the solutions proposed. That is not an attractive option given the importance of innovation for North Carolina's future prosperity.

Summary Endnotes

[1] Atkinson, R. D., R. H. Court, and J. M. Ward, *The State New Economy Index: Benchmarking Economic Transformation in the States*, p. 3 (Washington, DC, Progressive Policy Institute, July 1999).

[2] Goetz, S. J., and D. Freshwater, *Kentucky's Entrepreneurial Capacity 1999*, p. ii (Lexington, KY, Kentucky Science and Technology Council, December 1999). See also Bollier, D., *Ecologies of Innovation*, (Washington, D.C., Aspen Institute, 2000).

[3] *Forces for Change—An Economy in Transition* (Raleigh, NC, North Carolina Board of Science and Technology, 1999).

[4] See Luger, M. I., Gorham, L., and B. Kropp, *Worker Dislocation in North Carolina: Anatomy of the Problem and Analysis of the Policy Approaches* (Chapel Hill, NC, UNC Office of Economic Development, May 2000).

[5] *Forces for Change—An Economy in Transition* (Raleigh, NC, North Carolina Board of Science and Technology, 1999).

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Tables and Figures

Background and Overview

A major impediment to the proper design and implementation of technology policy is the lack of up-to-date information on innovation rates, R&D performance, and trends in technology-intensive industries. Nearly all states are grappling with the problem, including North Carolina. No agency or organization in the state presently monitors technology trends, although many assemble data on an ad hoc basis as their own needs arise. That leads to duplicated effort, confusion over the availability and quality of alternative data sources, and the use of outdated information. The latter is a particularly vexing problem for policymakers, as the high tech sector is undergoing extremely rapid quantitative and qualitative changes. Levels and rates of innovation and R&D in industry, universities, public agencies, and other organizations can vary significantly from year to year.

With *Tracking Innovation*, North Carolina joins the growing number of states that are monitoring technology-related trends on an on-going basis. The report uses existing published data from a wide variety of sources to track over fifty measures relevant to understanding the role of innovation in the state, including indicators of economic performance, industry structure, innovation, technology infrastructure, and education and training. The measures describe twenty-six dimensions of the innovation economy, which, in turn, are summarized under five broad categories: performance outcomes (e.g. gross state product, firm growth, employment, wages, income distribution), economic structure (e.g. technology intensity, industry clusters, exports), innovation outcomes (e.g. patents, technology transfer, initial public offerings), innovation inputs (e.g. R&D, STTR and SBIR grants, Ph.D. scientists and engineers), and preparation (e.g. educational attainment, technology infrastructure).

The report does not claim to present a fully adequate representation of technology-related trends in North Carolina. On the contrary, the picture assembled is undoubtedly a distorted one, shaped as much by data availability as solid conceptual foundations. Such is the poor state of existing data on innovation and technology.

Nor does the report make many normative judgements regarding which measures are most significant for plotting the course of technology policy. Instead, the facts—as best they can be gathered from existing sources—are presented as concisely as possible, leaving it to the reader to gauge the significance of specific trends. While the Executive Summary offers an interpretation of findings and discussion of significance, it is based on the general pattern of trends as revealed by all of the indicators. Though every measure is inadequate in isolation, together they lend useful insight into the state of innovation and technology in North Carolina. The following sections discuss the comparison states, rankings issues, and future technology monitoring efforts.

The Comparison States

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), and two Southeastern states (Georgia and Virginia). National rankings for the comparison states and North Carolina are also reported where possible.

Evaluating Rankings

State-by-state economic rankings have become commonplace. Progressive Policy Institute's *The State New Economy Index* and Corporation for Enterprise Development's *Development Report Card for the States* are widely cited and discussed when they are released each year. There is nothing quite like being ranked behind a traditional set of peer states on a given measure to inspire an introspective look at what is driving the particular trend. Certainly reference or comparison cases are helpful for evaluating a state's performance on any indicator; rankings are merely a simple way of conducting such a comparison.

However, rankings can be misleading and therefore must be used cautiously. First, on some measures there is very little significant variation between states such that the difference between the state ranked first and the one ranked last is not economically meaningful. An example in the current report is the share of gazelle firms (Figure 4), which ranges from 3.67 percent in Texas to 4.71 percent in Massachusetts. Georgia, ranked 15th among the fifty states and District of Columbia with 4.22 percent differs only slightly from Pennsylvania, ranked 18th with 4.21 percent.

Second, on other measures ties obscure the results. Indicators often resist a convenient ordinal pattern.

Third, rankings imply that absolute values of given measures are unimportant. If the rate of poverty in every state ranged from between 1 and 3 percent, a virtual miracle from an historical standpoint, some state would still be ranked 50th. Yet poverty in that state would be a non-issue for all intents and purposes. Rankings can lead to too little attention to the actual values—or targets—on given measures that make sense for development policy to try to reach. At what point does it make sense to rank states on a given indicator? The proliferation of rankings has meant that such a question is rarely asked.

In this report, the actual values of all measures are usually reported in addition to the rank (which is revealed by default in each graphic), permitting careful interpretation of the findings. Although rankings are summarized in Figure 1 of the Executive Summary, some of the more questionable indicators (e.g., gazelle firms) are not included in that summary.

Data Challenges and Future Updates

Following the practice established by other states (e.g., Massachusetts with its *Index of the Massachusetts Innovation Economy* and Kentucky with its *Kentucky's Entrepreneurial Capacity*), this report utilizes only existing secondary data sources. No surveys or other forms of primary data collection have been undertaken to assemble information. The intention is to update the report on an annual basis, ensuring that policymakers have current data and a sense of longer-run trends.

Unfortunately, annual updates do not solve the fundamental problem with *Tracking Innovation*: the fundamentally partial view of technology-related trends it provides given available data sources. Existing data on technology trends are deficient at best. Many available sources of statistics on innovation, R&D, and technology suffer from one or more of the following limitations: 1) significant time lags, including up to seven years for some indicators; 2) data suppression; 3) unsuitable variables for technology planning; 4) high margin of error due to small or inappropriate samples; and 5) unsystematic and unreliable data collection procedures. Some of the most important measures of technology-related activity are simply not available at the state level at all, or on anything approaching a timely basis. They include:

- Research and development trends by industry sector. Which industries in the state are most active in R&D? How do all the state's industries compare against R&D trends nationwide? In the comparison states?

- Which regions in the state—outside of the Triangle—are most active in R&D and innovation?

- What are impediments to increased innovation by North Carolina companies?

- What skills are innovative companies in knowledge-based industries—software, information technology, biotechnology, and the like—looking for? Are North Carolina educational institutions providing those skills?

- What companies have been formed out of university-based research activities?

It is clear that *Tracking Innovation* offers only an incomplete documentation of technology-related trends in the state. To properly monitor North Carolina's technology-related activities requires the determination of an ideal set of technology indicators and the collection of *primary* data where existing data are inadequate. That would generate information on technology trends and issues specific to North Carolina, thereby proving more useful for policymaking in this state. The indicators should be developed through a consensus-building process and in consultation with state statistical agencies, providing an opportunity to leverage existing data collection resources and identify major technology data needs. A clearinghouse for technology-related data should also be established and maintained to avoid the costly duplicated efforts of multiple public and nonprofit agencies.

The best indicators are those that can significantly improve technology policy effectiveness by providing the means to better target scarce resources. The alternative is to continue with the status quo, i.e., the over-reliance on low quality and often inappropriate data, the high cost of duplicated data collection efforts, and the design and implementation of policies that fail to meet their goals for want of adequate information regarding technology needs. But that would be like developing technology policy with a blindfold on, hardly a defensible option in the emerging knowledge economy.

Performance Outcome Indicators

1. Overall Performance

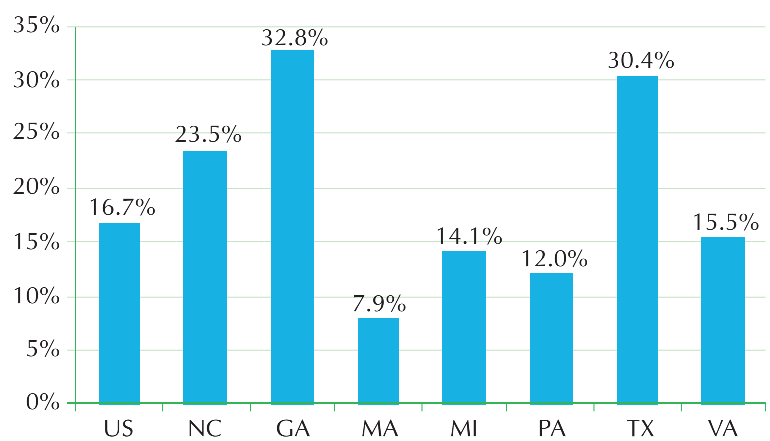
Despite substantial restructuring in the state's manufacturing industry, including significant declines in tobacco manufacturing, textiles, and apparel, North Carolina's economy posted solid gains over the last decade. In March 2000, civilian employment in the state stood at 3.82 million, roughly 2.8 percent of the total U.S. civilian workforce. Employment expanded by 14.7 percent between 1990 and 2000, matching the U.S. growth rate and leaving the state's share of overall U.S. employment at roughly the same level.

In 1997, the latest year for which figures are available, gross state product (GSP) in North Carolina was $218.9 billion, 2.7 percent of U.S. gross product (up from 2.6 percent in 1989). At 23.5 percent, North Carolina's GSP growth over the 1989 to 1997 period ranks third among the seven comparison states, behind Georgia's 32.8 percent and Texas' 30.4 percent. Over the first three months of 2000, unemployment in the state has averaged 3.6 percent, slightly higher than the rate in Virginia, Massachusetts and Georgia, but below that of Pennsylvania and Texas. Michigan's unemployment also averaged 3.6 percent between January and March 2000.

FIGURE 2

Percent change in gross state product, 1989-97

Source: Bureau of Economic Analysis.



2. New Firms

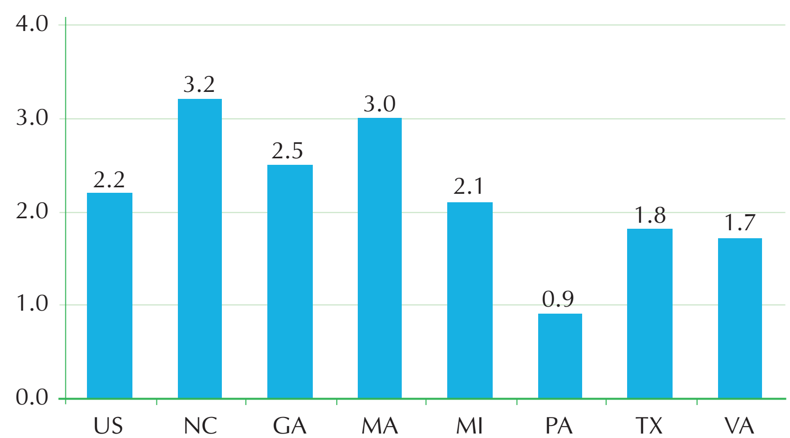
Since many new business ventures fail within the first few years, a vibrant economy is typically characterized by high rates of firm deaths as well as births. Net firm creation is the overall change in the number of firms from year-to-year and takes into account start-ups, firm deaths, locations and relocations, and reorganizations. Positive net firm growth generally reflects a healthy economy in which new business locations and start-ups are outpacing firm deaths and relocations out-of-state.

North Carolina Leads in Net Firm Growth

North Carolina leads all comparison states and the national average in the rate of net firm growth over the 1996 to 1997 period. The total number of firms in the state expanded by 3.2 percent over the period, compared to 2.2 percent nationwide and an average 1.7 percent among the comparison states. The state ranks eleventh among the 50 states and District of Columbia on the measure.

FIGURE 3

Percent change in number of firms, 1996-97
Source: Small Business Administration.



Nat'l Rank		11th	18th	13th	20th	43rd	23rd	25th

3. Gazelle Firms

The term "gazelle" as defined by Cognetics, Inc., a Cambridge, Massachusetts consulting firm, describes young business enterprises that are 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. Most gazelle firms have fewer than 100 employees at the beginning of their growth phase, but they are estimated to be responsible for more than 70 percent of all new jobs created in the U.S. By generating substantial increases in output and jobs, gazelles stimulate growth of other businesses as well as personal spending. A high concentration of gazelles indicates the presence of innovative companies and a positive environment for firm expansion.

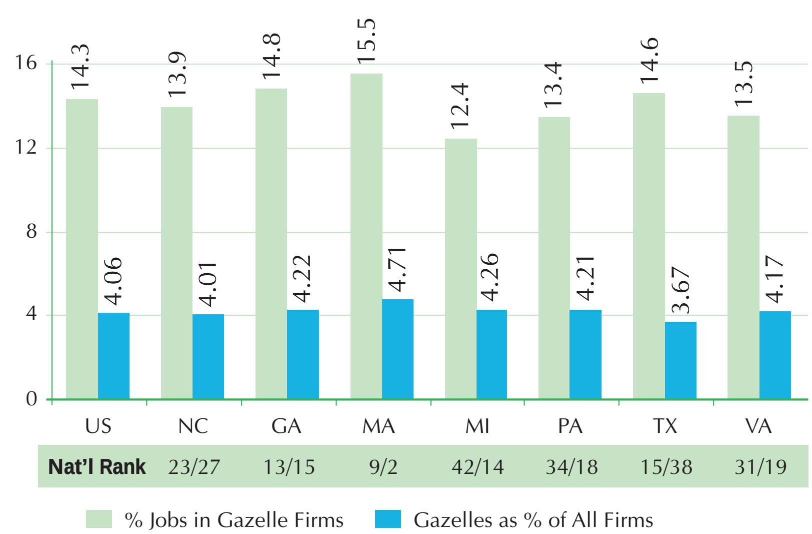
Presence of Gazelles Matches National Average

In 1997, an estimated 4 percent of North Carolina firms were gazelles (or fast-growers), a share that matched the national average as well as most comparison states. They accounted for 13.9 percent of employment, slightly higher than shares in Michigan, Pennsylvania, and Virginia. Massachusetts leads all comparison states slightly in both the relative presence of gazelles and the share of jobs in gazelle companies. However, there is relatively little variation across the 50 states and District of Columbia in the share of gazelle firms or jobs, making rankings with the indicator less meaningful.[1] Gazelle data are included here to facilitate comparison with innovation index studies of other states.

FIGURE 4

Gazelle firms and jobs

Source: Cognetics, Inc. and Progressive Policy Institute.



4. Worker Pay

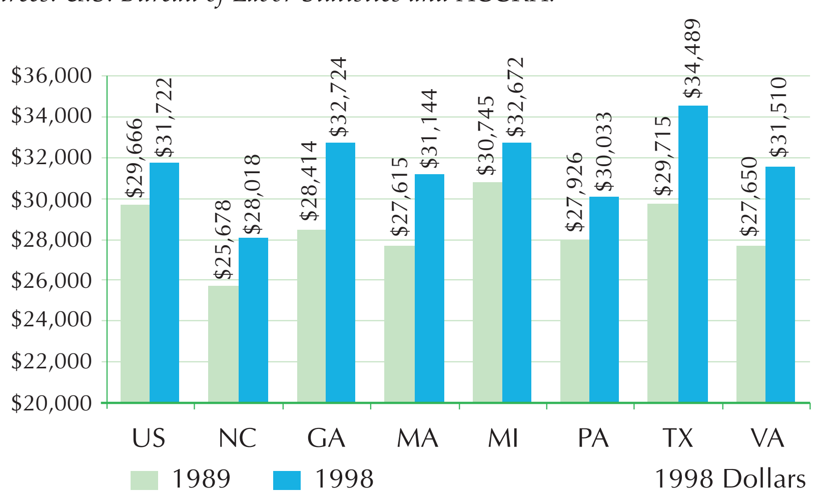
Average wages and salaries reflect worker quality and productivity, industry mix, and the state's cost of living. Historically, North Carolina's private sector average wage has been one of the lowest among the major manufacturing states, reflecting the state's heavy endowment of relatively low-technology and/or labor intensive durable and non-durable goods industries (including textiles, apparel, household furniture, and packaged foods) and the comparatively low cost of living. Over time, as higher-wage knowledge- and technology-intensive industries grow, real wages earned by North Carolina workers will increase, generating greater spending multiplier effects and related growth.

North Carolina Wages Remain Low

In 1998, U.S. private sector workers earned, on average, roughly $31,700. The typical North Carolina worker earned $28,000 in the same year—88 percent of the U.S. average even after adjusting for cost of living differences. Driven by an industrial base dominated by low technology, labor-cost sensitive industries, North Carolina's average wage is below that of all six comparison states. Moreover, while real wages in North Carolina grew faster than the national average between 1989 and 1998, they lagged growth in Virginia, Georgia, Texas, and Massachusetts. Only wages in Michigan and Pennsylvania failed to grow faster than North Carolina's. Like North Carolina, Michigan and Pennsylvania are manufacturing-intensive states with relatively modest complements of technology-intensive industry.

FIGURE 5

Annual average wages, private sector, 1989 & 1998
Adjusted for cost of living differences
Sources: U.S. Bureau of Labor Statistics and ACCRA.



5. Personal Income

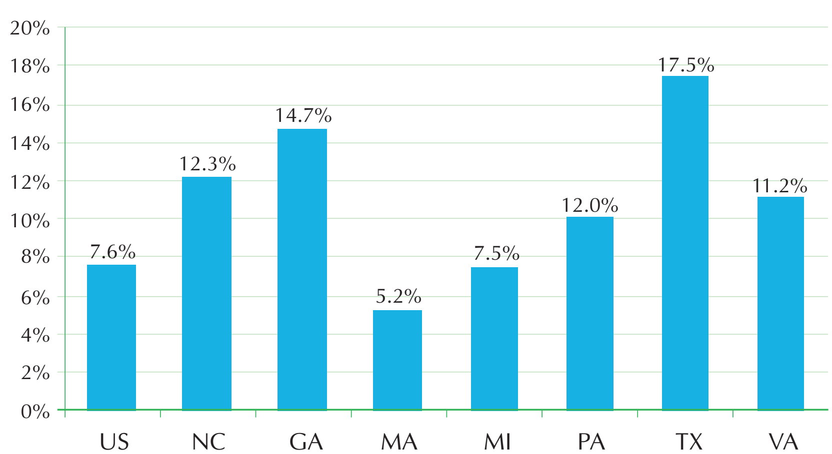
Personal income, which includes wages and salaries as well as transfer payments, dividends, interest, rents, and proprietors income, is a key indicator of the overall health of the economy. Major goals of technology-oriented development strategies are to increase the number of higher wage technology jobs, expand investment opportunities in fast growth, innovative companies, and raise productivity by diffusing advanced technologies and best practices. A key successful result of such initiatives is higher incomes.

North Carolina's Per Capita Income Lags Behind

Income per person in North Carolina was $23,168 in 1997, 92 percent of U.S. level. Either adjusted or unadjusted for cost of living differences, per capita income in North Carolina ranks last in the set of peer states. However, if recent trends continue, the state's relative position will improve. Cost-of-living-adjusted incomes in North Carolina rose by 12.3 percent in real terms between 1989 and 1997, faster than in Massachusetts, Michigan, Pennsylvania, and Virginia. Only Georgia and Texas recorded faster growth over the period. Real per capita income rose nationwide by 7.6 percent.

FIGURE 6

Growth in real per capita income, 1989-97
Incomes adjusted for cost of living differences
Source: Bureau of Economic Analysis and ACCRA.



Median Household Income Close to National Average

Per capita income can obscure significant differences in income distributions in the various states. 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 alternative indicator, median household income, is based on the income distribution itself: it is the level at which half of all families report higher incomes and half of all families report lower incomes.

Unadjusted for cost of living differences, 1997 median household income in North Carolina is 99 percent of the national average and ranks 5th (ahead of Georgia and Texas) among the seven comparison states. Adjusted for cost of living differences, the state's median income exceeds that of Massachusetts and Pennsylvania.

FIGURE 7

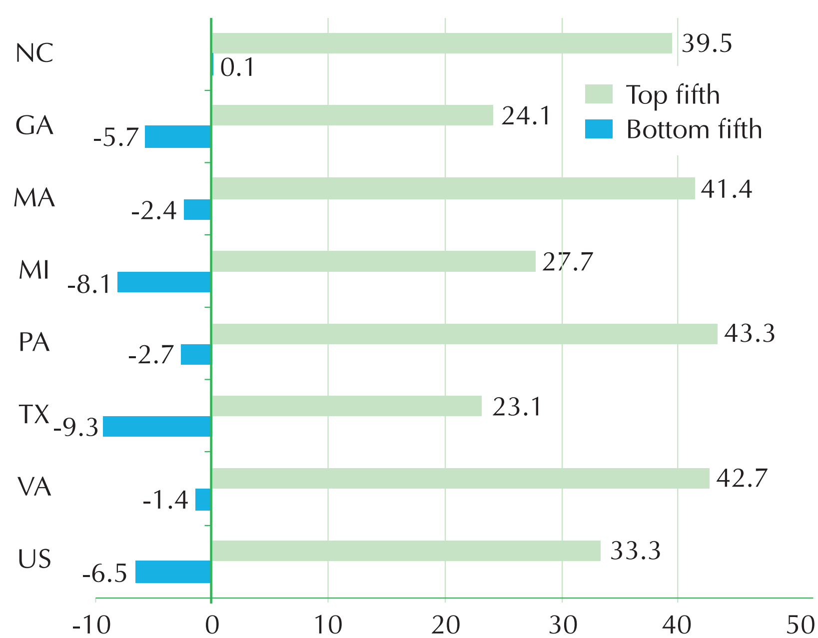
Median household income, 1996-97
Unadjusted and adjusted for cost of living
Source: Bureau of the Census and ACCRA.

6. Income Distribution and Poverty

Ensuring economic opportunities for all North Carolinians is an important goal of economic development policy.[2] Some workers with insufficient education or skills, or that reside in cities and towns distant from growing technology centers in the state, may be unable to obtain the quality jobs knowledge-based industries typically bring. Moreover, the "digital divide" (the gap in access to information technologies between higher and lower income households, or between urban and rural households and businesses) also threatens to limit some North Carolinians' access to the broader innovation economy and its associated investment opportunities and higher wage jobs. The distribution of income and level of poverty are important indicators for monitoring the degree to which the emerging technology industry is yielding gains for all residents in the state.

FIGURE 8

Percent change in average real incomes
Top and bottom fifth of families, 1978-80 to 1996-98
Source: Bernstein, McNichol, Mishel, and Zahradnik (2000).



Incomes of Poorest Households Stagnating in North Carolina

Between the late 1970s and late 1990s, the distribution of income in the U.S. became significantly less even, with the wealthiest households enjoying significant gains while real incomes among the lowest income households actually declined. In the late 1970s, the average income of the wealthiest fifth of households in the U.S. was 7.2 times that of the poorest fifth of households. By the late 1990s, the average incomes of the wealthiest households had risen to 10.6 times that of the poorest. Trends in North Carolina mirrored the national pattern, though they were somewhat less extreme.

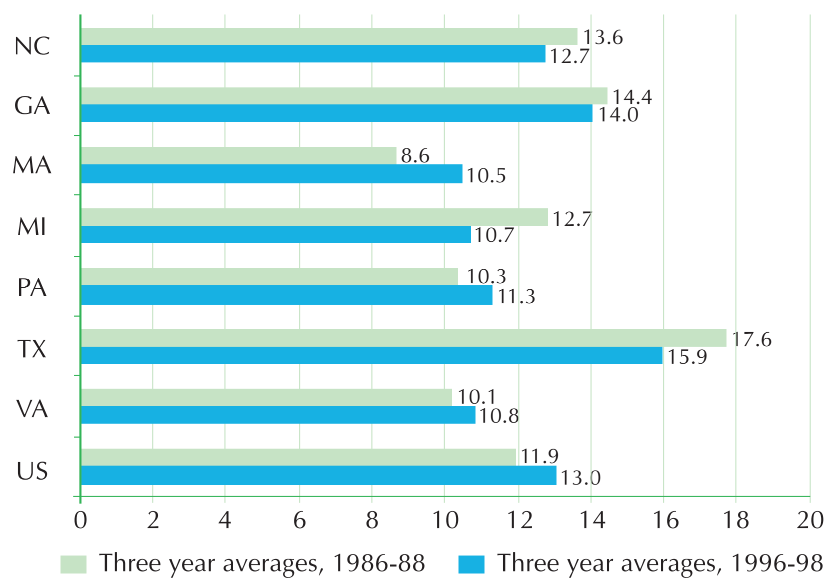
Between the late 1970s and late 1990s, real average incomes in the top fifth of households in North Carolina increased by 39.5 percent, compared to 33.3 percent for the same cohort nationwide. The average incomes of the poorest fifth of households remained essentially unchanged, with real gains of less than 1 percent. In contrast, real average incomes among the poorest fifth fell nationwide (by 6.5 percent) and in all six comparison states. The poorest households fared worst in Texas, Michigan and Georgia, where their real incomes declined by 9.3, 8.1, and 5.7 percent, respectively, over the period.

Poverty in North Carolina Declining

Some 12.7 percent of North Carolinians currently live in poverty according to the federal definition, down from 13.6 percent in the late 1980s. Nationwide, the poverty rate is 13.0 percent. Among comparison states, the latest data indicate that it is highest in Texas (at 15.9 percent) and Georgia (14 percent). Poverty rates are comparatively low in Massachusetts, Pennsylvania, and Virginia, although the incidence of poverty increased in all three of those states over the period.

FIGURE 9

Percent persons in poverty
Three year averages, 1986-88 and 1996-98
Source: Bernstein, McNichol, Mishel and Zahradnik (2000).



Economic Structure Indicators

7. Technology-Intensive Activity

As a group, technology-intensive industries—here distinguished 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 enterprises require access to pools of skilled labor, advanced infrastructure, and quality living conditions for employees. Those are assets that North Carolina and the rest of the U.S. must develop as traditional labor cost-sensitive industries migrate to low-cost locations in Latin America, Southeast Asia, and elsewhere.

Examples of Technology-Intensive Sectors:

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

North Carolina is Less Technology-Intensive

In 1998, more than 7,200 technology-intensive enterprises in the state employed over 433,000 workers and paid out some $16.6 billion in wages and salaries. Eleven and a half percent of private sector workers in the state were employed in technology-intensive businesses in 1997 (the latest year for which data for all comparison states are available), compared to 12.9 percent for the U.S. as a whole and an average 13.8 percent among the comparison states. North Carolina ranks behind five of six comparison states in overall technology-intensity (as measured by employment). In addition, within the technology sector, a greater proportion of North Carolina high tech workers are employed in somewhat technology-intensive businesses than is the case in the U.S. or the group of comparison states.[3]

State's Technology Sector is Growing Fast

At the same time, North Carolina's technology sector is growing fast. Technology jobs in the state grew by nearly 4 percent annually between 1989 and 1997, second only to Georgia among comparison states. The fastest growth occurred among moderately technology-intensive businesses (e.g., plastics, electronics, medical services, instruments). By contrast, very tech-intensive businesses led technology growth in five of six peer states.

Concentration of High Tech in Triangle Increasing

The Triangle continues to garner the lion's share of new technology jobs. In 1989, 27 percent of North Carolina's technology-intensive jobs were located in the Triangle, the highest share of any region. The Triangle gained 42 percent of all new technology jobs created in North Carolina over the subsequent nine years, increasing its share of the state's tech jobs to 31 percent by 1998. While the absolute number of technology-intensive jobs in-

FIGURE 10

Technology-intensive employment

Percent share of all private sector employment, 1989 & 1997

Source: Minnesota IMPLAN Group, Inc. ES-202 files.

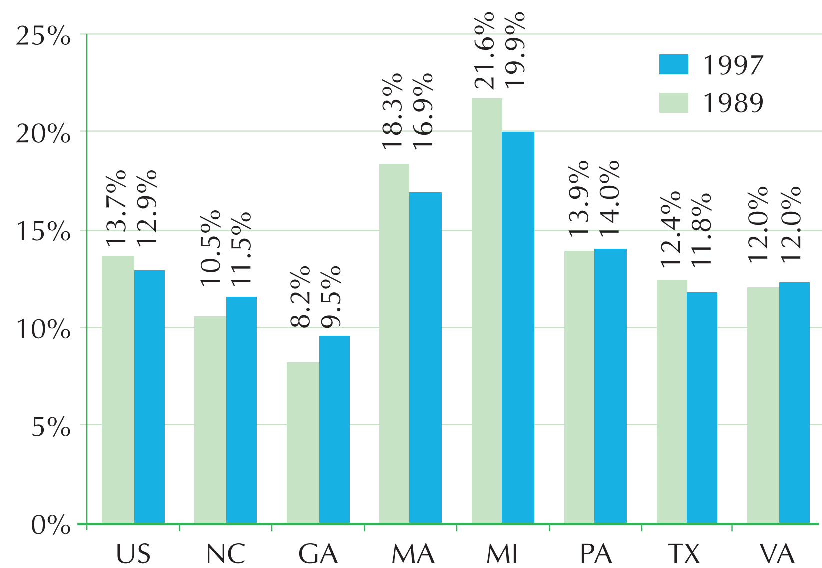


FIGURE 11

Annual percent employment growth, 1989-97

Source: Minnesota IMPLAN Group, Inc. ES-202 files.

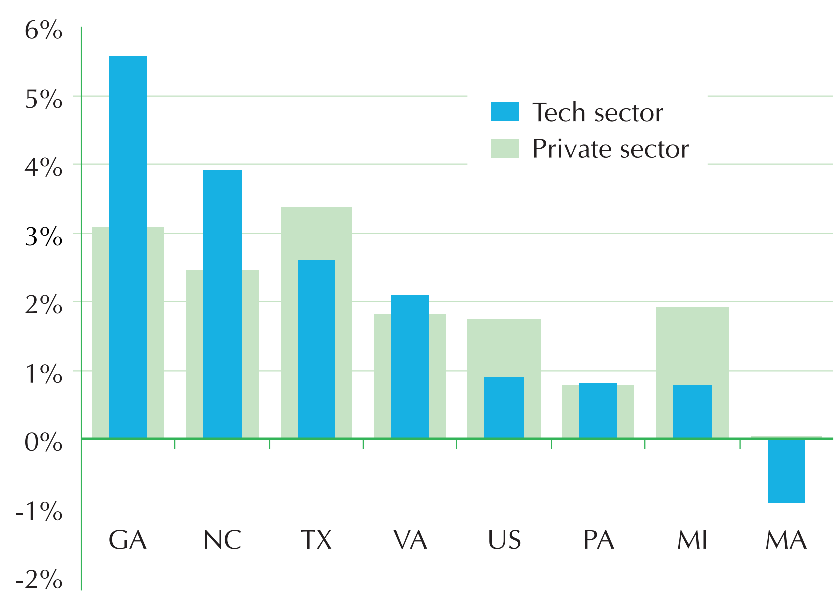


FIGURE 12

Annual percent employment growth, 1989-1997 by technology category

Source: Minnesota IMPLAN Group, Inc. ES-202 files.

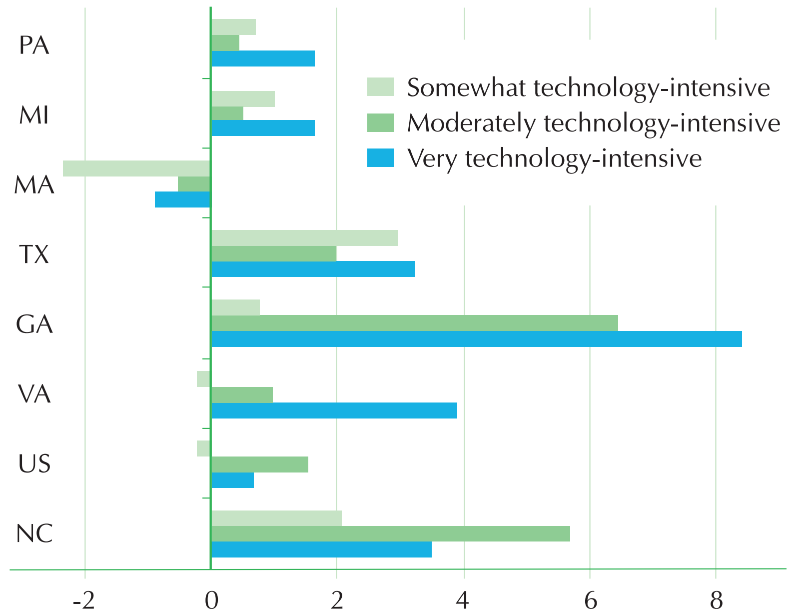
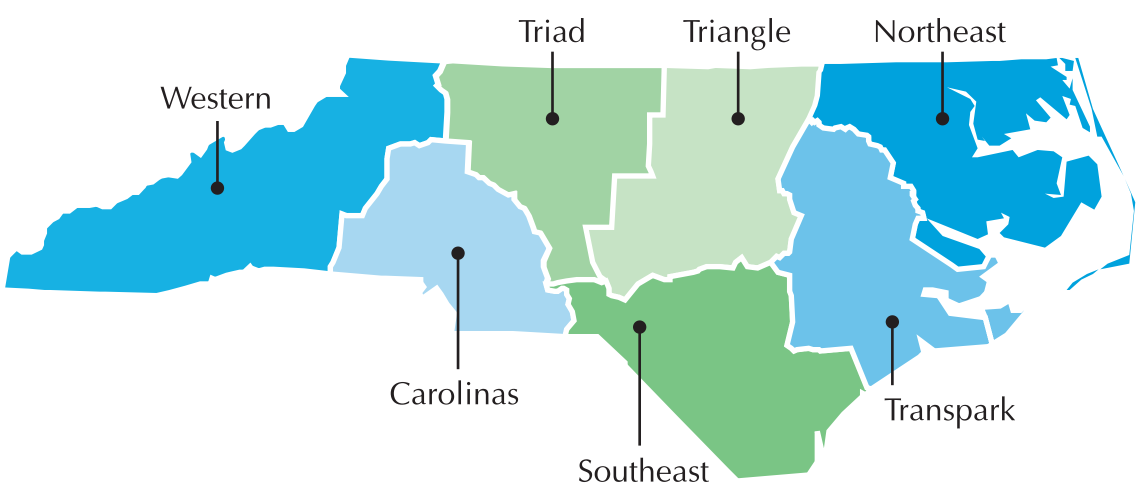


FIGURE 13

Economic Development Partnership Regions



creased in every region over the period, all regions but the Triangle and the Northeast saw their share of statewide technology activity decline. The trend toward concentration of high technology industries and jobs in the Triangle is strongest for very technology-intensive sectors. Over two-thirds of all very tech-intensive jobs added between 1989 and 1998 were created in the Triangle.

Technology Sector Pays Better Wages

In 1997, the average wage in the technology sector overall was $39,918, 151 percent of the private sector average (of $26,509). However, North Carolina technology workers earn about 10 percent less than U.S. technology workers and 13 percent less than the comparison state average. The difference is primarily a function of industry mix: somewhat and moderately tech-intensive jobs account for more technology jobs in North Carolina than in most other comparison states. Those jobs pay lower wages, on average, than very technology-intensive jobs.

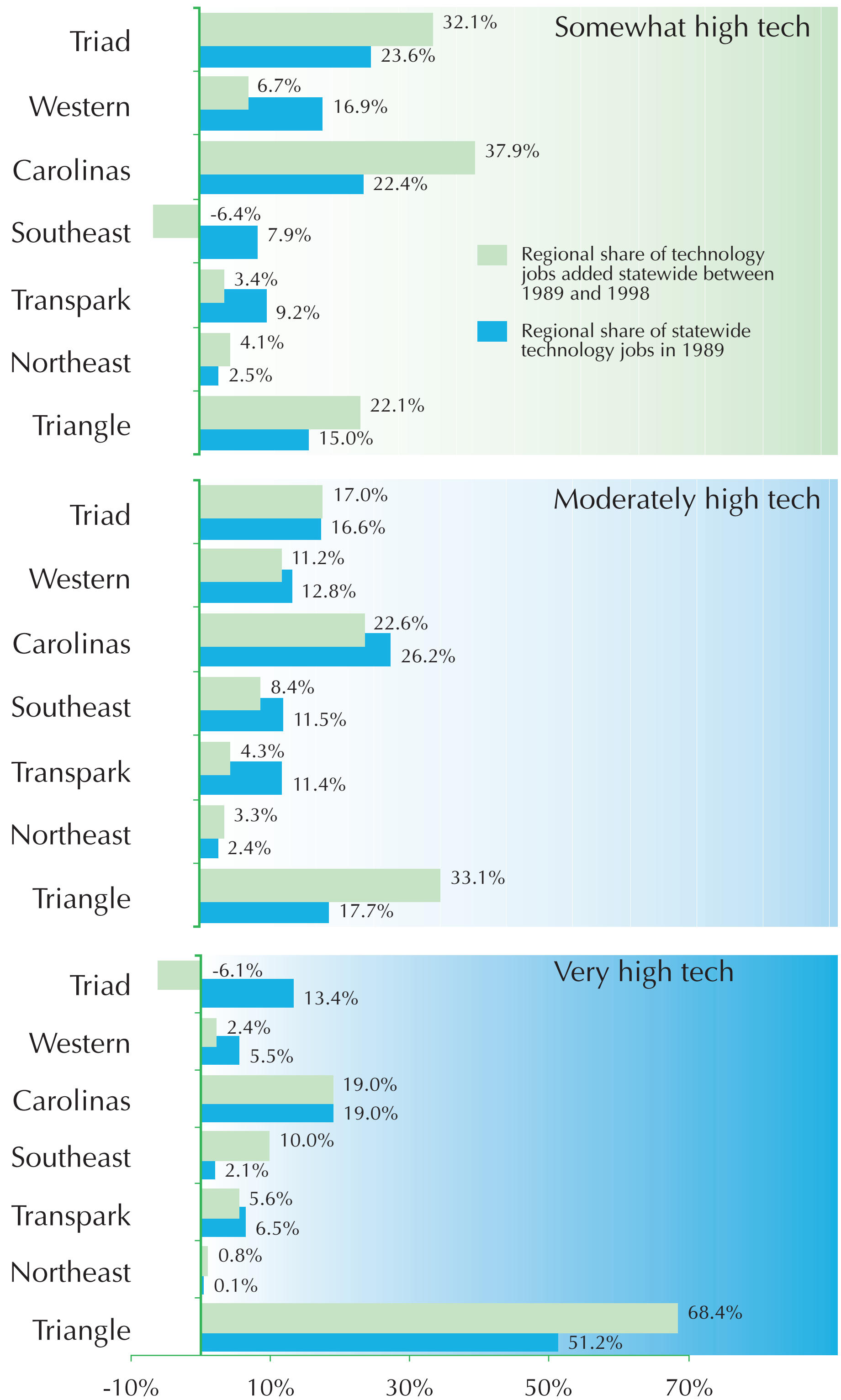
Methodological Note:

While North Carolina employment and wage data are available for 1998, 1997 is the latest year for which we could obtain comparable data for all comparison states. We therefore use 1997 figures whenever we make comparisons to the U.S. or the comparison states. The classification of technology-intensive industries is from the North Carolina Employment Security Commission, adjusted to include technology-related non-manufacturing sectors. The full list of technology industries is provided in the appendix.

FIGURE 14

Distribution of high tech job growth by region, 1989-98

Source: NC Employment Security Commission ES-202 files.



8. Industry Clusters

It is now widely recognized that every 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

Table 1

North Carolina Industry Clusters

All private sectors except agriculture, construction, wholesale, retail, personal services, and education.

Clusters	Employment 1998	Employment Annual % Change 1989-98	Employment Location Quotient 1998	Average Wage
Existing industry clusters				
Apparel	207,698	-3.3	4.46	25,057
Fabricated textiles	128,893	-3.8	2.70	23,538
Wood products (incl. furniture)	77,549	0.0	2.15	26,445
Pharmaceuticals (incl. some biotech)	17,783	3.0	1.82	48,538
Tobacco products	16,151	-3.8	10.84	47,151
Stone and clay products	13,838	5.8	1.26	40,161
Emerging industry clusters				
Banking and advertising	95,259	5.3	0.79	40,978
Printing and publishing	279,849	4.9	0.87	35,621
Information technology and instruments	105,796	4.4	0.74	47,378
Chemicals and plastics	104,367	3.9	1.04	36,070
Transportation, shipping and logistics	118,989	2.6	1.06	32,918

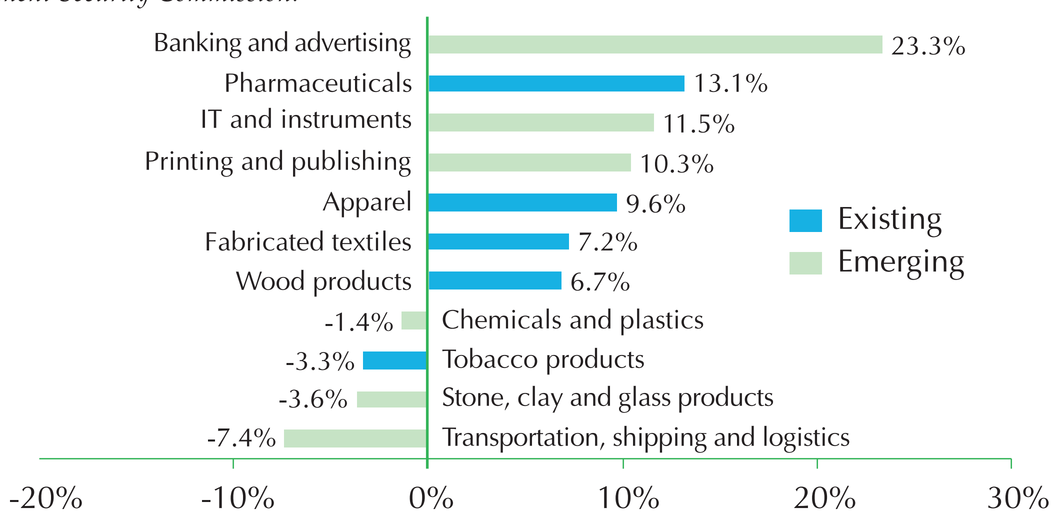
Source: NC Employment Security Commission and Minnesota IMPLAN Group, Inc. (ES-202 files).

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 *vis-à-vis* 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.[4]

FIGURE 15

Real growth in average wages, 1989-98
Existing and emerging North Carolina industry clusters
Source: NC Employment Security Commission.



Few of North Carolina's Existing Clusters Generating New Jobs

Based on three criteria—absolute size, relative size, and depth (a diversity of underlying sectors)—North Carolina's principal industry clusters include tobacco products, apparel, pharmaceuticals, stone and clay products, fabricated textile goods, and wood products (including furniture). With the exception of stone and clay products and pharmaceuticals, the existing clusters are all in decline or are failing to generate significant new employment opportunities. Employment in the both the tobacco and fabricated textiles clusters declined by 3.8 percent annually between 1989 and 1998. Apparel cluster jobs fell by 3.3 percent each year over the period while there was little net change in employment in wood products.

Output has remained strong in some of the clusters (particularly textiles and apparel), even as workers have been laid off. Automation is displacing labor in many sectors, producing a pool of workers that require substantial re-training before they can enter higher skilled positions in growing industries. The size and depth of the textile, apparel, and wood products clusters will probably help many North Carolina businesses remain viable even in the face of stiff competition from overseas competitors, but those clusters will not be a significant source of new jobs in the future.

Emerging Clusters Small in Relative Terms, But Growing

Based on employment and wage trends over the 1989–1998 period, a number of clusters appear to be emerging in North Carolina. They include construction materials, printing and publishing, in-

Key Features of NC Industry Clusters:

- They are based on a detailed analysis of inter-industry trade and labor usage patterns. See methodological note below.
- Every cluster includes end-market and supplier industries (e.g., fabricated textiles includes conventional textiles industries, as well as some apparel, leather goods, toys, and surgical appliances and supplies).
- 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.

formation technology and instruments, chemicals and plastics, and banking and advertising. In *relative* terms (i.e., compared to their size in the U.S. economy as a whole), the emerging clusters remain small. For example, although the printing and publishing cluster employs close to 280,000 people in North Carolina, its share of total private sector employment (7.6 percent) is slightly lower than the comparable share for the U.S. as a whole (8.7 percent).[5] Yet employment in the cluster expanded by nearly 5 percent annually between 1989 and 1998, compared to annual growth at the national level of 2.1 percent. All of the emerging clusters except transportation, shipping and logistics are significantly out-pacing U.S. growth trends. Transportation, shipping and logistics is included as an emerging clus-

FIGURE 16

Core U.S. Technology Clusters in North Carolina
Size, concentration (location quotient), and growth

Source: NC Employment Security Commission and Minnesota IMPLAN Group, Inc. (ES-202 files)

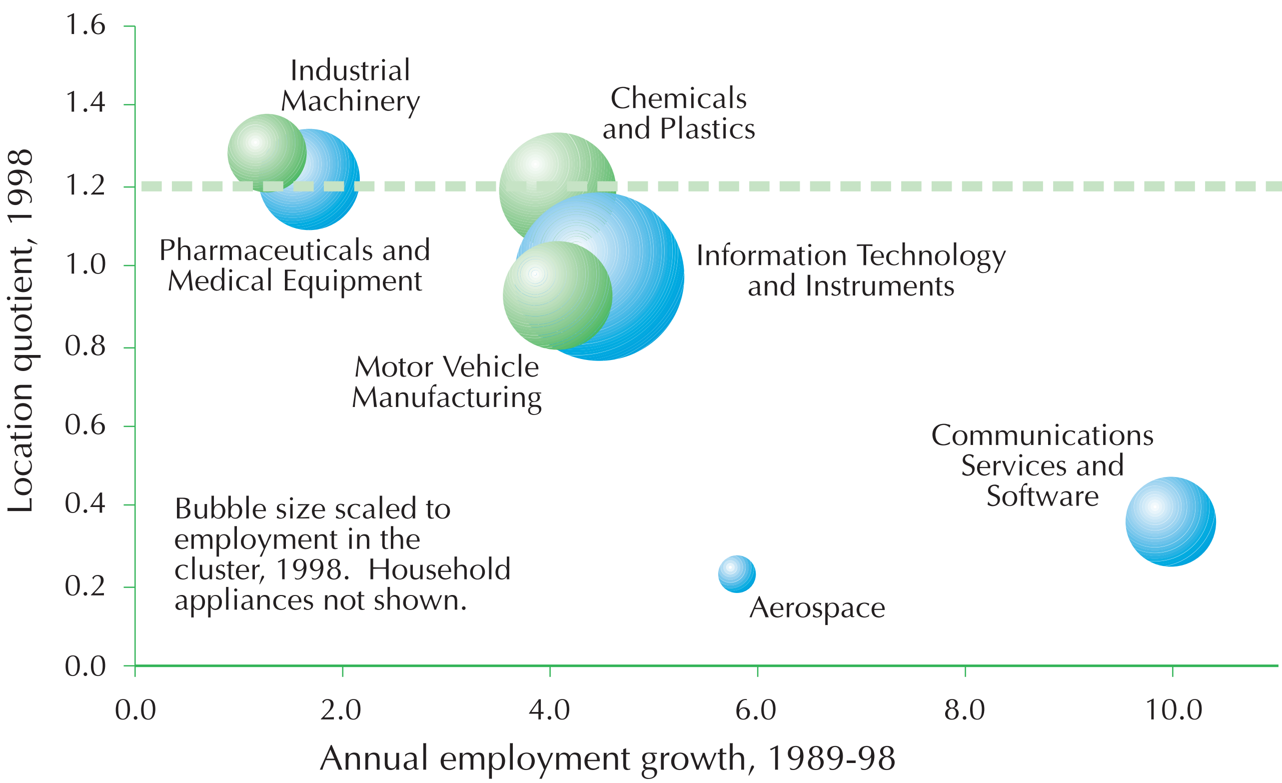
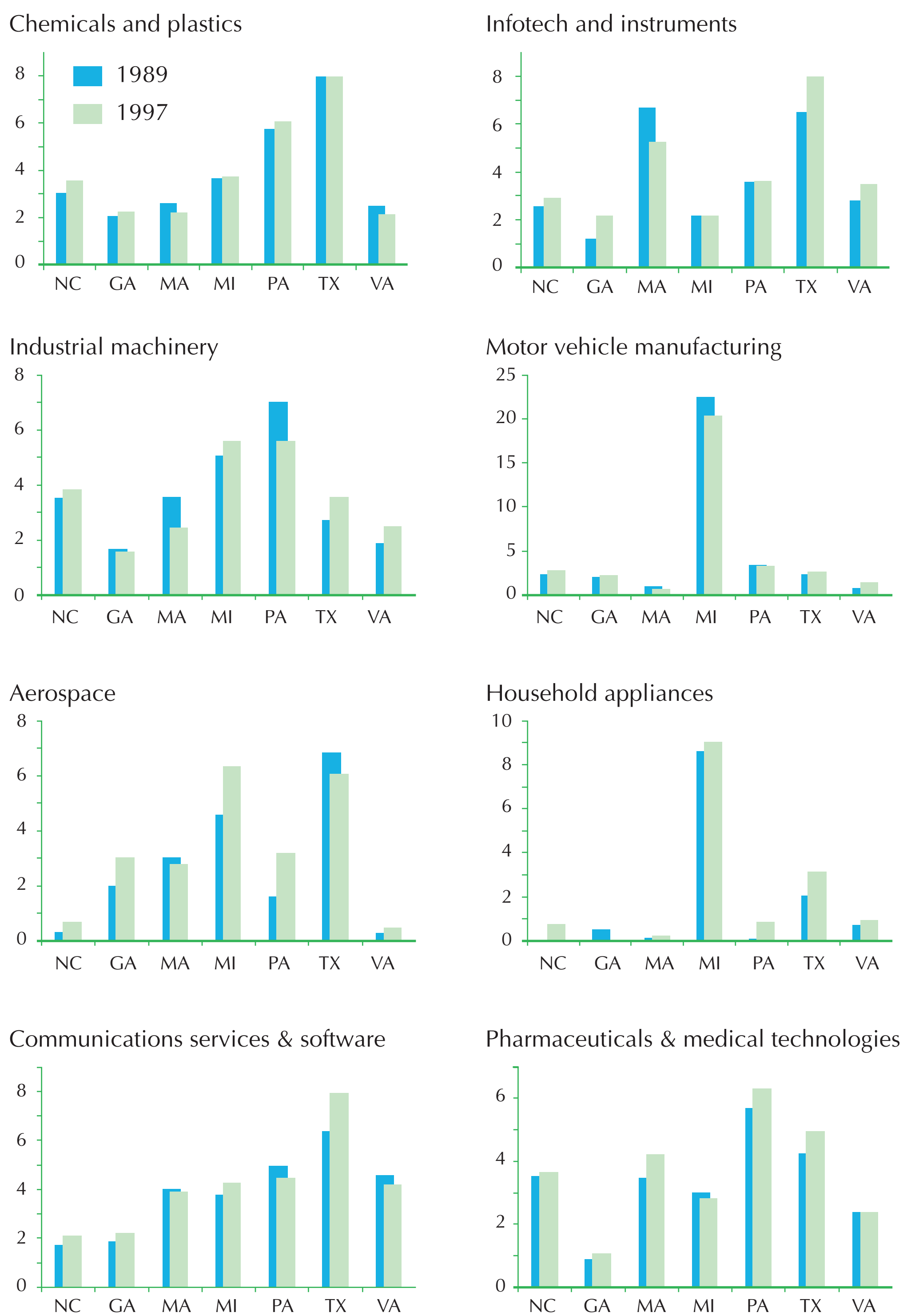


FIGURE 17

Core U.S. technology clusters
Percent of U.S. cluster employment in each state, 1989 & 1997
Source: Minnesota IMPLAN Group, Inc. ES-202 files.



ter because of its large relative size, its solid growth, and the fact that the location of the Federal Express hub in the Triad is likely to give the cluster a significant boost.[6]

The five emerging clusters pay an average wage of roughly $38,600, compared to an average $25,013 for apparel, fabricated textiles, and wood products (in 1998). However, they also demand better trained and higher skilled workers, placing increased importance on the quality and extensiveness of the secondary and post-secondary education and training systems in the state.

Faster Pay Growth in Higher Technology and Knowledge-Intensive Clusters

The apparel, fabricated textiles, and wood products clusters all posted real increases in average wages between 1989 and 1998. However, the fastest wage gains came in banking and advertising, pharmaceuticals, information technology and instruments, and printing and publishing. As those clusters expand relative to traditional, existing clusters, the real wage gap between North Carolina and the U.S. average will continue to narrow.

Some Core High Technology Clusters Also Emerging– Growth of Communications Services and Software Nearly Four Times U.S. Rate

To focus only on high technology industries, we analyzed relationships among strictly high tech sectors to identify eight core technology clusters in the U.S. economy (Table 2). Examining the relative presence of the clusters in North Carolina provides some sense of major technology strengths in the state. The U.S. technology clusters can also be used to make comparisons across the six benchmark states. Note that some of the sub-industries within each technology cluster are also members of the existing and emerging clusters in Table 1. For example, information technology and instruments in Table 1 includes both high tech sectors (such as software, electronics) as well as lower tech industries (computer rental and leasing).

The core technology clusters with the strongest relative presence in North Carolina include chemicals and plastics, industrial machinery, and pharmaceuticals and medical technologies. But information technology and instruments (led by activity in the Research Triangle) and motor vehicle manufacturing (led by intermediate supplier sectors and after-market parts industries in the Western and Carolinas regions) are also beginning to attain critical mass. Aerospace and household appliances each have a very minor presence in the state. The state's strongest relative gains between 1989 and 1997 came in chemi-

Table 2

U.S. Technology Clusters

Based on technology-intensive sectors only; presence and growth in North Carolina.

	Employment			
Clusters	1998	Annual % Change 1989-98	Location Quotient 1998	Average Wage
Information technology and instruments	104,420	4.5	0.86	47,363
Communications services and software	63,660	10.0	0.66	48,241
Chemicals and plastics	53,923	4.1	1.12	38,106
Motor vehicle manufacturing	44,277	4.1	0.82	35,169
Pharmaceuticals and medical technologies	34,629	1.7	1.01	41,915
Industrial machinery	21,464	1.3	1.06	35,870
Aerospace	5,545	5.8	0.19	41,168
Household appliances	1,139	n.a.	0.36	23,492

Source: NC Employment Security Commission and Minnesota IMPLAN Group, Inc. (ES-202 files).

Methodological Note:

The most common approach to industry cluster analysis involves two steps. First, measures of size, concentration, and growth are used to identify large and/or high performing sectors. Second, those sectors are grouped into clusters based on judgment or secondary information about their interdependence. The result is a set of key industry clusters *as they exist at the time of the study*.

In many states, the first approach reveals little about important technology-intensive industries (e.g., information technology, health sciences, etc.) simply because such sectors are not as large as other industries. In a restructuring economy such as North Carolina's—one in which traditional industries remain dominant and knowledge-intensive sectors are only beginning to attain critical mass—a *benchmarking* approach to industry cluster analysis is more useful.

The benchmarking method begins by identifying major industry clusters—groups of interdependent and related sectors—for the U.S. economy as a whole using detailed data on industrial interdependence. Then, the distribution, composition, and performance of such clusters are examined in North Carolina. While the usual analytical approach focuses mainly on what a state or region *does have*, the benchmarking method identifies what is emerging and what an economy *could have*, perhaps with properly focused technology policy. It is well-known that tobacco, textiles, apparel, and furniture are key clusters in North Carolina. The more interesting issue is whether knowledge-based clusters, such as information technology, health sciences and medical devices, pharmaceuticals, financial services, and so forth, will emerge as the employment base of the future.

The benchmark clusters used here are based on statistical analysis of two sets of data: the *Benchmark Input-Output Accounts of the United States* and the *U.S. Staffing Patterns Matrix*. Input-output data provide a useful characterization of trading patterns and general technological similarities between all U.S. industries, but with a particular emphasis on manufacturing sectors. In many non-manufacturing sectors, human capital is the principal input. For such industries, we used staffing patterns information to group sectors according to shared occupational labor requirements. We then used other sources of industry information and judgment to reconcile the results derived from the two data sources. We excluded from the analysis those sectors that are largely local-serving, including personal services, construction (though not construction equipment), retail, wholesale, government, and education. Farming is also excluded, primarily because of lack of appropriate data.

The core technology clusters (eight in total, based on separate analysis only of technology-intensive industries) span some of the base clusters (twenty-eight in total, which include all industries, high and low technology). Note that the clusters are not mutually exclusive—since they are based on interdependence between sectors, some industries fall into multiple clusters. The full methodology is outlined in *High Tech Clusters in North Carolina*. The benchmarking approach to industry cluster analysis is described more generally in "National industry cluster templates: A framework for applied regional cluster analysis," by E. J. Feser and E. M. Bergman, *Regional Studies* 34 (1), 2000, pp. 1-20.

cals and plastics, while it fell from third to fourth among comparison states (behind Pennsylvania, Texas, and Massachusetts) in pharmaceuticals and medical technologies employment.

The communications services and software cluster is growing at an exceptionally high rate. Employment in the cluster expanded by 10 percent annually between 1989 and 1998, compared to a national annual growth rate of 2.6 percent. The cluster has the second largest presence in the state of all technology clusters, although it is small in relative terms (accounting for 1.7 percent of private sector employment compared to 4.9 percent at the national level). Among comparison states, communications services and software is also expanding rapidly in Texas, Michigan, and Georgia (each of those states' share of U.S. employment in the cluster is growing).

9. International Exports

International exports are an important indicator of the competitiveness of North Carolina businesses. Exporting companies must frequently adapt products in unique ways for foreign consumers—negotiate trade restrictions and certification requirements, work with foreign suppliers, and manage far-flung distribution channels—all of which imply a high degree of flexibility and determination that can translate to greater competitiveness in home markets.

North Carolina Exports Growing Strongly

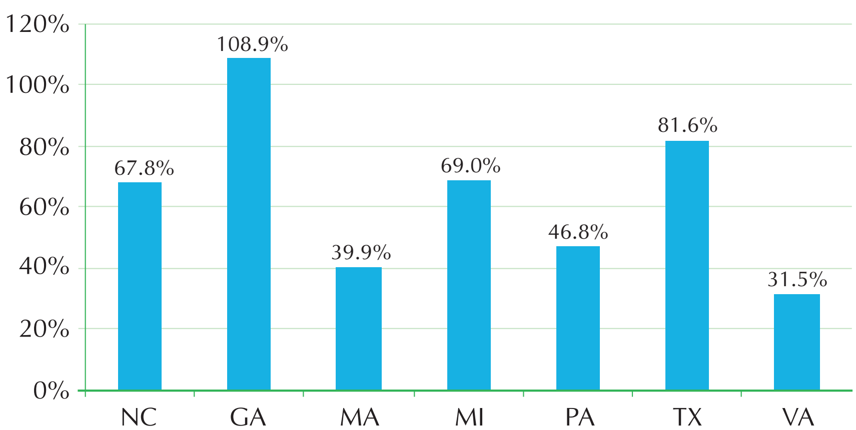
In 1999, North Carolina business exports totaled $13.6 billion; $12.4 billion (or 91 percent) of which were of manufactured commodities. North Carolina exports constituted 2.0 percent of the U.S. total in 1999, up very slightly from 1.9 percent in 1997. Between 1993 and 1999, the volume of the state's exports expanded by 68 percent, ranking it fourth behind Georgia, Texas, and Michigan among the comparison states.

Economy's Export Intensity Modest but Increasing

Over the 1990s, exports have grown in North Carolina by about 11 percent annually, while growth in gross state product has averaged 3 percent. Thus the state's export intensity, or ratio of exports to gross state product, has increased. At 6 percent in 1997, North Carolina's export intensity ranked 25th among the 50 states and District of Columbia. U.S. export intensity is 7.5 percent. Leading comparison states are Michigan (13.9 percent, 4th nationally), Texas (9.4

FIGURE 18

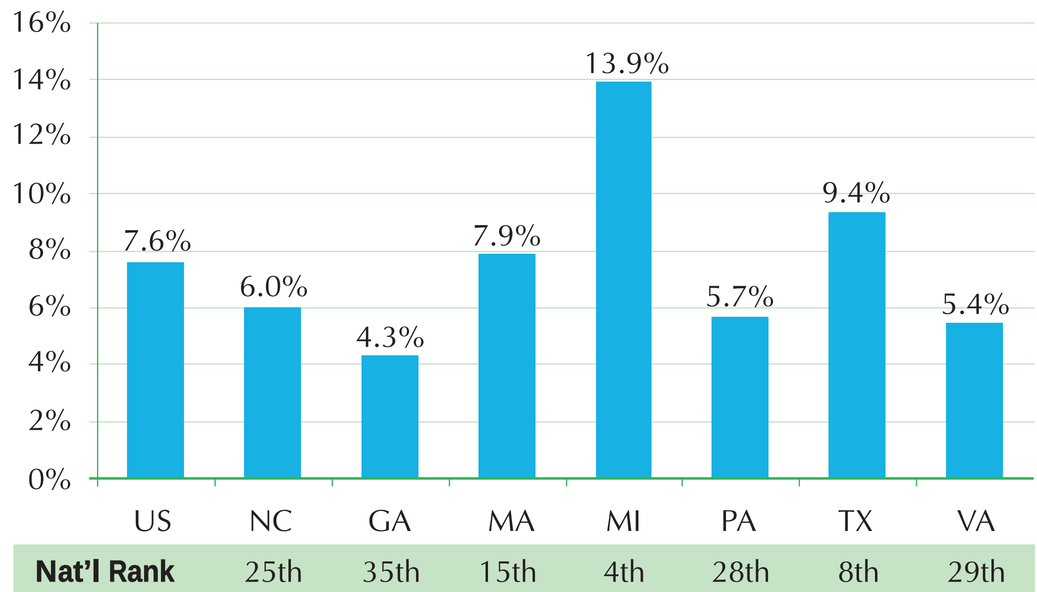
Growth in international exports
Percent change, value of exported goods, 1993-1999
Source: Bureau of the Census, Foreign Trade Division.



percent, 8th nationally), and Massachusetts (7.9 percent, 15th nationally).

FIGURE 19

Export intensity, 1997
Ratio of exports to gross state product
Sources: Bureau of the Census, Foreign Trade Division, and Bureau of Economic Analysis.



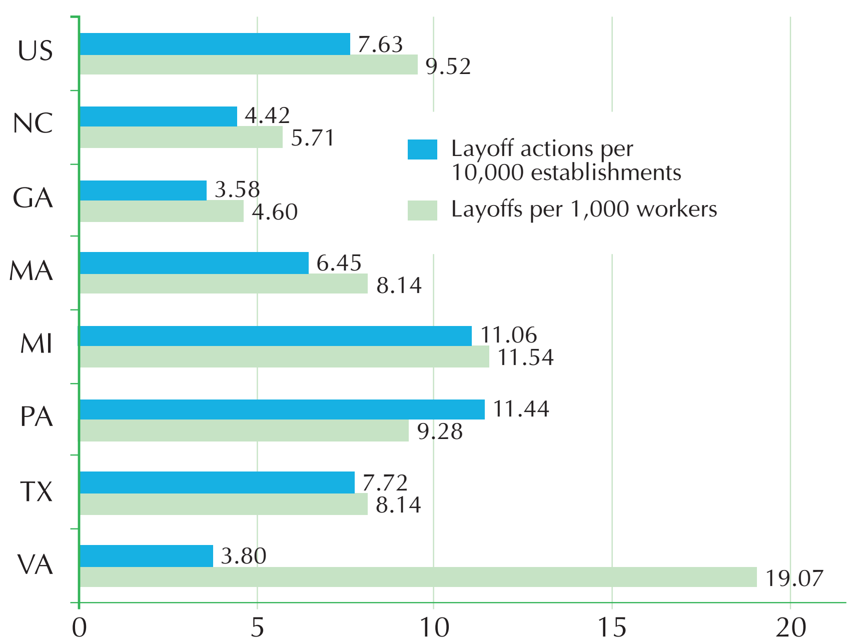
10. Industrial Transition

With increases in foreign competition and trade liberalization, announcements of plant closings—sometimes due to failure but often due to relocations to low-wage production sites overseas—have been commonplace during the 1990s. 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, considerable restructuring is on-going in North Carolina. North Carolina also industrialized later than states in the Northeast and Midwest, and thus still faces restructuring that has already taken place in those regions.

Two measures of industrial restructuring are mass layoff actions (major layoff announcements and total workforce displacements) that the ratio of wages of major growth sectors to 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.

FIGURE 20

Mass layoff actions, 1997-99
Annual figures averaged for three-year period
Sources: U.S. Bureau of Labor Statistics.



Major Layoffs Comparatively Limited in North Carolina

Federal statistics indicate that North Carolina averaged 88 layoff actions annually over the period 1997 to 1999; an average 21,000 lost their jobs each year in such actions. In relative terms, mass layoff activity in the state is relatively modest. The state is averaging of 4.4 layoff actions per 10,000 establishments, compared to 7.6 layoffs per 10,000 establishments nationwide. Among the comparison states, North Carolina ranks third behind Georgia and Virginia in the fewest layoff actions for the total number of establishments. The state ranks second behind Georgia in separations (or total layoffs) per 1,000 workers. Layoff activity—in terms of job losses—is much more severe in relative terms in Virginia and Michigan.

New Jobs Paying Slightly Less on Average

The industries accounting for most net job gains during the 1990s in North Carolina pay a slightly lower wage, on average, than sectors accounting for most net job declines. Yet the state still out-performs the national average on the measure. Nationwide, industries accounting for most net job gains between 1989 and 1997 paid an average wage roughly 90 percent of the average wage for industries accounting for most net declines. That is a reflection of the contraction of major industries that have historically offered high wages (in addition to relative job secu-

Methodological Note:

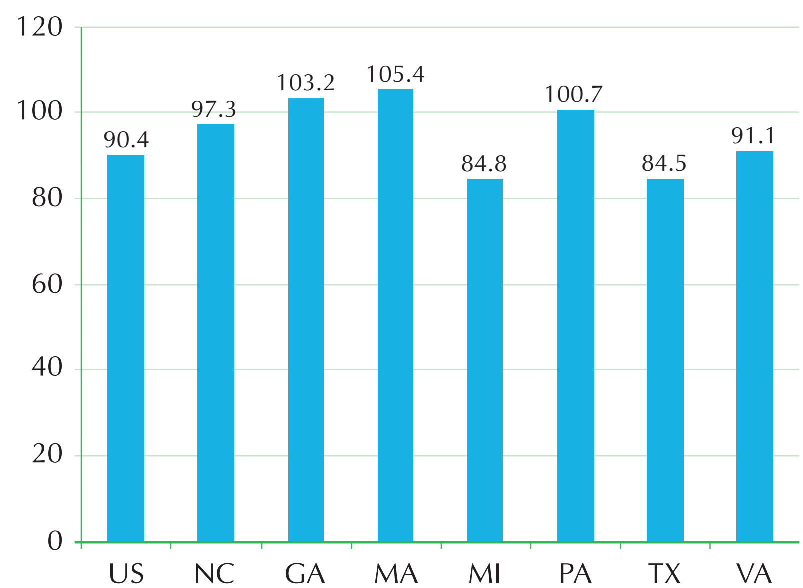
The mass layoff indicators reported here are based on quarterly data from the U.S. Bureau of Labor Statistics, which report actions for establishments that have at least 50 initial claims filed against them during a 5-week period and where the employer indicates that 50 or more people were separated 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 counted.

We developed the growth/decline wage index as follows. For the given state, we identified the sectors that added the most net new jobs between 1989 to 1997 period (sorting sectors in descending order according to job creation and using the first 80 percent of net new jobs as the cut-off). We also identified the sectors that eliminated the most net jobs over the period (also using an 80 percent cutoff). We then took the mean of the 1997 top growth sectors' average wage and the mean of the 1997 major declining sectors' average wage. The ratio of the two means is the growth/decline index. A ratio over one indicates that jobs in the state's principal growth industries pay a higher wage than the jobs in its principal declining industries.

rity and lengthy job tenure), and the growth of many lower-wage non-manufacturing industries. In North Carolina, growing industry wages are 97 percent of wages for declining industries; the industrial transition underway in the state involves a greater shift toward higher wage sectors than is occurring nationwide. The state ranks fourth among comparison states on the measure, ahead of Texas, Michigan, and Virginia. Put differently, the likelihood that a worker displaced from her job will find work at a wage at or exceeding her previous wage is somewhat greater in North Carolina than in Texas, Michigan, and Virginia.

FIGURE 21

Growth/decline average wage index, 1997
Ratio of average wage for major growth sectors to average wage for major declining sectors
Source: Minnesota IMPLAN Group, Inc, ES-202 data.



Innovation Outcome Indicators

11. Patents

Patents measure attempts by inventors to fully and exclusively appropriate any returns derived from their innovations, at least for a limited period. As such, they are a broad indicator of innovative activity. Patents are sometimes used to identify innovations with practical application. However, there are considerable differences in the propensity of different industries to patent new ideas, and thus differences in patenting rates across states can be partly explained by differences in industry mix. They must therefore be interpreted cautiously.

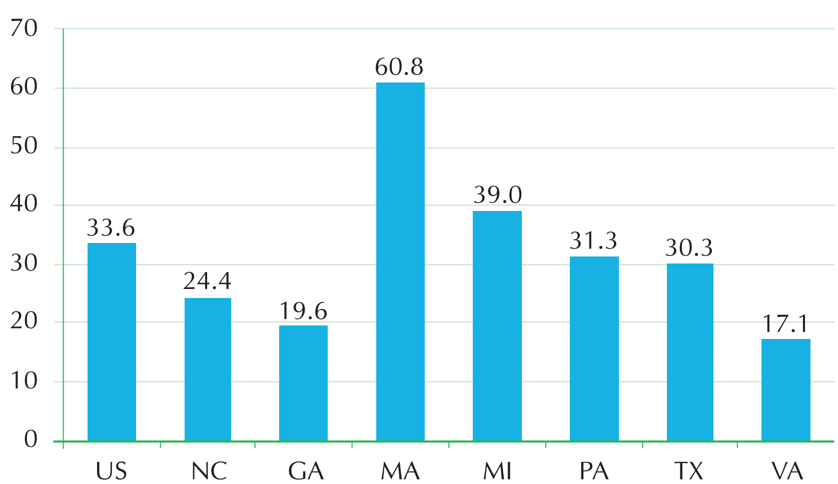
Patent Grants Lag U.S. Average but Growth is Strong

North Carolina lags the nation and all comparison states save Georgia and Virginia in the number of patents awarded per capita. In 1998, 24.4 patents were awarded in North Carolina for every 100,000 people, compared to the national rate of 33.6

FIGURE 22

Patents per 100,000 population, 1998

Source: U.S. Patent and Trademark Office and Bureau of the Census.

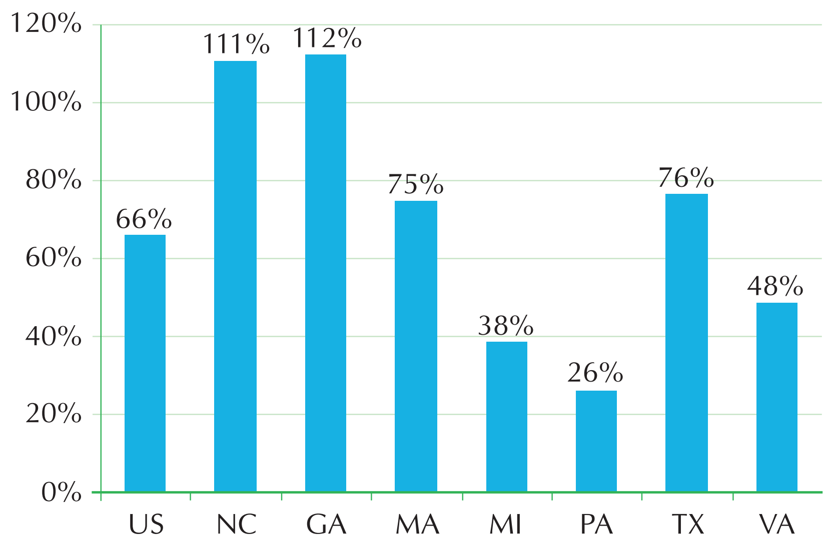


patents per 100,000. At the same time, the state's patent growth has been exceptionally strong during the 1990s. Between 1989 and 1998, the number of patents issued to North Carolina inventors increased by 111 percent, compared to a nationwide increase of 66 percent. Among the comparison states, only Georgia matched North Carolina's patent growth.

FIGURE 23

Patent growth, 1989-98

Source: U.S. Patent and Trademark Office.



12. Technology Transfer Activity

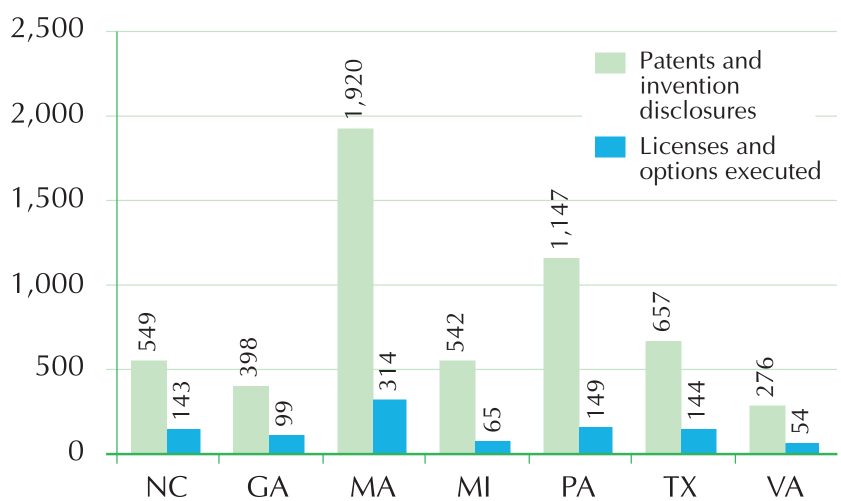
Technology transfer is the process whereby intellectual property derived from research at major universities and research institutions is licensed and conveyed to industry. There are several measures of the ability of research institutions to connect with business in bringing the results of academic research to market. Invention disclosures and patent applications indicate the number of inventions and intellectual properties created through academic or institutional research. Innovations of commercial interest and value are transferred to industry through licensing arrangements. The number of licenses and options executed and incomes generated from licensing are indicators of the value of those intellectual properties.

Technology transfer activity—particularly invention disclosures and licensing actions, rather than licensing income—from major research institutions and universities can vary significantly from year to year. Subsequent issues of *Tracking Innovation* will develop a time series of technology transfer in the state. The reader should bear in mind that current year figures (1997 in the present case) present only a partial picture of tech transfer activity in the various states.

FIGURE 24

Technology transfer activities by major research institutions, 1997

Source: Association of University Technology Managers, Inc.



Tech Transfer Activity Robust

North Carolina's major universities generated 549 invention disclosures and patent applications in 1997. That exceeded similar technology transfer activity in Virginia, Georgia, and Michigan, although both Massachusetts and Pennsylvania more than doubled North Carolina's volume. With a total of 143 in 1997, North Carolina lagged only Massachusetts, Pennsylvania, and Texas in licenses and options executed.

In absolute terms, gross license income earned by North Carolina universities remains modest. North Carolina research universities generated a total of $6.4 million in licensing income in 1997, compared to Massachusetts' $49.9 million, Michigan's $20.4 million, Pennsylvania's $19.6 million, Texas' $17.7 million, and Georgia's $8.2 million. Only Virginia produced less with $4.8 million. North Carolina's ratio of license income to gross state product is 38 percent of the national average, and is below that of Massachusetts, Georgia, Michigan, and Pennsylvania.

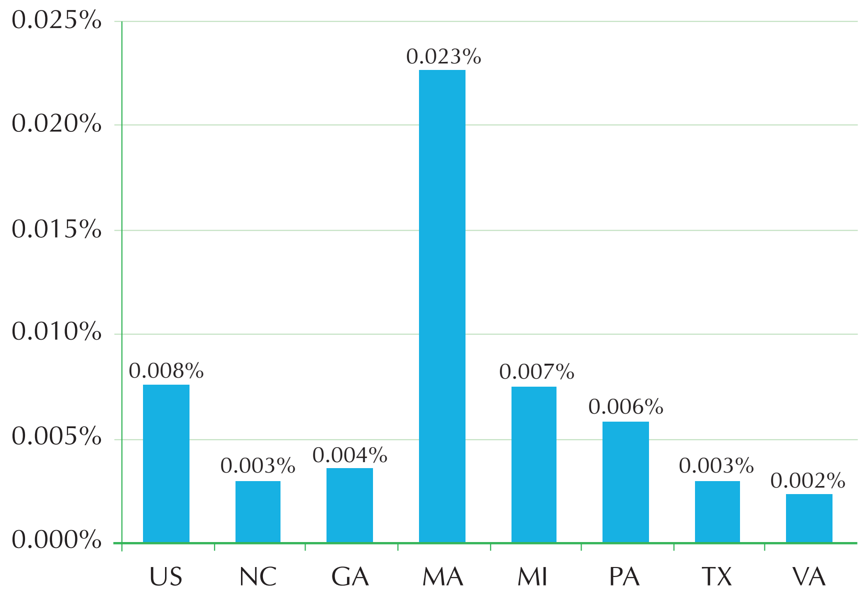
Note:

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 and Duke University submitted patent and license disclosure data for fiscal year 1997. The most active states in the comparison group, Massachusetts and Pennsylvania, are those with the most institutions conducting transferable research.

FIGURE 25

Ratio of license income to gross state product, 1997 (License Income received by universities)

Source: Association of University Technology Managers, Inc. and Bureau of Economic Analysis.



13. Venture Capital

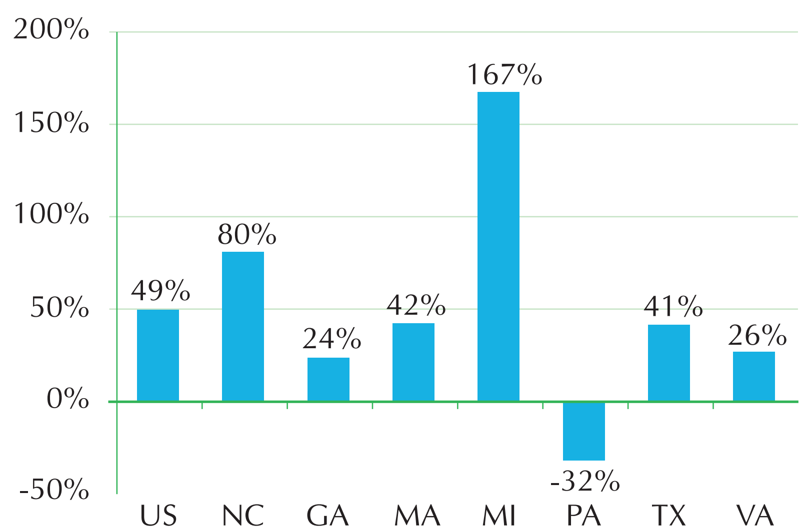
Venture capital is a critical source of funding for technology-based start-ups and expansions. Without venture capital, many innovative companies in North Carolina will not realize their growth potential. Research indicates that venture capital is highly concentrated in a few regions in the U.S. and that entrepreneurs with venture capital needs often have little choice but to locate in those areas. That raises the prospect that North Carolina businesses, universities and research institutions will spin-off technology companies that must leave the state in order to obtain the financing they require to grow. To the extent that that occurs, the state will not fully capture the gains, in terms of downstream jobs and income, of research and innovation.

Upward Trend in State's Share of U.S. Venture Capital Funding

In 1999, North Carolina businesses garnered $239.8 million in venture capital funding. Over the previous three-year period, venture capital in the state increased by 80 percent, well over the U.S. rate of growth of 49 percent, and faster than in all comparison states except Michigan. The latter saw venture capital funding grow by 167 percent over the period, a rate exaggerated by its relatively small volume of venture capital in 1996 ($11.4 million). The rapid pace of growth in North Carolina is leading to a modest increase in the state's share of the national venture capital investment pool, from 1.7 percent in 1996 to 2.0 percent in 1999. Consistent with

FIGURE 26

Venture capital growth, 1996-99
Source: PriceWaterhouseCoopers



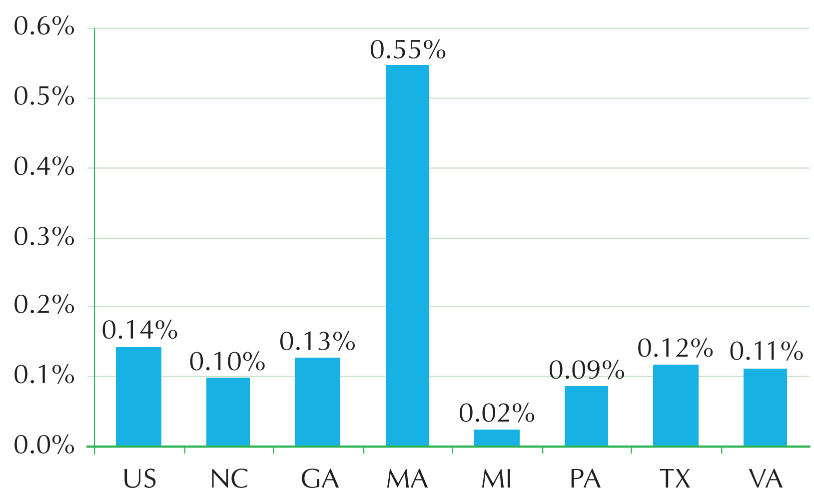
national trends, most venture capital investments in North Carolina enterprises are being made in software and information technology companies (43 percent) and health sciences companies (35 percent).

Overall, and in comparison to several peer states, venture capital activity is a relatively small part of the North Carolina economy. In 1997, the ratio of venture capital investments to gross state product stood at 0.10 percent, below the national average of 0.14 percent and below rates in Massachusetts (0.55 percent), Georgia (0.13 percent), Virginia (0.11 percent), and Texas (0.12 percent).

FIGURE 27

Ratio of venture capital to gross state product, 1997

Source: PriceWaterhouseCoopers and Bureau of Economic Analysis.



14. Initial Public Offerings

An initial public offering (IPO) is the first time a firm offers general stock to the public. Most IPOs are for small to medium sized businesses raising capital essential for growth. As an indicator, IPOs signify the entry of young companies with proven business concepts and management to global capital markets. They also identify firms that investors believe have high potential for future profits.

IPO Activity in North Carolina Weak

Between 1996 and mid-year 1999, 32 North Carolina firms were approved by the Securities and Exchange Commission for initial public offerings. That ties North Carolina with Michigan for last among the seven comparison states. North Carolina also ranks sixth out of the seven states in IPOs per capita. Its 7.2 IPOs per million state residents is 58 percent of the national average and 49 percent of the rate in neighboring Georgia. Almost all of North Carolinas' IPOs over the period were in the Research Triangle area; eight (25 percent) were in high technology sectors, a share comparable to most peer states except Massachusetts.

FIGURE 28

Initial Public Offerings Filed
January 1996 to September 1999
Source: Hoover's Online.

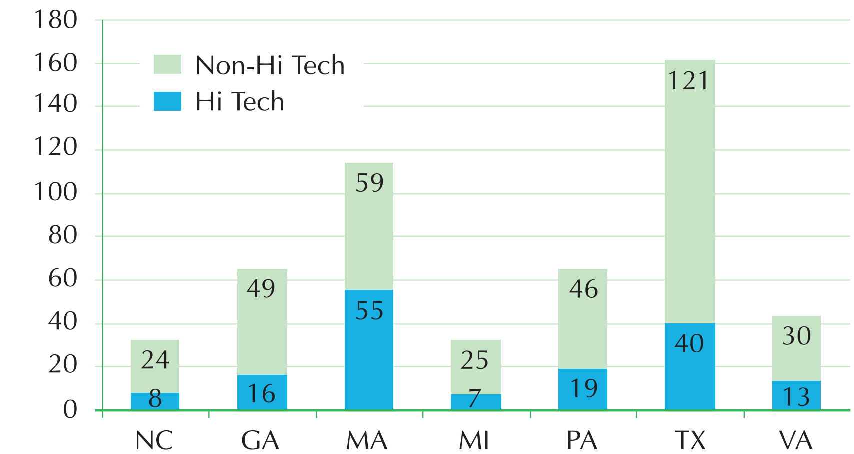
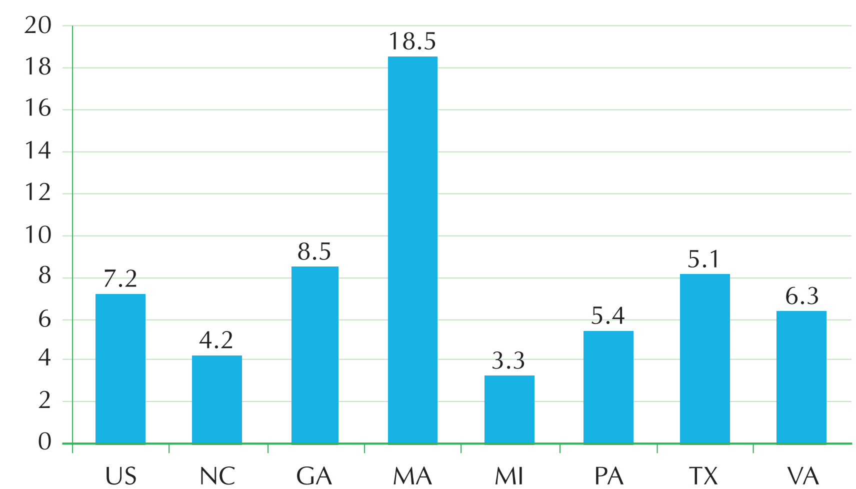


FIGURE 29

Initial Public Offerings Filed per Million Population
January 1996 to September 1999
Source: Hoover's Online and Bureau of the Census.



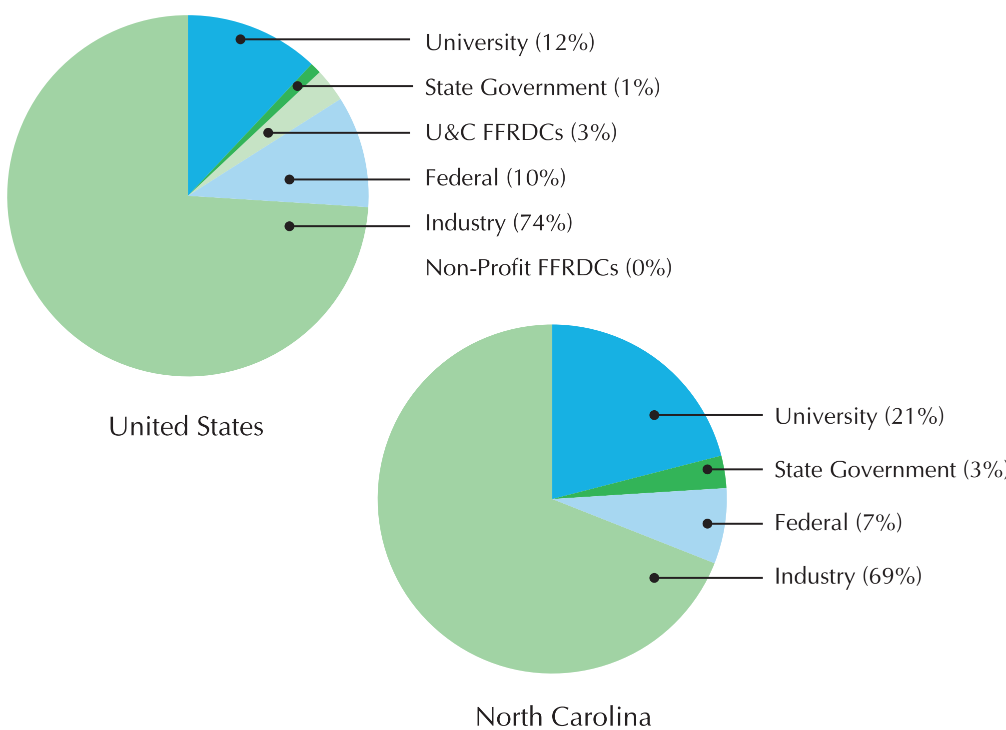
Innovation Input Indicators

15. Research and Development

Research and development (R&D) is the driving force behind innovation and sustained economic growth. Companies performing R&D create more new product innovations, thus expanding markets and sales and ultimately jobs. Process innovations improve productivity, sometimes resulting in layoffs in the short run as workers with outdated skills become redundant. In the long run, productivity improvements are critical to sustained economic growth. There is also increasing evidence that firms located near the centers of R&D benefit from knowledge and expertise shared between businesses, universities, and government and non-profit laboratories. Such firms are also often the first to adopt new production technologies.

FIGURE 30

Distribution of R&D by performer, 1995
Source: National Science Foundation.



Most R&D is performed by private industry and universities. In 1995, industry conducted 74 percent of total R&D in the U.S. Universities conducted 12 percent of R&D in the same year, most of it funded by the federal government. The federal government also carries on its own R&D within its system of labs. Most federal labs conduct research related to national defense and space exploration and are concentrated in relatively few states.

Industry R&D is Comparatively Low

In North Carolina, 69 percent of total R&D is performed by private industry (compared to 74 percent nationwide). Industry R&D intensity—or the ratio of industrial R&D to gross state product—is roughly 1 percent in North Carolina, compared to almost 2 percent for the U.S. as a whole. Both Massachusetts' and Michigan's industrial R&D intensity dwarf all other states in the comparison group. Among the peer states, North Carolina out-performs only Virginia and Georgia on this measure.

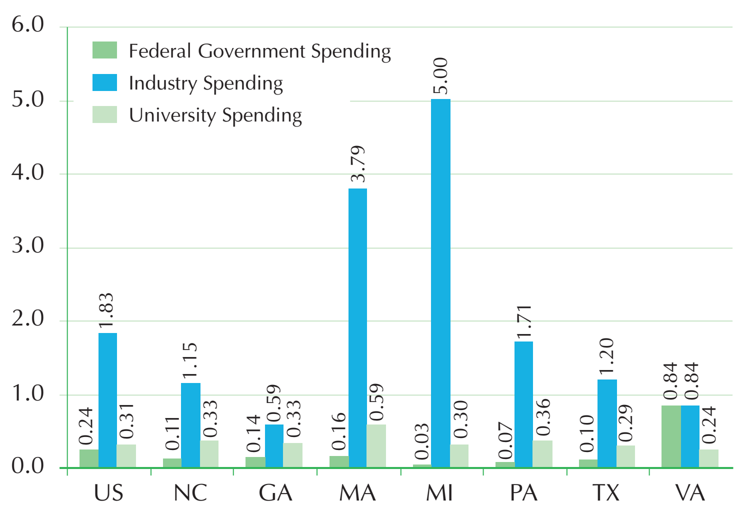
Federal R&D Activities in North Carolina Significant

Research and development performed by federal labs and agencies in North Carolina places the state in the middle of its peers, slightly below the national average. The peer group is skewed by Virginia, which captures an extraordinarily large amount of the federal R&D because of its proximity to Washington, DC. Virginia, Maryland, and the Dis-

FIGURE 31

R&D spending as a share of gross state product, 1995
By performer; ratio for total R&D in parentheses

Source: National Science Foundation and Bureau of Economic Analysis.



Ratio Total R&D	2.53	1.65	1.06	5.10	5.36	2.22	1.63	2.07

trict of Columbia alone are home to 45 percent of the federal government's R&D efforts.

Academic R&D North Carolina's Principal Strength

North Carolina's real strength is in university-based R&D, which makes up 21 percent of the state's total R&D activity. North Carolina is above the national average in university R&D intensity—or the ratio of university R&D to gross state product—and is highest among its peer group except for Pennsylvania and Massachusetts. The latter nearly doubles North Carolina in university R&D spending as a share of gross state product.

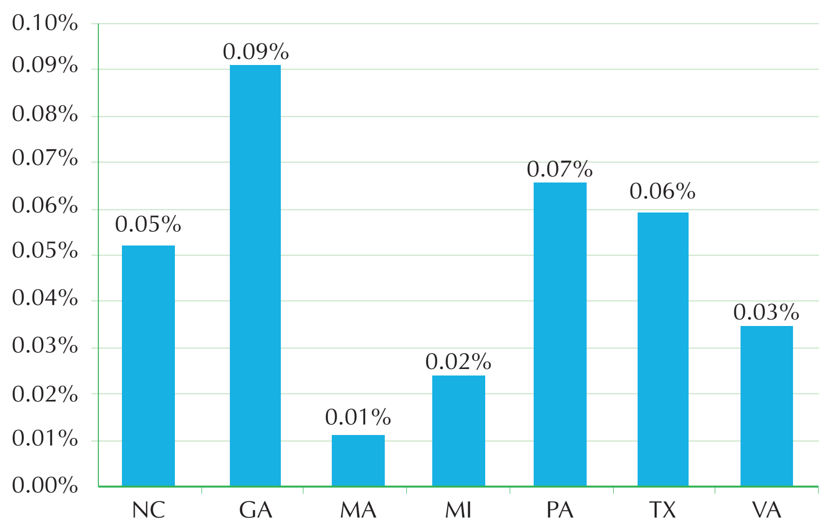
State Government Supportive of R&D

Traditionally, states 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. In North Carolina in 1995, the ratio of state spending on R&D to gross state product was 0.05 percent. That is above the national average and ranks 14th among all states and 4th among the peer states. North Carolina spends much of its R&D dollar (roughly 38 percent) on agriculture research. R&D related to science and technology constitutes only 9 percent of the state's R&D spending.

FIGURE 32

State government R&D spending as a share of gross state product, 1995

Source: State Science & Technology Institute, Bureau of Economic Analysis.



Nat'l Rank	14th	5th	39th	34th	10th	12th	21st

16. R&D per Tech Transfer Action

Comparing numbers of patents and license options to research expenditures by academic institutions provides an indication of the relative propensity of university researchers to generate innovations that can be patented and licensed for commercial use. The indicator must be interpreted with care, however. Basic research plays an important role in yielding marketable innovations, though its influence is often difficult to detect in the short run.[7] A low number of tech 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.

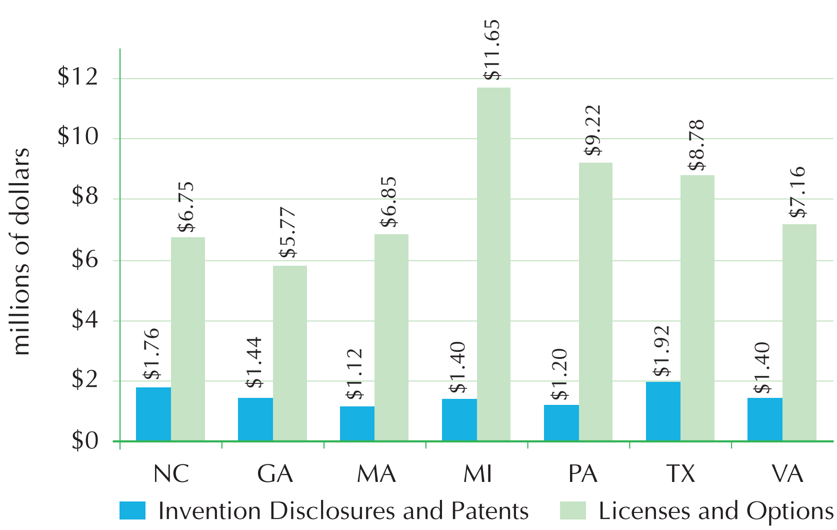
Licensing Activity High per R&D Dollar

In 1997, North Carolina research institutions' produced one invention disclosure or patent application for every $1.76 million in R&D, the second highest rate of R&D spending per tech transfer action in the comparison group. Massachusetts universities and research houses generate significantly more marketable ideas per unit "input" by this measure (at one invention disclosure or patent application per $1.12 million in R&D), as do academic and non-profit R&D performers in Pennsylvania, Georgia, Michigan, and Virginia. However, North Carolina research universities generate significantly more licenses and options per dollar of R&D than five of the six comparison states.

FIGURE 33

R&D expenditures per tech transfer action, 1997 (R&D and tech transfer conducted by universities)

Source: Association of University Technology Managers, Inc.



17. Ph.D. Scientists and Engineers

The technology economy is driven by the scientists, engineers, and technical personnel that generate breakthroughs in process and product technologies. 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 effort in the state, an *input* measure of innovation activity similar to R&D expenditures.

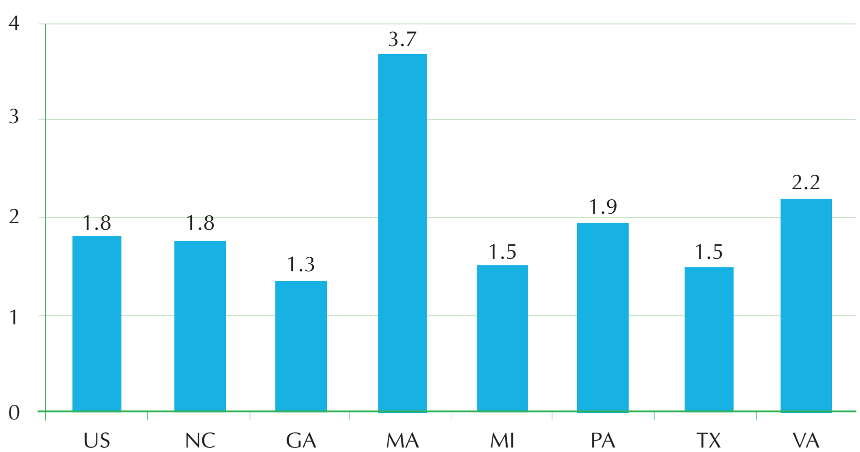
Number of Scientists and Engineers at National Average

Roughly 2.6 percent of Ph.D. scientists and engineers in the United States are employed in North Carolina. That is above Georgia's 2.0 percent but is below all other peer states. Some 5.7 percent of scientists and engineers in the U.S. work in Texas, 4.8 percent in Pennsylvania, and 4.6 percent in Massachusetts. Standardizing for population differences, the number of scientists and engineers in the state matches the national average (at 1.8 scientists and engineers per 1,000 population) and exceeds that of Georgia, Michigan, and Texas. Massachusetts has the highest relative complement of scientists at 3.7 per 1,000 people.

FIGURE 34

Employed Ph.D. scientists and engineers, 1997 per 1,000 population, state rank indicated

Source: National Science Foundation and Bureau of the Census.



Nat'l Rank	20th	37th	5th	31st	18th	34th	12th

18. Perceived Academic Science Strengths

Faculty reputations in particular science and technology areas are an important, though imperfect, indicator of a university's strength. Strong reputations 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, making those companies relatively more competitive in the global economy. The total number of highly reputed programs in particular areas also provides an indication of the state's principal academic research specialties.

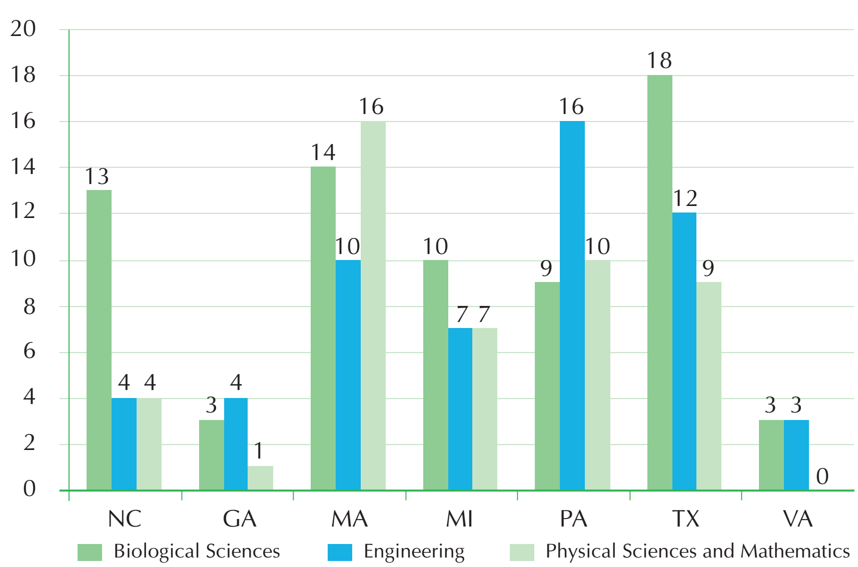
Biological Sciences Highly Reputed Strength

Twenty-one North Carolina programs in biological sciences, engineering, and physical sciences and mathematics are ranked by U.S. academicians as among the top 25 percent of U.S. programs in faculty quality. By this measure, one of North Carolina's principal academic strengths vis-à-vis the rest of the country is biological sciences, leading all peer states except Massachusetts and Texas in the number of top-ranked programs.

FIGURE 35

Number of graduate programs rated in top 25 in perceived faculty quality

Source: National Research Council.



Methodological Note:

As an indicator, faculty reputation does not measure program performance or quality. Measuring the quality and performance of academic programs is extremely difficult, as data that permit the consistent evaluation of programs across multiple states are rare. Many strong and highly specialized programs are not detected in the limited data that do exist (i.e., the surveys of the National Research Council). The simple indicator used here is meant to provide only the broadest picture of the leading programs in the state's various universities, as perceived by U.S. academicians themselves. For a more detailed evaluation of disciplinary strength in North Carolina universities, *see At the Crossroads: North Carolina's Place in the Knowledge Economy of the 21st Century* (North Carolina Board of Science and Technology, April 1998). Subsequent editions of *Tracking Innovation* may include measures of academic research quality and performance, if suitable data can be assembled.

19. SBIR and STTR Awards

The Small Business Innovation Research (SBIR) Program provides competitive grants to entrepreneurs to help finance R&D, start-up, and commercialization of innovative business ideas. Nationally, companies that receive Phase II (implementation) funding from the SBIR program have significantly out-performed similar companies that do not receive support. Success in the SBIR program also attracts outside capital investment. The Small Business Technology Transfer (STTR) Program facilitates partnerships between small businesses and non-profit research institutions, including universities. Tracking STTR funds provides an indication of how well the state's universities are working with small businesses on R&D efforts. The state's funding under the SBIR and STTR program indicates both how aggressive North Carolina small businesses are in pursuing support for innovation activity as well as their competitiveness in developing and commercializing innovative technologies and products.

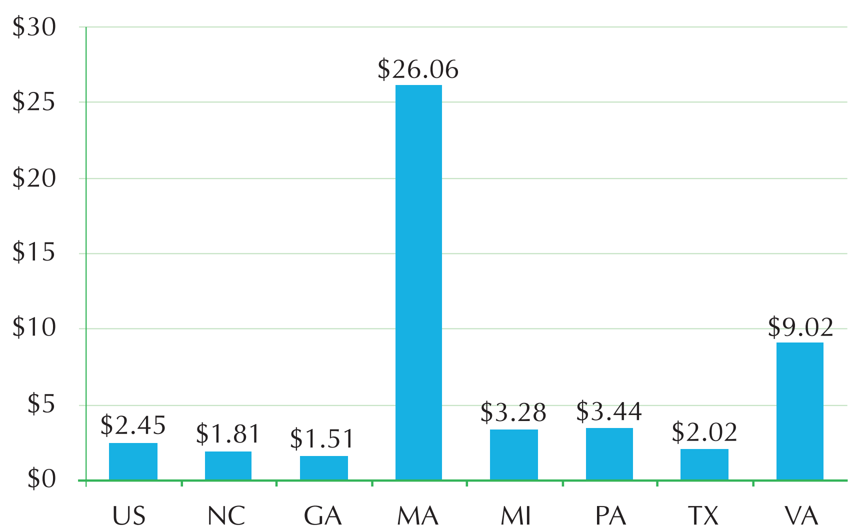
SBIR/STTR Awards Low But Increasing

North Carolina falls below the national mean in both SBIR and STTR funding per capita. Among the group of comparison states, North Carolina ranks third in its level of STTR funding per capita and fifth in SBIR funding per capita. Two comparison states, Massachusetts and Virginia, both garner disproportionate shares of SBIR and STTR awards. Against the remaining states, North Carolina performs more competi-

FIGURE 36

SBIR funding per capita, 1998

Source: Small Business Administration and Bureau of the Census.



Nat'l Rank	24th	27th	1st	18th	17th	23th	5th

tively, suggesting that small businesses in the state are moderately successful in attracting federal dollars. North Carolina's ability to attract SBIR/STTR awards has risen in the last few years, with both the number of awards and dollar amount per award rising. Whether that trend will continue is uncertain.

FIGURE 37

STTR funding per capita, 1998

Source: Small Business Administration and Bureau of the Census.

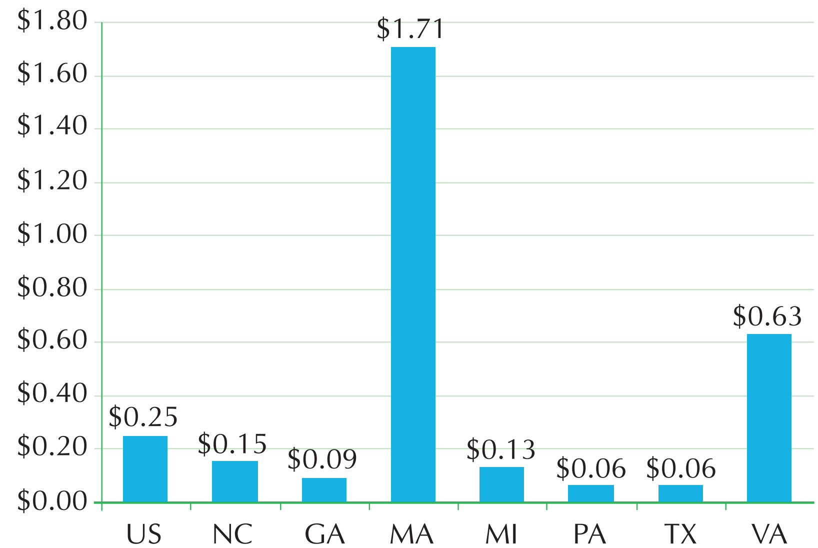
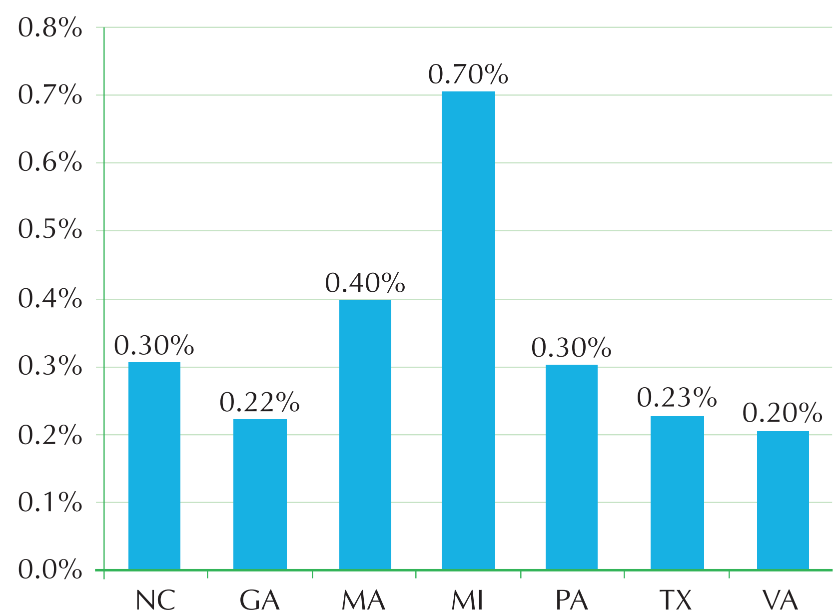


FIGURE 38

Percent of firms that are ISO compliant, 1999

Source: Mid American Manufacturing Technology Center.



Preparation Indicators

20. ISO Compliance

ISO compliance is an indicator of North Carolina companies' ability to penetrate foreign markets. ISO 9000 is a series of quality systems standards and associated guidance materials published by the International Organization for Standardization. ISO 9000 standards ensure that a firm has a quality management system that ensures its products meet customers' requirements. ISO 9000 standards are recognized and accepted worldwide, and are most common among firms that export to international markets. ISO 9000 compliant firms are more prepared to compete on a global basis, and are therefore more likely to have adopted best-practice process and management technologies.

ISO Compliance Moderate

According to the Mid American Manufacturing Technology Center, some 900 firms are ISO compliant in North Carolina, 0.3 percent of North Carolina companies. That ranks the state ahead of Georgia, Texas, and Virginia, but well behind Michigan and Massachusetts. ISO compliance in Michigan and Massachusetts is driven by the high level of export activity in both states. Note, however, that because of the paucity of data on ISO compliance, it is uncertain whether North Carolina truly lags or leads other states. ISO compliance is more important—in terms of market access—for some sectors than others. Unfortunately, there are no available secondary data on ISO compliance by industry.

Methodological Note:

The International Organization for Standardization, established in Switzerland in 1947, first issued its international quality assurance standards in 1987. ISO sought to encourage international trade by providing a common set of standards that multiple countries would accept and utilize. Increasingly, companies are demanding that their suppliers adopt ISO standards. Thus ISO compliance is becoming a pre-requisite to access to some markets.

21. Educational Attainment

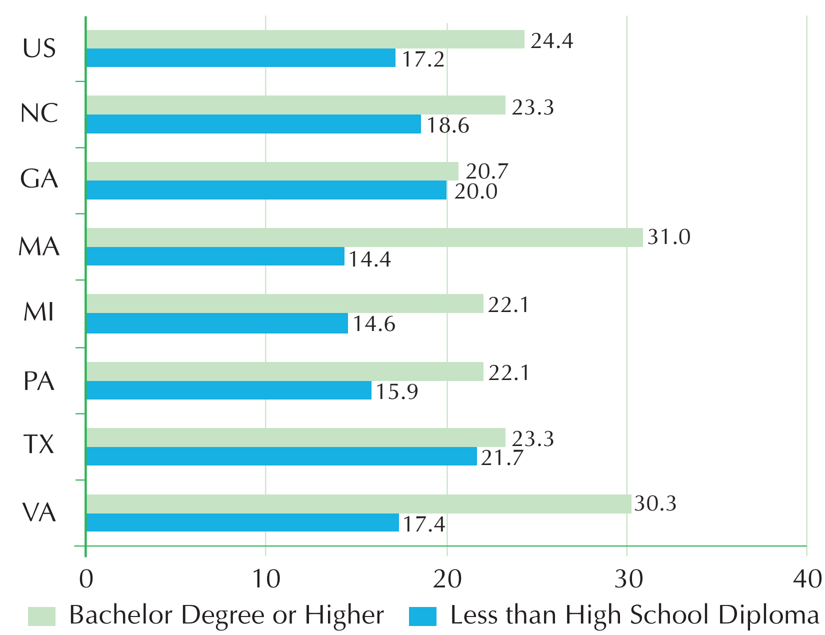
A well-educated and skilled workforce is a pre-requisite for success in the knowledge-based economy. The economic prospects of workers with limited formal education grow dimmer each year as higher skilled and technology-oriented jobs replace well-paid, lower skill jobs in manufacturing. The innovation economy is characterized by constant 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.

College Education Attainment High Relative to Peer States

On the one hand, a reasonably high share of the North Carolina adult population is college-educated. In 1998, 23 percent of North Carolina residents 25 years and older had earned at least a bachelors degree. North Carolina surpasses all peer states except Massachusetts and Virginia in college education attainment; the state's 23 percent is slightly below the national average of 24 percent. On the other hand, nearly 19 percent of North Carolina adults have never earned a high school diploma, a percentage that is higher than both the national average and the share in all peer states except Georgia and Texas.

FIGURE 39

Educational attainment, 1998
Percent persons 25 years and older
Source: U.S. Bureau of the Census

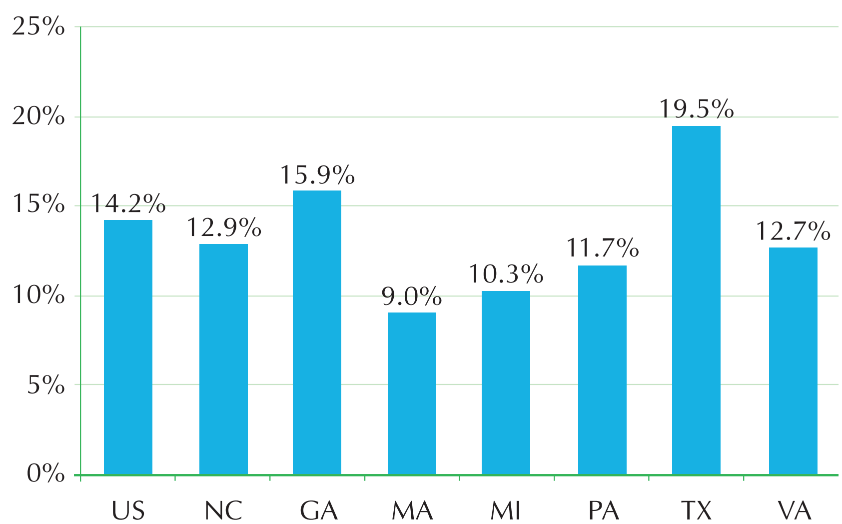


Dropout Rate May be Falling

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. At present, 19 percent of all North Carolina adults lack a high school degree. But only 13 percent of individuals between the ages of 18 and 24 (and not presently in high school) have failed to complete high school.[8] That is slightly better than the national average and ranks 17th in the country. North Carolina ranks in the middle of peer states on the measure (lower than dropout rates in Georgia and Texas, but above rates in Massachusetts, Michigan, and Pennsylvania).

FIGURE 40

High school drop-out rate, 1995-97
Persons not in high school aged 18-24
without a high school diploma
Source: National Center for Education Statistics.



	US	NC	GA	MA	MI	PA	TX	VA
Nat'l Rank		34th	41st	8th	14th	21st	48th	31st

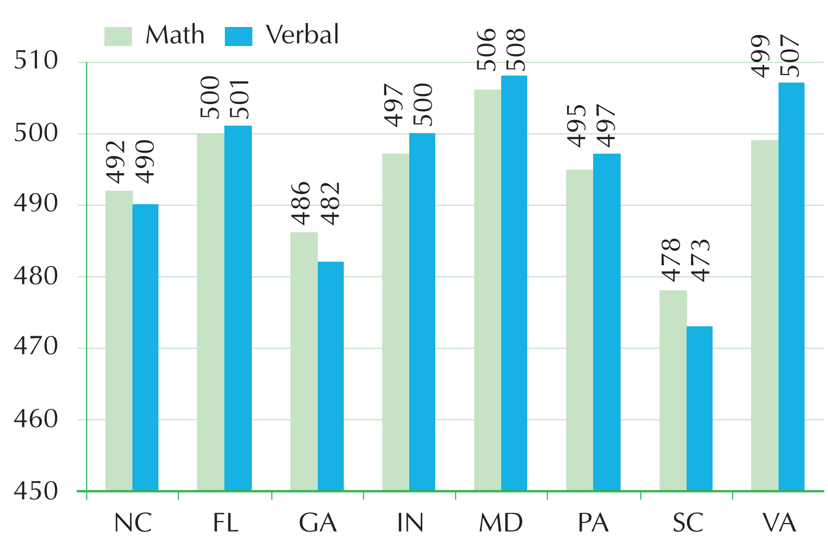
22. Test Scores

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 other sectors. Second, re-training 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.

As a comparative measure, Scholastic Aptitude Test (SAT) test scores partially reflect the quality of states' primary and secondary education systems. However, there is a high negative association between average SAT scores and the share of students that take the exam; students likely to perform poorly on the exam are less likely to take it. For example, in Michigan, where the average SAT score is 11th highest among the 50 states, only 11 percent of students take the exam. Below, North Carolina's SAT scores are compared only with those states with roughly the same rates of student participation.

FIGURE 41

Average SAT scores, 1998
States with comparable test participation rates
Source: The College Board.



North Carolina SAT Scores Low

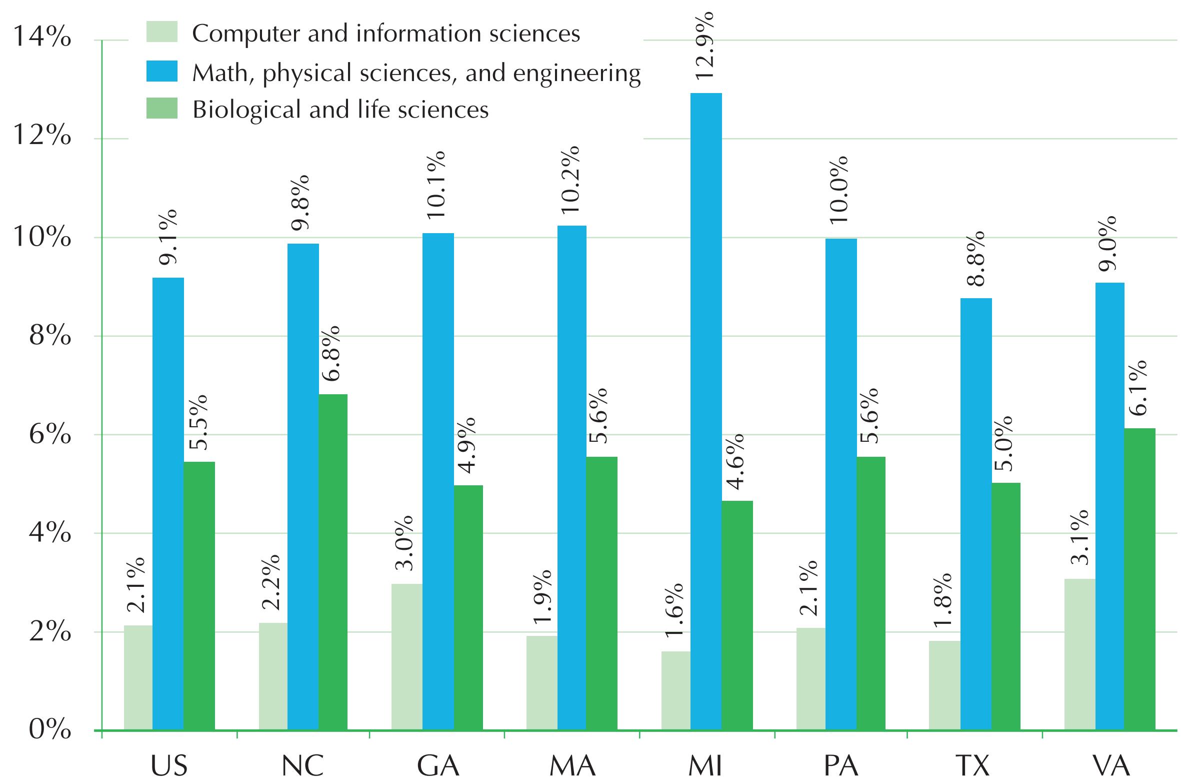
North Carolina's students perform comparatively poorly on the SAT. Only Georgia and South Carolina post lower math and verbal scores among seven states with comparable participation rates. The statistic raises the issue of whether North Carolina students will be capable of competing in the innovation economy, given their skills and that they will be less likely to gain admittance to top flight colleges and universities.

23. Science and Engineering Education

Individuals with university training in math, science, and engineering are in top demand in the private sector. An inadequate supply of suitably trained workers can limit the growth of technology related industries. Many states and regions rely heavily on in-migration (and immigration) of technically skilled workers to staff technology companies. The number of bachelors degrees in science, engineering, and math (per capita and as a share of all bachelors awarded by universities and colleges in the state) is an important measure of whether the skills of the typical North Carolina graduate meet the needs of the state's growing innovation companies.

FIGURE 42

Share of science and engineering degrees in total, 1996-97
Percent each state's total bachelors degrees awarded in each discipline
Source: National Center for Education Statistics, IPEDS database.



Nat'l Rank	17/15/3	4/13/34	26/11/18	35/2/40	19/14/19	28/27/33	3/23/12

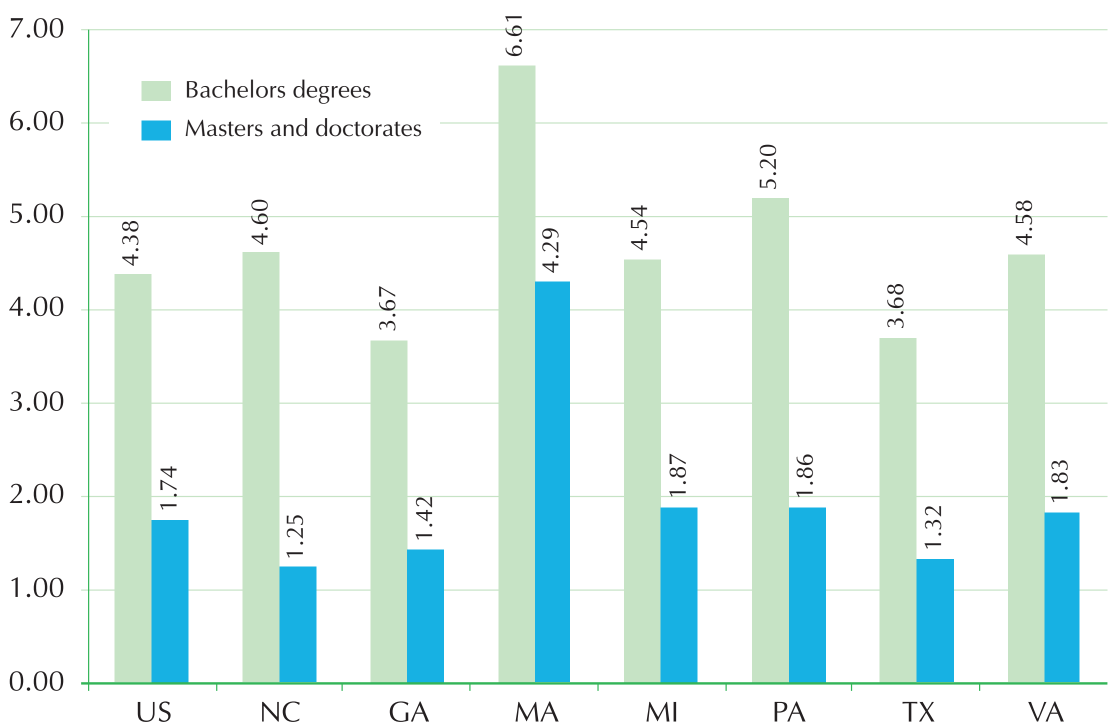
Many innovative companies seek individuals with graduate-level education for key research and leadership positions. Therefore, graduate degrees awarded in math, science, and engineering is another important measure of the emerging skill set in the state, as well as of specialized academic research strength.

High Share of Students Majoring in Math, Sciences and Engineering

Some 18 percent of all bachelors degrees in North Carolina in a given academic year are awarded in computer and information sciences, math/physical sciences/engineering, and biological and life sciences. That compares to 18.8 percent nationwide and is higher than all comparison states except Michigan. Over-

FIGURE 43

Science and engineering degrees awarded, 1996-97
Per 1,000 state residents
Source: National Center for Education Statistics, IPEDS database.



Nat'l Rank	22/41	42/31	6/2	25/13	17/15	41/36	23/18

all, in academic year 1996-97, North Carolina ranked 7th among the 50 states and the District of Columbia in science and engineering degrees as a share of total bachelors degrees awarded. The state ranks 3rd in the share of its students majoring in the biological and health sciences.[9] Virginia and Georgia lead the peer states in the share of bachelors degrees in computer and information sciences.

NC Schools Award 3.6 Percent of Health Sciences Bachelors in U.S.

Colleges and universities in North Carolina granted 9.7 percent of all science and engineering bachelors in the U.S. in 1996/97. In comparison, Texas granted 16.7 percent, Pennsylvania 16.4 percent, Michigan 11.4 percent, Massachusetts 10.4 percent, Virginia 9.4 percent, and Georgia 8.0 percent. North Carolina institutions granted 3.6 percent of all biological and health sciences bachelors in the U.S. in the same year, more than any peer states except Texas and Pennsylvania. Only five states in the country award more biological and health science bachelors degrees than North Carolina.[10]

Science & Engineering Graduate Degrees Per Capita Lags Peer States

North Carolina ranks 22nd nationally in science and engineering bachelors degrees awarded per capita. Its rate of 4.6 degrees granted per 1,000 residents in academic year 1996-97 exceeds the national average, leads Georgia and Texas, matches rates in Virginia and Michigan, and is significantly below rates in Massachusetts and Pennsylvania. The number of graduate degrees awarded per capita, however, is below all peer states and the national average. In 1996-97, North Carolina colleges and universities awarded 1.25 masters and doctorates in the sciences and engineering per 1,000 residents. That is considerable lower than the national average rate of 1.74 and the rates in Michigan, Pennsylvania and Virginia which exceed 1.80.

Not surprisingly, within three major disciplines (computer and information sciences; math, physical sciences, and engineering; and biological and health sciences), the state fares best in biological and health sciences, ranking 2nd nationally in bachelors degrees per capita and 7th nationally in graduate degrees per capita. In 1996-97, the number of graduate degrees in computer and information sciences per capita ranked only 38th in the country, suggesting that the growing software and information technology sectors in the state will have to import highly trained and specialized workers in order to continue expanding.

24. Computers in Schools

Information technology is an enabling technology. It plays a vital role in all industries and is increasingly an important learning tool in primary, secondary, and post-secondary education. North Carolina schools must be at the forefront of the digital revolution so that children have the opportunity to learn from and with information technology. In addition to a strong foundation in the traditional subject matter, tomorrow's workforce must be comfortable carrying out work-related tasks in a digital environment. The development of that comfort-level and familiarity must begin at an early age.

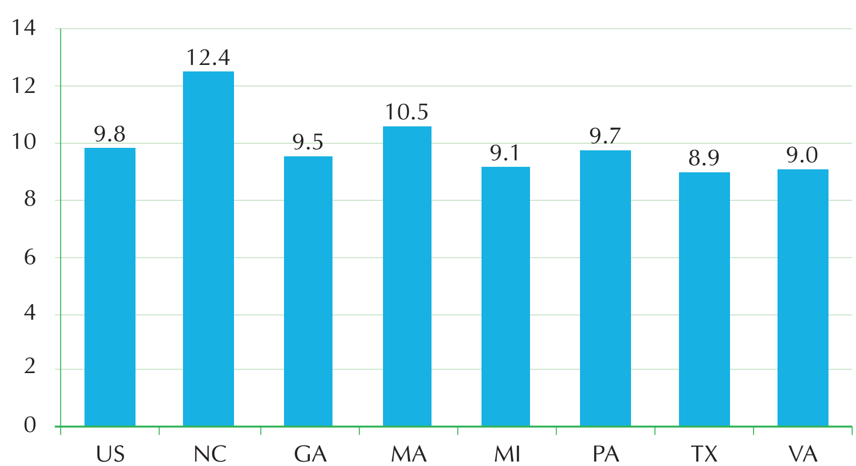
The ratio of instructional multimedia computers per 100 students is a good measure of the accessibility of computers to elementary and secondary school students. Multimedia computers reflect a more-advanced generation of interactive personal computer technology. They are a necessity for making full use of today's advanced software and the Internet.

North Carolina Nearly Last Among States

North Carolina ranks nearly last (47th) among the 50 states in the number of students per multimedia computer. Its rate of 12.4 students per computer is 127 percent of the national rate and is higher than all six comparison states.

FIGURE 44

Students per multi-media computer, 1999
Source: Market Data Retrieval.



Nat'l Rank	47th	24th	32nd	21st	28th	19th	20th

25. Internet Access in Schools

Internet access allows students to learn to locate, analyze, and exchange information from global sources. The Internet is increasingly being used to supplement in-class training; both teachers and students in classrooms without Internet access are less able to tap into the growing number of learning tools on the World Wide Web.

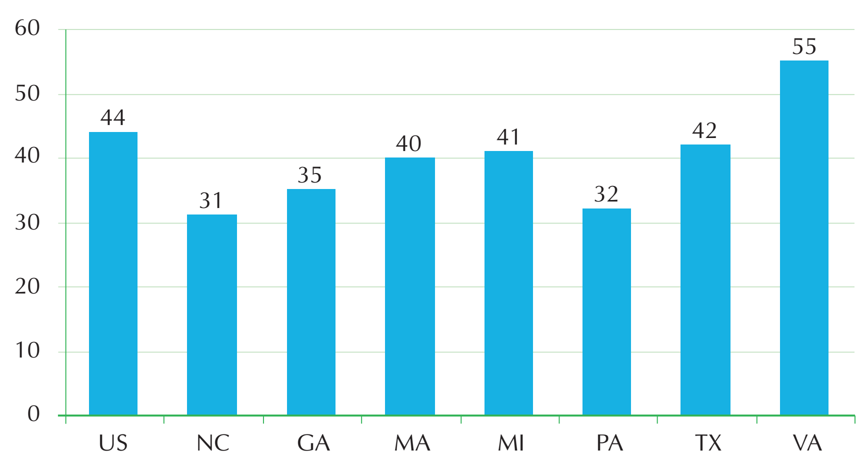
Comparatively Few Classrooms Have Internet Access

Thirty-one percent of classrooms in North Carolina had Internet access in 1998, compared to 44 percent for the U.S. as a whole. North Carolina ranks 43rd on this measure, behind Pennsylvania (42nd), Georgia (39th), Massachusetts (33rd), Michigan (32nd), Texas (31st) and Virginia (15th).

FIGURE 45

Percent of classrooms with Internet access, 1998

Source: Education Week on the Web.



Nat'l Rank	43rd	39th	33rd	32nd	42nd	31st	15th

26. General Internet Connectivity

An Internet host is any computer system physically connected to the Internet. Individual households and businesses must go through a host to access the World Wide Web. The number of hosts per 1,000 people is a measure of a state's existing level of Internet connectivity, its information technology infrastructure, and Internet use by the general public.

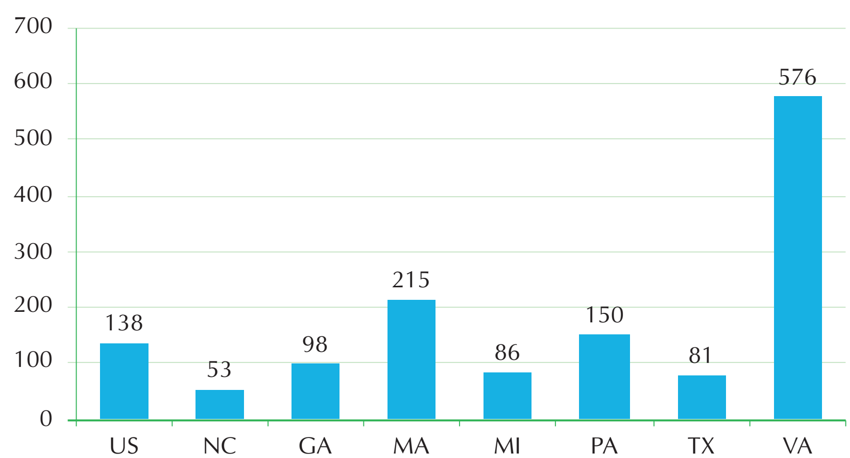
North Carolina Lags Peer Group

North Carolina is last in its peer group and ranks 34th in the nation in the number of Internet hosts per capita. The 53 host connections for every 1,000 people—well below the national level of 138—suggests a low level of Internet usage in the state.

FIGURE 46

Internet connections per 1,000 population, 1999

Source: Matrix Information and Directory Services, Inc.



Nat'l Rank	34th	13th	4th	17th	8th	21st	2nd

Endnotes

1 Indicators based on gazelle data (from Cognetics, Inc.) are not included in Table 1 (summary of rankings) because of the lack of variation across states.

2 North Carolina Economic Development Board, *Comprehensive Strategic Economic Development Plan* (Raleigh, NC, North Carolina Department of Commerce, July 1999).

3 Twenty-six percent of North Carolina's high tech employment is in somewhat technology-intensive sectors (see Appendix for definition), versus 19 percent nationwide and an average 17 percent among comparison states.

4 See *Boosting Innovation—The Cluster Approach*, edited by T. J. A. Roelandt and P. den Hertog (Paris, Organisation for Economic Co-operation and Development, 1999).

5 The ratio of the two shares is the location quotient in Table 1; location quotients significantly above 1.0 signify state specializations.

6 For a discussion of the cluster-related implications of Federal Express in the Triad, *see Federal Express in the Piedmont Triad: Economic Impacts and Opportunities* (Regional Technology Strategies, Inc., Chapel Hill, NC, November 1999).

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

8 Figure based on data averaged over the period 1995 to 1997.

9 The comparison states and their comparable rankings are as follows: Georgia (11^{th}), Massachusetts (14^{th}), Michigan (6^{th}), Pennsylvania (15^{th}), Texas (33^{rd}), and Virginia (9^{th}).

10 Those states are California, New York, Texas, Pennsylvania, and Illinois.

Sources (by indicator)

1. Overall Performance

Gross state product figures are from the *Regional Economic Information System*, Bureau of Economic Analysis, available with an approximate 3-year lag. Employment and unemployment are from the Bureau of Labor Statistics.

2. New Firms

Data are from the report *Small Business Economic Indicators, 1997* (Office of Advocacy, Small Business Administration). Raw data are compiled by the SBA from the Employment and Training Commission, Bureau of Labor Statistics, Administrative Office of the United States Courts, Bureau of Economic Analysis, and the Bureau of the Census. Report can be obtained online at www.sba.gov/ADVO/special/indicators.

3. Gazelle Firms

Data for the percentage of jobs in gazelle firms came from the *State New Economy Index* published online by the Progressive Policy Institute (http://207.158.225.143/states/part3_ page1.html.) Their data are from Cognetics, Inc. Data on the percentage of gazelle firms in a particular state came from the *Corporate Almanac*, published by Cognetics, Inc. in 1999 (updated annually).

4. Worker Pay

Private sector wages for 1998 are from the Bureau of Labor Statistics. Wages were adjusted with a cost of living index published by the American Chamber of Commerce Researchers Association (ACCRA). Average wages by industry cluster (adjusted for inflation using the Consumer Price Index, U.S. Bureau of Labor Statistics) are from the North Carolina Employment Security Commission enterprise-level ES-202 files, obtained with special permission.

5. Personal Income

Total personal income is from the *Regional Economic Information System*, Bureau of Economic Analysis, available with an approximate 3-year lag. Incomes were adjusted using ACCRA's cost of living index (see Indicator 4). Population and median household income (for the latter see www.census.gov/hhes/income/histinc/h08a.html) are from the Bureau of the Census. Population is from the Bureau of the Census.

6. Income Distribution and Poverty

All figures 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.

7. Technology-Intensive Activity

Four-digit SIC employment and wage data for 1989 and 1997 are from Minnesota IMPLAN Group, Inc., available with a 2-3 year lag. MIG data are based on the U.S. ES-202 (Covered Wages and Employment Program, Bureau of Labor Statistics) and are adjusted to estimate cells suppressed for confidentiality reasons. Employment and wage data for 1998 are from the North Carolina Employment Security Commission, obtained with special permission and available with a 1-2 quarter lag. North Carolina location quotients for 1998 are calculated using U.S. data for 1997. See Appendix for technology sector definitions.

8. Industry Clusters

Employment and wage date for 1989 and 1997 are from Minnesota IMPLAN Group, Inc.; 1998 figures are from the North Carolina Employment Security Commission, obtained with special permission. Industry cluster definitions are provided in the Appendix.

9. International Exports

Data on state exports are from the Bureau of the Census, Foreign Trade Division, FT900 foreign trade statistics (www.census.gov/foreign-trade/www/press.html#supplement). Updated monthly.

10. Industrial Transition

Mass layoff data are from the Mass Layoff Statistics program of the Bureau of Labor Statistics, available with an approximate 3 quarter lag. Four-digit Standard Industrial Classification (SIC) employment and wage data underlying the growth/decline wage index are from Minnesota IMPLAN Group, Inc. (enhanced ES-202 files). Agriculture, mining, and construction are not included among growing or declining sectors because of lack of consistent data.

11. Patents

Total patents by state are from the U.S. Patent and Trademark Office (www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.pdf).

12. Technology Transfer Activity

Figures are from the Association of University Technology Managers, Inc. publication *AUTM Licensing Survey: Fiscal Year 1997.* Population and gross state product are from the Bureau of the Census and Bureau of Economic Analysis, respectively.

13. Venture Capital

Data obtained from PriceWaterhouseCoopers MoneyTree™ Survey (special thanks to Clare Knight). Venture capital funding data are compiled on a quarterly basis.

14. Initial Public Offerings

Data on filings for initial public offerings with the Securities and Exchange Commission were compiled from Hoover's Online *IPO Central* (www.ipocentral.com). Updates are reported on a quarterly basis.

15. Research and Development

R&D by performer data are from the National Science Foundation (www.nsf.gov/sbe/srs/natpat97/#tables). Population is from the Bureau of the Census (www.census.gov/population/estimates/state/st-98-7.txt). Gross state product is in current dollars and is from the Bureau of Economic *Analysis (Regional Economic Information System)*. R&D spending by state is from a publication of the State Science and Technology Institute, *Survey of State Research and Development Expenditures: Fiscal Year 1995*, published in September 1998.

16. R&D per Tech Transfer Action

From the Association of University Technology Managers, Inc. publication *AUTM Licensing Survey: Fiscal Year 1997.*

17. Ph.D. Scientists and Engineers

Data on employed doctoral scientists and engineers are from the National Science Foundation report *Characteristics of Doctoral Scientists and Engineers in the United States: 1995*. Updated every five years.

18. Perceived Academic Strengths

Obtained from the National Research Council publication *Research-Doctorate Programs in the United States, 1995.* Authors' calculations identified the 25 percent threshold.

19. SBIR and STTR Awards

Awards and dollar values are from the United States Small Business Administration. Population is from the Bureau of the Census.

20. ISO Compliance

Total ISO 9000 compliant firms by state were provided by Paul Clay and Curt Lopez of the Mid America Manufacturing Technology Center (available on an annual basis). Total firms by state are from the Dun and Bradstreet online marketing database.

21. Educational Attainment

Data are from the Bureau of the Census' *Educational Attainment in the United States: March 1998* (available online at www.census.gov/prod/3/98pubs/p20-513u.pdf). Drop-out rates are from the National Center for Education Statistics' *Dropout Rates in the United States: 1997*, released in March 1999 (available online at nces.ed.gov/pubs99/1999082.pdf). NCES information is based on data from the Bureau of the Census and the Current Population Survey, along with unpublished data.

22. Test Scores

Data for average SAT scores and percentage of students taking the SAT are from the College Board (www.collegeboard.org/press/senior98/html/satt2.html). Updated on an annual basis.

23. Science and Engineering Education

Data on the number of science and engineering graduate students are from the National Science Foundation report *Graduate Students and Postdoctorates in Science and Engineering: Fall 1997 Supplemental Tables*. Available online at www.nsf.gov/sbe/srs/nsf99324/pdfstart.htm.

24. Computers in Schools

Data on multi-media computer intensity are from Market Data Retrieval's *Technology in Education 1999*.

25. Internet Access in Schools

Data on the percentage of schools and classrooms with Internet access obtained from Education Week on the Web (from the report *Do Students and Teachers Have Adequate Access to Education Technology*?). See www.edweek.org/sreports/tc98/data/tables/ac-tl1b.htm.

26. General Internet Connectivity

Data are from Matrix Information and Directory Services, Inc. (www.mids.org). Data updated annually.

Appendix: SIC-Technology Classification

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

Very Technology Intensive

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

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

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	Electric 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.

Appendix
Component Industries, U.S. Benchmark Clusters

(Note: Clusters are not mutually exclusive.)

Printing and Publishing

SIC	Description
2611	Pulp mills
2650	Paperboard containers and boxes
2670	Misc converted paper products
2711	Newspapers: publishing, or pub. & printing
2721	Periodicals: publishing and printing
2730	Books
2741	Miscellaneous publishing
2750	Commercial printing
2761	Manifold business forms
2771	Greeting cards
2780	Blankbooks and bookbinding
2790	Printing trade services
3275	Gypsum products
3861	Photographic equipment and supplies
3953	Marking devices
3955	Carbon paper and inked ribbons
3993	Signs and advertising specialities
3999	Manufacturing industries, nec
4810	Telephone communications
4822	Telegraph & other message communications
4899	Communications services, nec
7370	Computer and data processing services
8060	Hospitals
8730	Research and testing services

Information Technology and Instruments

SIC	Description
3471	Plating and polishing
3570	Computer and office equipment
3596	Scales and balances, exc. laboratory
3625	Relays and industrial controls
3629	Electrical industrial apparatus, nec
3651	Household audio and video equipment
3660	Communications equipment
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, nec
3694	Engine electrical equipment
3699	Electrical equipment & supplies, nec
3728	Aircraft parts and equipment, nec
3761	Guided missiles and space vehicles
3769	Space vehicle equipment, nec
3812	Search and navigation equipment
3820	Measuring and controlling devices
3841	Surgical and medical instruments
3844	X-ray apparatus and tubes
3845	Electromedical equipment
3861	Photographic equipment and supplies
3873	Watches, clocks, watchcases and parts
3931	Musical instruments
7370	Computer and data processing services

Chemicals and Plastics

SIC	Description
2087	Flavoring extracts and syrups, nec
2611	Pulp mills
2621	Paper mills
2631	Paperboard mills
2812	Alkalies and chlorine
2813	Industrial gases
2816	Inorganic pigments
2820	Plastics materials and synthetics
2841	Soap and other detergents
2842	Polishes and sanitation goods
2843	Surface active agents
2851	Paints, varnishes, lacquers, enamels, etc.
2865	Cyclic crudes and intermediates
2869	Industrial organic chemicals, nec
2875	Fertilizers, mixing only
2879	Agricultural chemicals, nec
2891	Adhesives and sealants
2893	Printing ink
2899	Chemical preparations, nec
3011	Tires and inner tubes
3060	Fabricated rubber products, nec
3080	Misc plastics products, nec
3111	Leather tanning and finishing
3291	Abrasive products
3399	Primary metal products, nec
3559	Special industry machinery, nec
3692	Primary batteries, dry and wet
3996	Hard surface floor coverings, nec
8042	Offices and clinics of optometrists
8043	Offices and clinics of podiatrists
8049	Offices of health practitioners, nec
8070	Medical and dental laboratories
8092	Health and allied services, nec

Apparel

SIC	Description
2211	Broadwoven fabric mills, cotton
2221	Broadwoven fabric mills, manmade
2231	Broadwoven fabric mills, wool
2241	Narrow fabric and other smallwares mills
2250	Knitting mills
2261	Textile finishing, except wool
2273	Carpets and rugs
2280	Yarn and thread mills
2296	Tire cord and fabrics
2297	Nonwoven fabrics
2298	Cordage and twine
2299	Textile goods, nec
2311	Men's and boys' suits, coats and overcoats
2320	Men=s and boys= furnishings
2330	Women=s and misses= outerwear
2340	Women=s and children=s undergarments
2353	Hats, caps, and millinery
2360	Girls= and children=s outerwear
2371	Fur goods
2380	Misc apparel and accessories
2395	Pleating and stitching
2397	Schiffli machine embroideries
2824	Organic fibers, noncellulosic
3965	Fasteners, buttons, needles, & pins

Fabricated Textiles

SIC	Description
2211	Broadwoven fabric mills, cotton
2221	Broadwoven fabric mills, manmade
2231	Broadwoven fabric mills, wool
2261	Finishing plants, cotton
2262	Finishing plants, manmade
2295	Coated fabrics, not rubberized
2311	Men's and boys' suits, coats and overcoats
2320	Men=s and boys= furnishings
2330	Women=s and misses= outerwear
2342	Bras, girdles, and allied garments
2353	Hats, caps, and millinery
2360	Girls= and children=s outerwear
2371	Fur goods
2380	Misc apparel and accessories
2391	Curtains and draperies
2392	Housefurnishings, nec
2393	Textile bags
2394	Canvas and related products
2396	Automotive and apparel trimmings
2399	Fabricated textile products, nec
2512	Upholstered household furniture
2515	Mattresses and bedsprings
2823	Cellulosic manmade fibers
3021	Rubber and plastics footwear
3052	Rubber & plastics hose & belting
3161	Luggage
3172	Personal leather goods, nec
3842	Surgical appliances and supplies
3942	Dolls and stuffed toys
3965	Fasteners, buttons, needles, & pins
3995	Burial caskets

Stone, Clay and Glass Products

SIC	Description
2873	Nitrogenous fertilizers
2874	Phosphatic fertilizers
2911	Petroleum refining
3011	Tires and inner tubes
3241	Cement, hydraulic
3255	Clay refractories
3260	Pottery and related products
3274	Lime
3295	Minerals, ground or treated
3297	Nonclay refractories
3299	Nonmetallic mineral products, nec
3629	Electrical industrial apparatus, nec

Wood Products and Furniture

SIC	Description
2411	Logging
2426	Hardwood dimension & flooring mills
2431	Millwork
2434	Wood kitchen cabinets
2439	Structural wood members, nec
2440	Wood containers
2450	Wood buildings and mobile homes
2493	Reconstituted wood products
2499	Wood products, nec
2511	Wood household furniture
2517	Wood TV and radio cabinets
2521	Wood office furniture
2611	Pulp mills
2621	Paper mills
2631	Paperboard mills
2861	Gum and wood chemicals
3792	Travel trailers and campers
3931	Musical instruments

Tobacco Products

SIC	Description
2111	Cigarettes
2121	Cigars
2131	Chewing and smoking tobacco
2141	Tobacco stemming and redrying

Banking and Advertising

SIC	Description
6010	Central reserve depositories
6020	Commercial banks
6030	Savings institutions
6060	Credit unions
6080	Foreign bank, branches, agencies
6090	Functions closely related to banking
6111	Federal and Fed.-sponsored credit
6141	Personal credit institutions
6150	Business credit institutions
6160	Mortgage bankers and brokers
6211	Security brokers, dealers, & flotation co
6221	Commodity contracts brokers and dealers
7310	Advertising

Transportation, Shipping, & Logistics

SIC	Description
4210	Trucking and courier services, nec
4220	Public warehousing and storage
4231	Trucking terminal facilities
4311	U.S. Postal Service
4412	Deep sea foreign transportation of freight
4424	Deep sea domestic transportation of freight
4432	Freight trans. on Great Lakes-St. Lawrence
4449	Water transport of freight, nec
4480	Water transport of passengers
4490	Water transport services
4510	Transportation by air
4522	Air transportation, nonscheduled
4610	Pipelines, exc natural gas
4731	Freight transportation arrangement
4741	Rental of railroad cars
4783	Misc transportation services

Pharmaceuticals

SIC	Description
2830	Drugs

Appendix

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, nec
2873	Nitrogenous fertilizers
2874	Phosphatic fertilizers
2875	Fertilizers, mixing only
2879	Agricultural chemicals, nec
2891	Adhesives and sealants
2893	Printing ink
2899	Chemical preparations, nec
3559	Special industry machinery, nec
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, nec
8099	Health and allied services, nec

Information Technology and Instruments

SIC	Description
3571	Electronic computers
3572	Computer storage devices
3575	Computer terminals
3577	Computer peripheral equipment, nec
3578	Calculating and accounting equipment
3579	Office machines, nec
3625	Relays and industrial controls
3629	Electrical industrial apparatus, nec
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, nec
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, nec
3694	Engine electrical equipment
3699	Electrical equipment & supplies, nec
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, nec
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, nec

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
3549	Metalworking machinery, nec
3553	Woodworking machinery
3555	Printing trades machinery

3556	Food products machinery
3559	Special industry machinery, nec
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, nec
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, nec
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, nec
3761	Guided missiles and space vehicles
3764	Space propulsion units and parts
3769	Space vehicle equipment, nec

Household Appliances

SIC	Description
3632	Household refrigerators and freezers
3633	Household laundry equipment
3635	Household vacuum cleaners
3639	Household appliances, nec
3716	Motor homes

Communications Services and Software

SIC	Description
4899	Communications services, nec
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, nec
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

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