Tracking Innovation

North Carolina Innovation Index 2013

North Carolina Board of Science & Technology

NORTH CAROLINA
DEPARTMENT OF COMMERCE™

Tracking Innovation

North Carolina

Innovation Index

2013

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North Carolina
Department of Commerce

Pat McCrory, Governor | Sharon Allred Decker, Secretary

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To the Citizens of North Carolina,

It is our pleasure to introduce you to the 2013 *Tracking Innovation* report. The fourth in a series of periodic reports produced by the Board of Science & Technology, it tracks North Carolina's performance across 38 measures of the state's innovation-related assets, activities, and trends.

What this report reveals about North Carolina is interesting and important, particularly given that our state's economy is recovering from the deepest recession in more than a generation. The recovery is slow going, in part because North Carolina, like other states, is in the midst of transitioning to a knowledge- and innovation-based economy. Accelerating that transition will require strong public-private partnerships to leverage our state's assets and maximize our economic opportunities.

As shown in this report, one of our strongest assets is our universities, which excel at research & development, generate significant intellectual property, and produce a well-educated and well-trained science & engineering workforce. North Carolina also has one of the fastest growing populations in the country, and its high-technology sectors are increasing in employment and have wages well above the U.S. average.

These strengths are not enough, however. To help increase the level of prosperity throughout the state, a larger share of the state's economy must transition to become high-technology, high-growth, high-income industries. This transition will happen only if a larger share of the state's population has the education, training, resources, and infrastructure needed to start, grow, and sustain companies that are innovative, entrepreneurial, and able to compete in an increasingly dynamic global economy.

A key goal of Governor Pat McCrory's economic development approach is to promote economic opportunity throughout the state by building effective partnerships between higher education, industry, and government. This report highlights key trends and themes that should be considered when undertaking these efforts, with the goal of generating informed decision-making among North Carolina's policymakers, industries, academic institutions, and citizens.

We invite you to read the report and join in efforts to advance our state's economy.

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Overview

Innovation fuels a knowledge-based economy: it creates new industries, makes existing ones globally competitive, and sustains economic growth. With this report, the fourth in a series of innovation indexes that began with *Tracking Innovation 2000*[1], North Carolina is one of a handful of enterprising states that regularly monitor innovation assets, activities, and trends within their borders.

This 2013 report measures the health of North Carolina's innovation economy. It tracks North Carolina's performance across 38 innovation measures weighed against that of the United States overall, six key comparison states (California, Massachusetts, Georgia, Virginia, Colorado, Washington) and leading countries. These measures provide insights into the links between innovation, resources, and economic results in the North Carolina economy.

Summary Findings

During the most recent time period for which data are available across the report's 38 measures, North Carolina's average rank among the 50 U.S. states is 24th. Its highest single rank is fifth; its lowest single rank is 47th. Additionally, on 27 of the 38 measures, North Carolina's "Percent of U.S. Average Value" is below average, meaning the state underperforms the nation as a whole on those measures *[Dashboard Overview, next page]*.[2]

During the past decade, North Carolina's performance relative to itself varied considerably—on 18 measures it improved, on 10 it declined, and on seven it stayed the same.[3] During that same decade, North Carolina's performance relative to the U.S. also varied considerably—on four measures it improved, on seven it declined, and on 24 it stayed the same. Overall, North Carolina's innovation ecosystem is moderately healthy and has not changed materially in recent history.

Findings by Category

- **Economic Well-Being:** North Carolina has one of the fastest-growing populations in the nation, but the productive capacity of its economy is below average, with a higher-than-average share of its residents either unemployed or with low wages and incomes.
- **Research & Development:** North Carolina excels at academic research & development, but the total level of the state's research & development, particularly that performed by business, is insufficient to fuel and sustain strong economic growth.
- **Commercialization:** North Carolina organizations, particularly its academic institutions, generate significant intellectual property, but the level of the state's commercialization activities must be stronger to realize the full economic and social benefits of that intellectual property.
- **Innovative Organizations:** North Carolina's high-technology sectors have wages well above the U.S. average and are increasing in employment, but a large share of the state's industries and employment is not high-technology in nature and has below-average levels of entrepreneurship.
- **Education & Workforce:** North Carolina has a well-educated and well-trained science & engineering workforce at the more-advanced levels, but the overall educational attainment level of its residents is below average, as is the educational attainment level of a majority of its recent in-migrants.

Across the state, these findings vary considerably by locale, with urban areas, particularly the Research Triangle region, having the greatest share of the assets and activities vital to creating, commercializing, and utilizing innovations.

[1] The NC Board of Science & Technology has produced three innovation indexes during the last 13 years, in 2000, 2003, and 2008. See: http://www.nccommerce.com/scitech/resources/innovation-reports.

[2] The Environment & Infrastructure measures are not included in the Dashboard Overview chart because they are less central to the innovation process. Their inclusion would not change North Carolina's rank. Details regarding each of these measures are available starting on page 57.

[3] Historical data are unavailable for three of the 38 measures.

Dashboard Overview of Measures

Measure	N.C. Rank	N.C. % of U.S. Average Value	N.C. Over Time Relative to its History[1]	N.C. Over Time Relative to the U.S.[1]
ECONOMIC WELL-BEING				
(1.1) Per Capita GDP, 2011	26	95%	↔	▼
(1.2) Per Capita Income, 2011	37	87%	↔	▼
(1.2) Median Household Income, 2011	37	90%	↘	▼
(1.3) Average Annual Wage, 2011	27	88%	▲	▼
(1.4) Unemployment Rate, 2012	47	117%	▼	↘
(1.5) Percentage of Citizens in Poverty, 2011	38	113%	▼	↔
(1.6) Population Growth, 2000-10	6	190%	▲	▲
RESEARCH & DEVELOPMENT				
(2.1) Total R&D Expenditures as a Percentage of GDP, 2008	24	82%	↗	↔
(2.2) Business-Performed R&D as a Percentage of Private-Industry Output, 2008	21	84%	↔	↔
(2.3) Academic S&E R&D per $1,000 of State GDP, 2009	5	136%	▲	↔
(2.4) Federal R&D Obligations per Employed Worker, 2008	23	48%	▲	↘
(2.5) Academic S&E Article Output per 1,000 S&E Ph.D. Holders in Academia, 2008	16	101%	▲	↔
COMMERCIALIZATION				
(3.1) Average Annual SBIR & STTR Funding per $1 Million of GDP, 2008-10	20	85%	↗	▲
(3.2) Academic Patents Awarded per 1,000 S&E Ph.D. Holders in Academia	17	92%	▼	↔
(3.3) Patents Awarded per 1,000 Individuals in S&E Occupations, 2010	18	88%	↗	↔
(3.4) Venture Capital Dispersed per $1,000 of GDP, 2010	10	71%	▼	↔
(3.4) Venture Capital Deals as Percentage of High-Technology Business Establishments, 2008	21	49%	▼	↔
(3.5) Average Annual Academy License Inc. (Gross) as Percentage of Academy. S&E R&D Expenditures, 2009-11	10	110%	NA	NA
(3.5) Average Annual Academy License Inc. (Running) as Percentage of Academy S&E R&D Expenditures, 2009-11	8	157%	▲	↔
INNOVATIVE ORGANIZATIONS				
(4.1) High-Technology Establishments as a Percentage of all Business Establishments, 2008	24	92%	▲	↔
(4.1) High-Technology Business Formations as a Percentage of all Business Establishments, 2008	27	50%	▼	↔
(4.2) Employment in High-Technology Establishments as a Percentage of Total Employment, 2008	29	90%	↔	↔
(4.3) Entrepreneurs per 100,000 People, 2012	23	93%	↔	▼
(4.4) Exports as a Percentage of GDP, 2011	37	62%	↔	↔
EDUCATION & WORKFORCE				
(5.1) Individuals in S&E Occupations as a Percentage of the Workforce, 2010	17	96%	▲	↔
(5.2) Employed S&E Doctorate Holders as a Percentage of the Workforce, 2008	17	104%	▲	↔
(5.3) Engineers as a Percentage of the Workforce, 2008	37	74%	↗	↔
(5.4) B.As in Natural S&E conferred per 1,000 Individuals 18-24 years old, 2009	30	95%	↔	↔
(5.5) Natural S&E Degrees as a Percentage of Total Higher Education Degrees Conferred, 2009	16	109%	↘	↔
(5.6) Educational Attainment of Residents Aged 25 and Over (composite Score), 2011	26	98%	▲	↔
(5.7) Average Years of Education Among In-Migrants, 2011	30	99%	▲	↔
(5.7) In-Migration of College Educated Adults as a Percentage of Total State Population, 2011	29	96%	↘	↔
Average	24[2]			

Legend	
Significantly Improving	▲
Marginally Improving	↗
No Meaningful Change	↔
Marginally Worsening	↘
Significantly Worsening	▼

[1] For each measure, tests of statistical significance were performed for N.C.'s change over time relative to its history and relative to the U.S.'s change over time, respectively. Vertical arrows indicate a level of change that is significant at the five percent level—i.e., for a given measure, the probability is less than five percent that N.C.'s change on that measure over time or relative to the U.S.'s change, respectively, is due to chance. Arrows at an angle indicate a level of change that is significant at the 32 percent level-i.e., for a given measure, the probability is less than 32 percent that N.C.'s change on that measure over time or relative to the U.S.'s change, respectively, is due to chance. Horizontal arrows indicate a change that is not significant.

[2] Assumes measures are weighted equally.

Implications and Priorities

These findings and trends paint a picture of North Carolina that is both beset with challenges but also rich with opportunities. The degree to which North Carolina prospers in response to these challenges depends on how quickly and effectively it addresses them. Drawing on the findings of this report, the following priorities are crucial for growing and developing North Carolina's innovation-fueled economy statewide:

- **Research & Development – Increase Volume and Intensity:** To grow its economy significantly in both the short term and long term, North Carolina must increase the volume and intensity of its research & development efforts—particularly those performed by business—relative to other U.S. states and to leading countries. In the near term it should, at a minimum, strive to be at parity with the U.S. average value. One opportune way North Carolina businesses could achieve this is by closer and more frequent research & development partnerships with the state's universities, which have well-above-average research & development performance, and facilities, equipment, and expertise often beyond the scope of most businesses.

- **Commercialization – Better Leverage Strong Asset Base:** To foster the growth of businesses developing and commercializing innovative technologies, North Carolina's universities should be incentivized and equipped to focus more on company and industry engagement and technology commercialization. Additionally, the state must continue to support its programs focused on capturing and leveraging the benefits of the federal grant programs, such as Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), which provide working capital to emerging companies. These steps alone will make North Carolina more attractive for later-stage commercialization resources such as venture capital, but they must be leveraged further by strategic, proactive efforts to market the state's innovative activities and attract investors and businesses.

- **Innovative Organizations – Boost Entrepreneurship and Business Linkages:** To advance the technology and innovation levels of its existing businesses and to start, grow, and attract new high-technology businesses, North Carolina must ensure that a greater share and range of its population has the training, resources, and support to be entrepreneurial. Similarly, it must enhance and extend programs focused on technology adoption and diffusion, particularly in rural regions with historically lower levels of innovation. In addition, to remain competitive in the global economy, the state must continue to explore new markets for the goods and services it produces, particularly by understanding how North Carolina industries fit within global commodity value chains and deepening and expanding relationships with overseas trading partners.

- **Education & Workforce – Emphasize STEM and Strengthen Core:** To intensify the innovation-relevant education and training levels of its workforce, North Carolina must grow the share of its community college and university-level students earning degrees in science, technology, engineering, and math (STEM) disciplines. One way to achieve this could entail industries, educators, and government regularly collaborating to develop a North Carolina innovation-focused technology workforce agenda and strategy. The strategy could organize education and workforce programs around broad clusters and skills, particularly ones the state has determined to be in its strategic interests. Additionally, North Carolina must raise the educational attainment of its citizens at all levels of the educational spectrum, to a level at least equal to the national average.

- **Environment & Infrastructure – Reinforce, Enhance, and Broaden:** To ensure that the greatest number and range of its citizens enjoy the economic and social benefits of science, technology, and innovation, North Carolina must continue to invest, throughout its regions, in basic infrastructure elements of its innovation economy, such as elementary, secondary, and higher education organizations; broadband deployment and adoption; and industries that use science and technology and a highly skilled workforce to develop, manufacture, distribute, and export products. Combined with North Carolina's low cost of living and high quality of life, these elements provide the richest and most fundamental foundation for starting, growing, and attracting businesses that improve our economic well-being and quality of life.

Efforts such as those above must be sufficiently long-term and well-funded to make a difference, and they must have the flexibility to respond to continually changing circumstances and to support different needs across regions. Moreover, decisions about their continuation and modification must be guided by clear benchmarks and performance criteria, such as those provided and explained in more detail throughout this report.

What are Innovation, Science & Technology?

Innovation is the creation and adoption of new products, services, and business models to yield value. While innovation has many sources, science (systematic knowledge) and technology (the practical application of knowledge) are its fundamental elements. Throughout history, science, technology, and innovation have brought about the development of tools, products, processes, and services such as the wheel, sailing ships, the plow, agricultural irrigation systems, municipal water and sewer systems, the internal combustion engine, the telegraph, audio and video, accounting processes, medicines and medical technologies, and information and communications technologies. Each generation of civilization has built on the technological achievements of prior generations and used them to create new possibilities and wealth and security. In short, science and technology, and their practical advancement via innovation, are what have enabled humans to get—on an ongoing basis—more value out of the earth's natural resources.

Why are Innovation, Science & Technology Important for the Economy?

Through decades of empirical research, economists have documented the central role of science, technology, and innovation in long-term productivity, job growth, output growth, and higher incomes.[1] In terms of productivity and growth, economic studies have valued the return on research, development, and innovation to be four times the return on investment in physical capital.[2] Put another way, between one-third to one-half of economic growth in the United States can be attributed to innovation.[3] And in terms of income, U.S. Bureau of Labor Statistics (BLS) data show that in all but one of 71 technology oriented occupations, the median income exceeds the median for all occupations; moreover, in 57 of these occupations, the median income is 50 percent or more above the overall industry median.[4]

Two fundamental effects of science- and technology-based innovation drive these impacts:

- Innovation empowers product and productivity improvements in *existing* companies;
- Innovation spurs the dynamic creation of *new* companies that create new value.

Together, these effects lead to a virtuous cycle of expanding employment, as well as increased wages and lower prices, all of which expand domestic economic activity and create jobs. A high-productivity, high-employment, high-income, growing economy must be a high-technology, innovation-driven economy. Other economies around the world, recognizing this and aspiring to the U.S. standard of living, have examined the technology-based economic growth process and are progressively evolving public-private asset growth models. The current global trends in investment and innovation are exceeding those in the U.S., and many economies across the globe are now establishing public-private research partnerships to pool risk, improve the efficiency of research and development (R&D), and diffuse innovation and new technology platforms more rapidly across and within domestic supply chains.

Why Tracking Innovation 2013?

A major impediment to the proper design and implementation of policies and programs that help advance innovation is a lack of accurate, comprehensive, and up-to-date information on the various factors related to innovation—R&D performance, innovation rates, technology commercialization rates, trends in high-technology industries, education and training levels of the workforce, and how all these relate to overall economic performance. Nearly all states and regions are grappling with this problem, including North Carolina. Critical questions concern the level of North Carolina's innovative activity, as well as whether it has the proper infrastructure and resources in place to support innovation to its fullest extent. At a minimum, finding the answers requires appropriate and timely baseline information on science, technology, and innovation in the state. This, in turn, will help identify strengths and weaknesses, inform decisions and policy making, and establish benchmarks for measuring effectiveness.

What is Tracking Innovation 2013?

The goal of *Tracking Innovation 2013* is to provide that information in a systematic and accessible format, and therefore to help inform science, technology, and innovation planning and policy at all levels throughout the state. As a follow-up to previous reports tracking North Carolina's innovation performance,[7] this report enables North Carolina to join a growing number of states regularly monitoring innovation trends within and outside their borders. It assembles information from a wide variety of sources to

1 For a review of these studies, see See Tassey 2007, Chapter 3.

2 Jones and Williams 1998, 2000.

3 U.S. Department of Commerce 2012.

4 Hecker 2005.

5 Atkinson and Ezell 2012.

6 Atkinson and Stewart 2012.

7 The NC Board of Science & Technology has produced three innovation indexes during the last decade, in 2000, 2003, and 2008. See: http://www.nccommerce.com/scitech/resources/innovation-reports. While the 2008 report was titled "Advancing Innovation" rather than "Tracking Innovation," it includes a detailed innovation index in "Chapter 2: North Carolina's Innovation Performance."

document innovation-related activity in North Carolina, six comparison states, and the U.S. Its 38 measures are summarized under 31 broad indicators of innovation, technology, and economic well-being. Each of the 31 indicators, in turn, falls into one of six general categories:

- **Economic Well-Being** (e.g., gross domestic product, income level and distribution)
- **Research & Development** (e.g., R&D expenditures, academic articles)
- **Commercialization** (e.g., intellectual property, commercialization funding)
- **Innovation Organizations** (e.g., high-technology establishments, entrepreneurs)
- **Education & Workforce** (e.g., science & engineering occupations, educational attainment)
- **Environment & Infrastructure** (e.g., support for education, broadband access)

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

What is the Methodology of Tracking Innovation 2013?

Innovation Ecosystem

Innovation occurs in an "innovation ecosystem"—the complex and dynamic collection of people, organizations, cultures, policies, and programs that creates innovative ideas and discoveries, translates those ideas into innovative products, services and business models, and enhances existing organizations and builds new organizations to improve our economic well-being and quality of life *[Figure 1, next page]*.

Accordingly, any effort to measure innovation comprehensively, accurately, and effectively in North Carolina should:

1. Focus on multiple components of the state's innovation ecosystem;
2. Include multiple indicators for each component.

The indicators included in this report meet these two goals while capturing, to the extent possible, the intersection of both what we *want* to measure and what we *can* measure using available data sources.[8] It also compares these indicators on multiple dimensions—spatially & temporally[9]—to generate a rich and comprehensive understanding of the health of North Carolina's innovation ecosystem.[10]

Data Sources

The report relies primarily on existing secondary data sources (see detailed listing on page 72). In rare cases, and unless otherwise noted, no surveys or other forms of primary data collection were undertaken to assemble measures. Additionally, all measures are:

- As current and accurate as possible;[11]
- Derived from objective and reliable data sources;
- Easy to understand and compare across states;
- Relevant and of interest to the public.

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

State-by-State Comparisons

For the point-in-time comparisons focused on the most recent periods possible, the report presents information for the U.S. average and each of the 50 states in bar-chart form. This enables a comprehensive and informative assessment of where North Carolina currently fares relative to the nation overall and to each of the 49 other states. In addition, to enable a more targeted assessment of North Carolina's performance relative to a handful of important states, the report highlights North Carolina's performance on each measure to that of the following six "comparison states:"

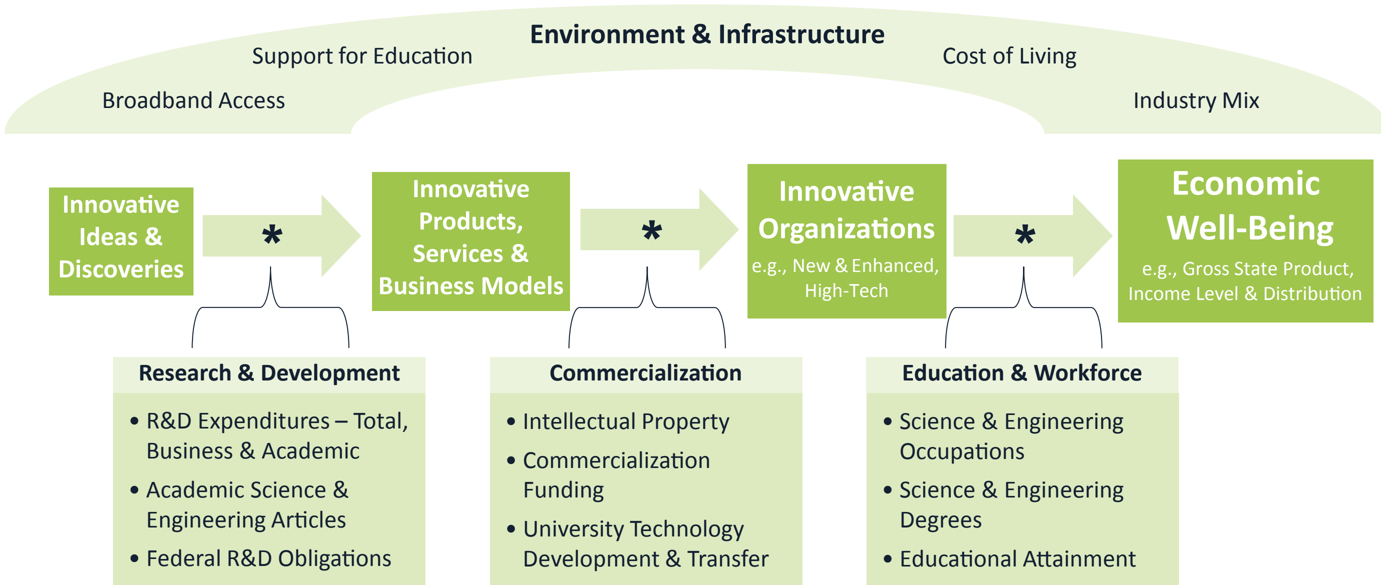
8 This acknowledges the oft-cited aphorism that "Not everything that can be measured matters, and not everything that matters can be measured."

9 The typical over-time period assessed in this report ranges from 2000 to the most recent year(s) for which current data are available, most often 2010, 2011, or 2012. For virtually all the indicators, there is a one- to three-year lag time between the current year (2013) and the most recent year for which data are available. This is because obtaining comprehensive (across all 50 states) data that are both reliable and accurate is labor intensive and time consuming and must be done with care and rigor.

10 The index is analogous to the results of regular, comprehensive medical examination designed to evaluate and understand the health of a person. In this case, the health of North Carolina's innovation ecosystem is being evaluated.

11 For a small number of indicators, the most current data are from as far back as 2008, and therefore may not reflect the sharp economic downturn beginning that year.

Figure 1 - Innovation Ecosystem



- Two leading technology states (California and Massachusetts)
- Two strong southeastern states (Georgia and Virginia)
- Two midrange but "up and coming" technology states (Colorado and Washington)[12]

For the over-time comparisons, the report presents information only for North Carolina, the U.S. average, and the six comparison states in line-chart form.[13] This enables an informative assessment of how North Carolina has fared relative to the nation overall and to each of the six comparison states over time, in particular the extent to which North Carolina is gaining ground, losing ground, or holding its own.[14]

International and Within-North Carolina Comparisons
An enhancement in this report, not available in previous *Tracking Innovation* reports, is the addition, when available, of international data (in the form of a selected set of 20 comparison countries)[15] and within-North Carolina data (most often in the form of county level data, but occasionally at other levels, such as ZIP code, city, Metropolitan Statistical Area (MSA), or university).[16] These additional levels of comparison provide deeper context for evaluating North Carolina's performance, particularly the within-North Carolina data, which provide a more nuanced understanding of the location and concentration of innovation-related factors throughout the state.[17]

[12] California and Massachusetts typically rank high on several indicators of science and technology. Georgia and Virginia are typically regarded as leading southeastern technology states with which North Carolina competes. Colorado and Washington often rank close to North Carolina on various innovation indicators and have improved their rankings significantly in recent years.

[13] Line charts including all 50 states are too detailed to interpret meaningfully.

[14] To facilitate a comparison of North Carolina's performance relative to that of the U.S. average and the six comparison states, the following color scheme is used on all charts: North Carolina (bold green), U.S. average (bold blue), California (pale red), Massachusetts (pale yellow), Georgia (pale purple), Virginia (pale orange), Colorado (pale blue), and Washington (pale green).

[15] The comparison countries were selected by computing, for each country, the average of its ranking on the following three factors: (1) the absolute size of its gross domestic product (GDP), (2) its per-capita GDP, and (3) the average of its ranking on the following two factors in the *2013 Global Manufacturing Competitiveness Index:* (a) its "current competitiveness" ranking and (b) its "competitiveness in five years" ranking, as derived from 550 survey responses from senior manufacturing executives around the world. The top 20 countries were selected as the comparison countries. For example, using this methodology, the United States ranks first, with an average score of 6.7 across the three factors (1*.33)+(15*.33)+(4*.33)=6.7; similarly, China, for example, ranks 14th, with an average ranking of 29 across the three factors (2*.33)+(84*.33)+(1*.33)=29. This average ranking is valuable because it includes both objective and subjective measures of each country's competitiveness. The above-referenced Index, produced by Deloitte Touche Tohmatsu Limited and the Council on Competitiveness, is available at: http://www.deloitte.com/view/en_US/us/Industries/Process-Industrial-Products/manufacturing-competitiveness/mfg-competitiveness-index/index.htm.

[16] For each indicator, the decision regarding the level at which to display the data was determined by a combination of (a) the most precise level at which accurate and comprehensive data were available and (b) the level at which displaying the data proved most informative for the purposes of this report.

[17] Accurate and reliable international and within-North Carolina data are available much less often than are state-level data. Hence, not every indicator includes international and within-North Carolina data.

Interpreting the Data

The data in this report are voluminous and can be overwhelming, and therefore must be interpreted appropriately and carefully. To that end, several points should be kept in mind:

- ***Values for most indicators are expressed as ratios or percentages.*** "This "standardizes" the data by controlling for factors such as state population and GDP, thus enabling an "apples to apples" comparison.

- ***Small differences in rankings and changes in value over time are not significant***. Accordingly, for each indicator, tests of statistical significance were performed for North Carolina's change over time relative to its history and relative to the U.S.'s change over time, respectively. In the text description accompanying each indicator, the words "significant" or "significantly" are used only when differences across rankings or values over time surpassed a minimum and commonly accepted level of significance—i.e., at least one standard deviation away from the mean value of the data. In some cases, what appears to be a large difference in percentages is not, in fact, a statistically significant difference. Care was taken not to overinterpret the data.

- ***Broad patterns and trends matter most.*** While it is tempting to draw conclusions based on a comparison of a small number of states or years (e.g., two or three),those conclusions are far less valid and compelling than ones based on a comparison of a larger number of states and years.

- ***Interpretation of an indicator should not be made in isolation.*** While each indicator, by itself, provides valuable information, that value increases dramatically when judged in light of the information provided by other indicators, as each is just one component of the larger interconnected innovation ecosystem. Moreover, whereas some indicators primarily reflect outcomes (e.g., gross state product, educational attainment, income levels, poverty levels), others primarily reflect causes or the broader environment and context (e.g., R&D expenditures, support for education, broadband access, industry mix). As such, each should be evaluated in light of its place in the ecosystem (see Figure 1).

- ***Data for states with smaller populations are less precise and may be misleading.*** While the data for states with small populations are correct in that they reflect what is available, they should potentially be discounted because the smaller number of observations means their error level may be higher and their smaller magnitude may be less meaningful and impactful overall.

- ***"Rankings tend to divert attention from the actual value of a given measure, which often is more important.*** On many indicators, there is very little statistically significant variation between state ranks, which simply are an ordinal-level measure.[18] This is most true for rankings with a low level of variation across the distribution, in which case the difference between the top-ranked state and the lowest-ranked state may be small and not particularly meaningful. Thus, in this report North Carolina's actual value (a ratio or percentage) on each indicator is reported, in addition to its rank (which is revealed by default in each graphic), permitting more meaningful interpretation of the findings. When measuring North Carolina's performance, it is better to know both its national rank and its percent of U.S. value. Each tells us something unique and helps us make sense of the other. Together, they provide more information than they would by themselves. The two numbers typically track together (e.g., when one is high, so is the other). When they don't, it typically is when a small number of states dominate U.S. activity (e.g., see Venture Capital in indicator 3.4) or when there is little statistically significant difference between states.

We hope you find the data informative and useful.

[18] Ordinal-level measures allow only for the rank order (1st, 2nd, 3rd, etc.) by which data can be sorted, but do not allow for relative degree of difference between the data.

Indicator 1.1: *Gross Domestic Product (GDP)*[1]

Key Findings

- **North Carolina's per capita GDP ranks below the U.S. average, has since at least 2000, and is increasing at a rate slower than the U.S. average.**
- **In comparison with top foreign countries, North Carolina's per capita GDP ranks approximately 20th overall but is increasing at a much slower rate.**
- **Within North Carolina, only two Metropolitan Statistical Areas (MSAs) had higher per capita GDPs than the national average for MSAs in 2010; since 2000, the per capita GDP of most of North Carolina's MSAs has increased at a rate slower than the U.S. average.**

Indicator Overview

Gross domestic product (GDP) per capita captures the overall economic performance of a locale (e.g., state, country, or region). GDP is a measure of the total value of goods and services produced by an economy; on a per capita basis, GDP provides a measure of the productive capacity of a locale's workforce. Although GDP is influenced by a wide range of factors—many of which are unrelated to the state's innovation economy—one of the ultimate aims of fostering innovation is to increase per capita GDP and other related indicators of economic performance.

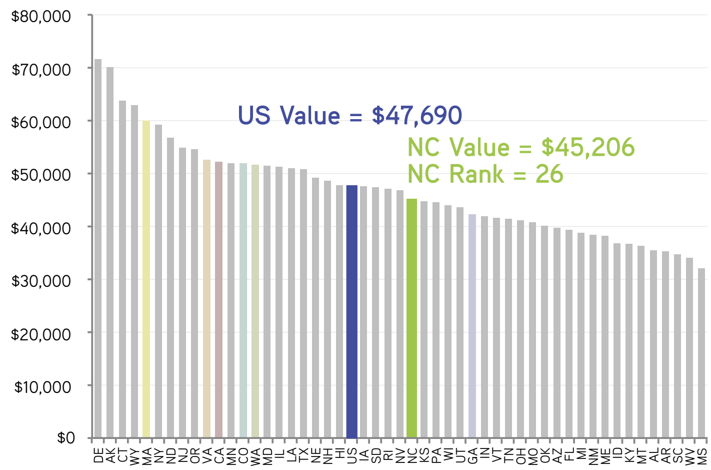
How Does North Carolina Perform?

In 2011, North Carolina's per capita GDP of $45,206 was below the national average ($47,690) and in the middle of the individual state distribution, ranking 26th overall *[1.1a]*. All comparison states except Georgia had an average per capita GDP above the national average. Since 2000, inflation-adjusted per capita GDP has increased in North Carolina by 1.9 percent. This percentage increase is slower than the 5.8 percent growth for the nation *[1.1b]*. Indeed, North Carolina has fallen from the 20th-ranked state in per capita GDP in 2000 to 26th in 2011. Among comparison states, only Colorado (1.5 percent) and Georgia (-7.0 percent) have experienced lower growth in per capita GDP.

Internationally, U.S. per capita GDP was the 15th highest in the world in 2011 *[1.1c]*. Many of the countries ahead of the U.S. have unique economies (often heavily dependent on native natural resources) and small populations, however, which explains their high per capita GDP levels. In comparison with top foreign countries, North Carolina's per capita GDP ranks approximately 19th overall, between that of Japan and Germany. While highly populated countries such as China and India have large absolute GDP's, their per-capita GDP's remain relatively small, ranking 84th and 131st, respectively.

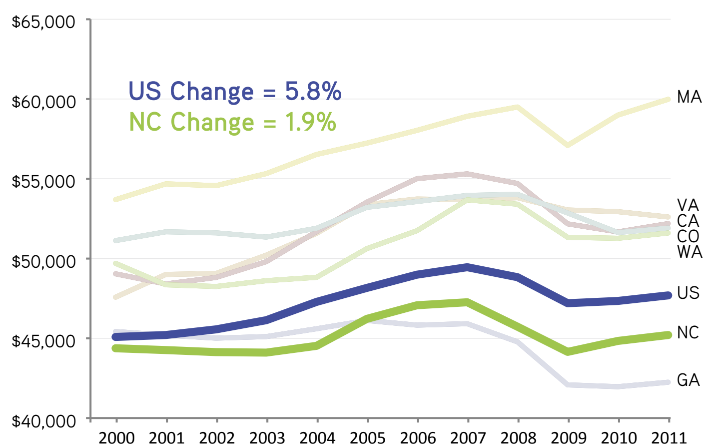
[1] For the purposes of this report, the term "gross domestic product (GDP)" is used as a general counterpart to the more specific terms "gross state product (GSP)" at the state level, "gross regional product (GRP)" at the regional level, and "gross metro product (GMP)" at the metropolitan statistical area level.

1.1a–Per Capita Gross Domestic Product, All U.S. States, 2011



Source: U.S. Bureau of Economic Analysis

1.1b–Per Capita Gross Domestic Product, Comparison States, 2000-2011
Adjusted for Inflation (2011 Dollars)



Source: U.S. Bureau of Economic Analysis

Indicator 1.1: *GDP, continued*

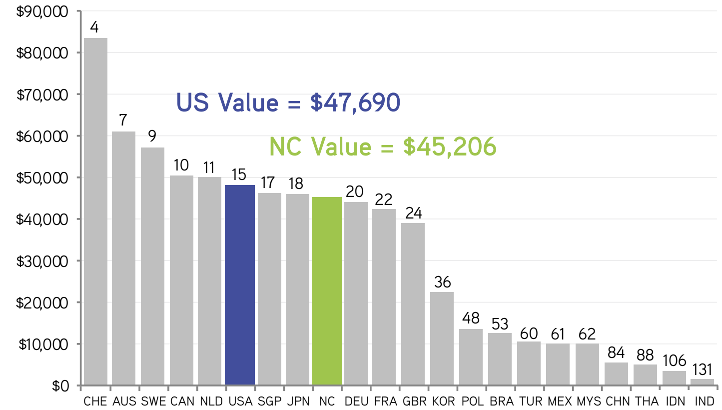
Since 2000, the per capita GDP of each of the 20 comparison countries except Mexico has risen at a much faster rate (an average of 67 percent across the countries) than that of the U.S. (5.8 percent) and North Carolina (1.9 percent) *[1.1d]*. Additionally, while the per capita GDP of all the 20 comparison countries was considerably lower than that of the U.S. and North Carolina in 2000, by 2011 the per-capita GDP in five countries had risen to be higher than the U.S.'s and North Carolina's, and the per-capita GDP in another five countries had risen to be nearly equal to the U.S.'s and North Carolina's. While the per-capita GDP in the remaining 10 comparison countries remained relatively low between 2000 and 2011, their average growth rate was 64 percent, with China's GDP growing especially rapidly at 256 percent and India's growing at 77 percent. Also notable was Poland's growth rate, at 125 percent.

Within North Carolina, only two Metropolitan Statistical Areas (MSAs)—Durham-Chapel Hill, and Charlotte-Gastonia-Rock Hill—had higher per capita GDPs than the U.S. average in 2010 *[1.1e and 1.1g]*. The remaining 11 metro areas fell below the U.S. average. Durham-Chapel Hill excelled over the past decade, increasing per capita GDP by 38 percent from 2001 to 2010 *[1.1f]*. Over the same time period, the U.S. average increased by 6 percent, and other large North Carolina MSAs such as Charlotte-Gastonia-Rock Hill and Raleigh-Cary declined, by 4 percent and 3 percent respectively; most other North Carolina MSAs (except Jacksonville and Fayetteville) grew at a slower rate than the U.S. average or declined overall.

What Does This Mean for North Carolina?

Trends in per capita GDP in North Carolina are a cause for concern. As of 2011, the state performed slightly below average in comparison with all U.S. states. Additionally, the North Carolina value has grown more slowly over the past decade than has the value for the nation as a whole and that of virtually all comparison countries. Because per capita GDP measures the ability of the state economy to support residents and weather economic turbulence, it is important that North Carolina improve this statistic by taking smart steps to grow the economy. Fostering innovation is one such step; the value added by innovation can improve productivity and is often compensated with jobs, income, and profit.

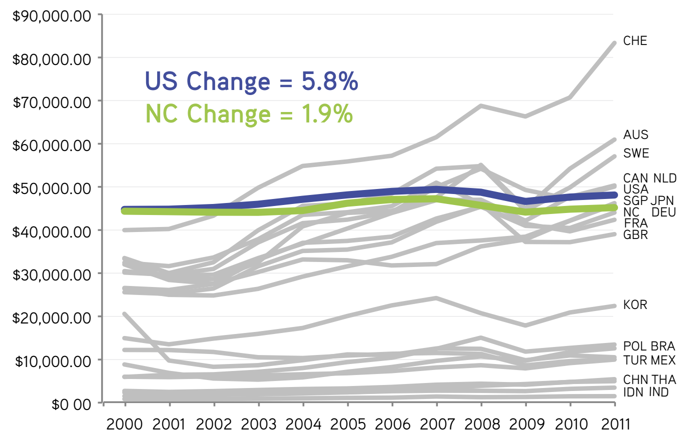
1.1c–Per Capita Gross Domestic Product, Comparison Countries, 2011



Source: World Bank

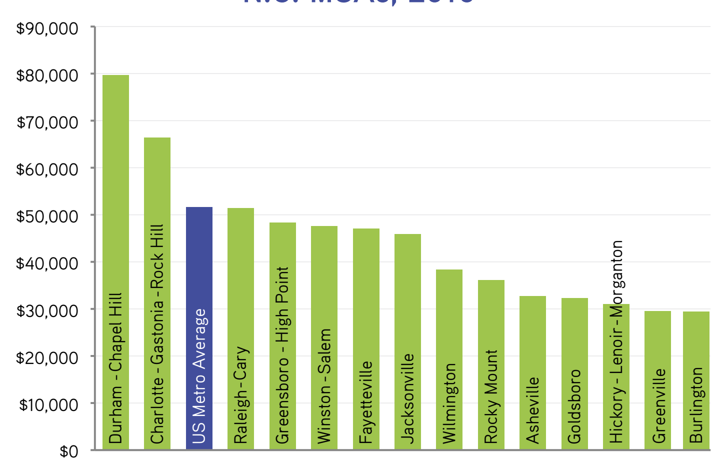
1.1d–Per Capita Gross Domestic Product, Comparison Countries, 2000-2011

Adjusted for Inflation (Current Dollars)



Source: World Bank

1.1e–Per Capita Gross Domestic Product, N.C. MSAs, 2010

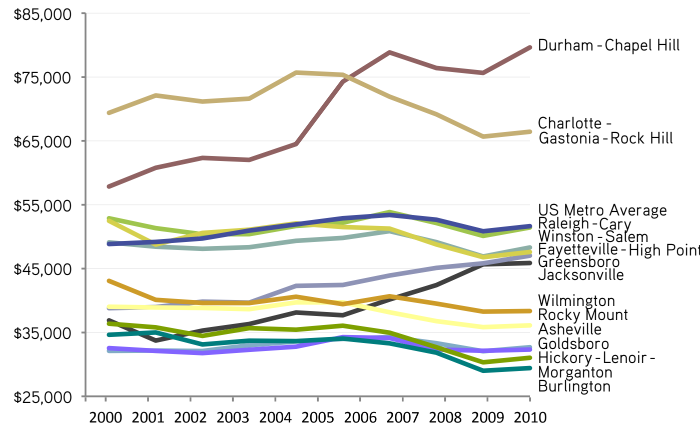


Source: U.S. Bureau of Economic Analysis

Indicator 1.1: *GDP, continued*

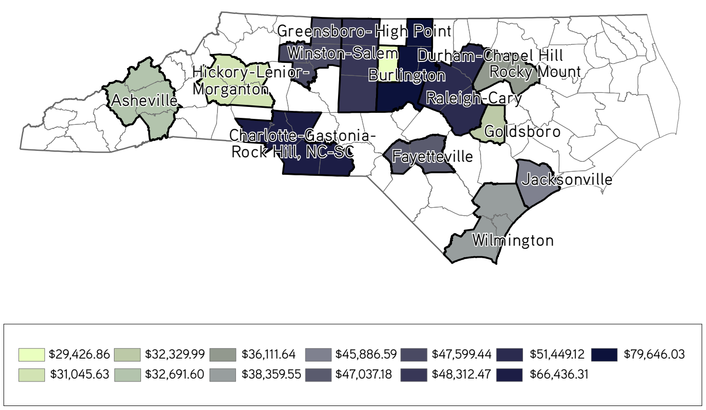
1.1f–Per Capita Gross Metro Product, N.C. MSAs, 2000-2010

Adjusted for Inflation (2005 Dollars)



Source: U.S. Bureau of Economic Analysis

1.1g–Per Capita Gross Metro Product, N.C. MSAs, N.C. Counties, 2010



Source: Quarterly Census of Employment and Wages, Labor and Economic Analysis Division, NC Department of Commerce

Indicator 1.2: *Income*[1]

Key Findings

- **North Carolina's per capita income ranks below the U.S. average, has since at least 2000, and, adjusted for inflation, is staying roughly the same while the U.S. per capita income is increasing.**
- **North Carolina's median household income ranks below the U.S. average, has since at least 2000, and, adjusted for inflation, is decreasing at a rate faster than the U.S. median household income is decreasing.**
- **Within North Carolina, county per capita income and median household income vary considerably. In both income measures, most North Carolina counties possess incomes below the state average and the U.S. average.**

Indicator Overview

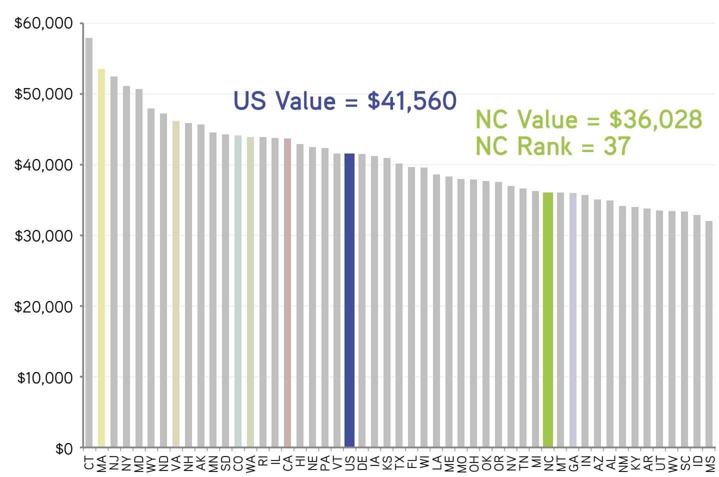
The two measures of income examined within this indicator—per capita income and median household income—can be used to approximate economic prosperity and the ability of the economy to generate improved standards of living for its citizens. Per capita personal income is the total income received from all sources divided by the total population; it measures the amount of wealth generated by an economy from wages and salaries, transfer payments, dividends, interest, rents and proprietor's income for each person in that economy. Per capita income may, however, obscure differences in income distribution, as it depends somewhat on demographics, such as the share of a state's population that is of working age. Thus, to add more clarity to North Carolina's income picture, median household income—the income amount at which half of all households fall above and half of all households fall below—is included here as a second measure of income. Median household income provides insight into changes in economic conditions for middle-income households.

How Does North Carolina Perform?

Per capita personal income in North Carolina was $36,028 in 2011 *[1.2a]*. This income is 87 percent of the national per capita personal income ($41,560) and places North Carolina as the 37th highest performing state in the country. Since 2000, the inflation-adjusted per capita personal income in North Carolina decreased very slightly by 1.2 percent even as per capita income increased by 4.9 percent for the country as a whole *[1.2b]*. North Carolina's per capita personal income falls below all comparison states except Georgia. Georgia is also the only comparison state that has witnessed a greater decline in per capita income since 2000. Over the same period, per capita income in some comparison states has increased faster than the national average; for example, per capita income increased in Massachusetts by 7.1 percent and in Virginia by 11.6 percent.

[1] Income measures in this indicator do not account for differences in cost of living. Thus, the income earned in one state may provide a citizen in that state with more or less purchasing power than the same income provides a citizen in a different state. See indicator 6.3 for cost of living comparisons.

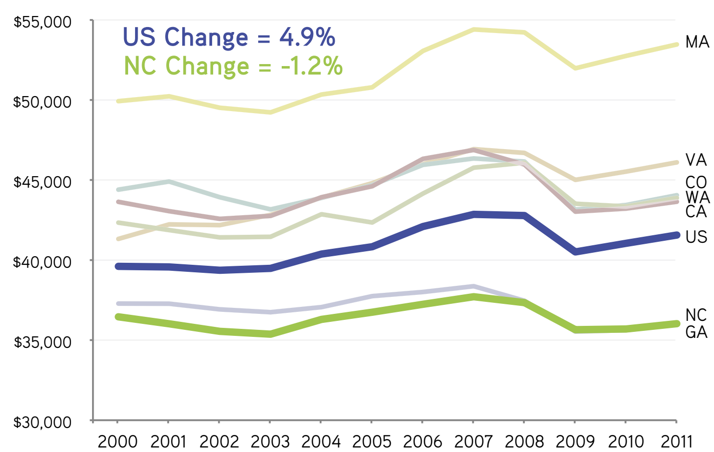
1.2a–Per Capita Income, All U.S. States, 2011



Source: U.S. Bureau of Economic Analysis

1.2b–Per Capita Income, Comparison States, 2000–2011

Adjusted for Inflation (2011 Dollars)



Source: U.S. Bureau of Economic Analysis

Indicator 1.2: *Income, continued*

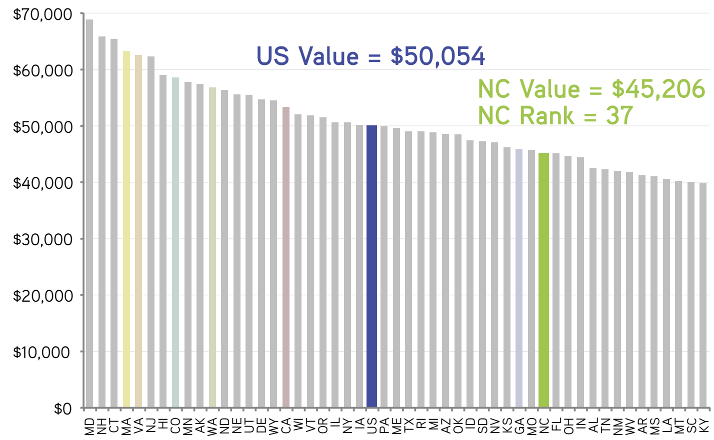
North Carolina's performance in median household income mirrors its performance in per capita income *[1.2c]*. With a median household income of $45,206 in 2011, North Carolina ranks 37th in the nation and possesses a median income that is 90 percent of the national average ($50,054). Furthermore, North Carolina had the lowest median household income among all comparison states. Along with Georgia and California, North Carolina median household income decreased at a faster rate from 2005 to 2011 (-6.4 percent) than did the national median household income (-5.2 percent) *[1.2d]*.

Within North Carolina, 18 counties have a per capita income higher than the state average, and six have a per capita income higher than the U.S. as a whole *[1.2e]*. The low number of counties above the state average indicates that high-income counties like Orange County and Chatham County, with per capita incomes of more than $48,000, skew the distribution. Although the state per capita income decreased from 2005 to 2011, 47 counties experienced per capita income growth over that period. Twenty-one counties had a median household income higher than the state average, and nine counties had a median income higher than the U.S. median income from 2007 to 2011. Median household income ranged from $65,289 in Wake County to $29,326 in Bertie County.

What Does This Mean for North Carolina?

Per capita personal income and median household income in North Carolina compared unfavorably with the U.S. and comparison states in 2011 and 2010, respectively, the most recent years for which data were available. Furthermore, historical data show that North Carolina's performance has been comparatively poor over time. Stagnant income growth indicates that the state economy may not be generating new opportunities for households to increase wealth and standards of living. Occupations in the innovation economy are often compensated with high incomes; to the extent that more individuals can enter the innovation economy, North Carolina income performance will improve. This may be accomplished through measures like improving education levels in the workforce and increasing the share of high-technology, innovative companies in the state's economy.

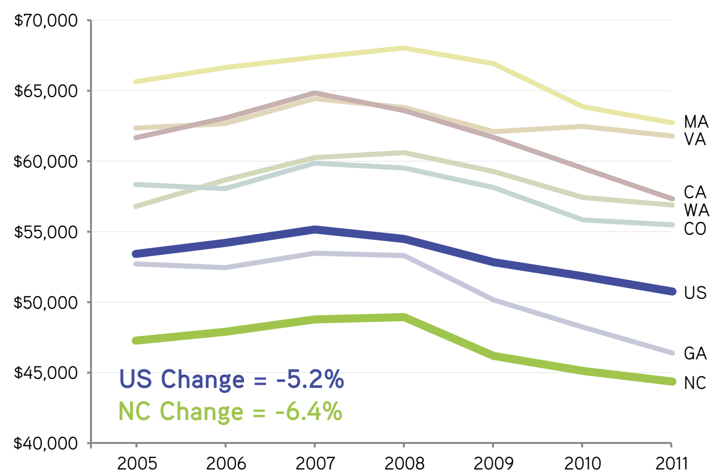
1.2c–Median Household Income, All U.S. States, 2011



Source: U.S. Census Bureau

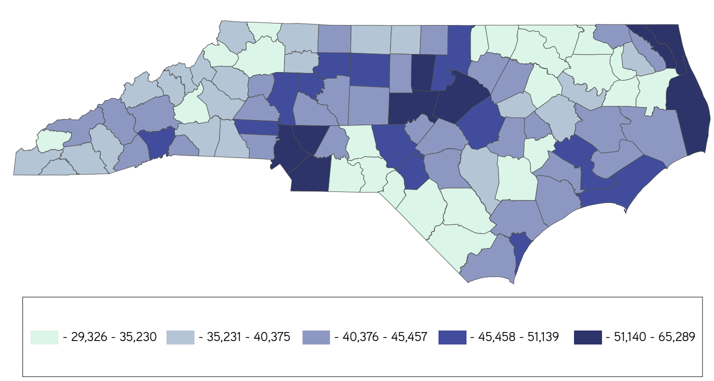
1.2d–Median Income, Comparison States, 2000–2011

Adjusted for Inflation (2011 Dollars)



Source: U.S. Census Bureau

1.2e–Median Household Income, N.C. Counties, 2007–2011 Average



Source: U.S. Census Bureau

Indicator 1.3: *Average Annual Wage*

Key Findings

- **North Carolina's average annual wage in 2011 ranked considerably below the U.S. average and the average wages of all comparison states.**
- **Between 2000 and 2011, North Carolina's inflation-adjusted average wage increased but was outpaced by the U.S. average wage and the average wages of all but one of the comparison states.**
- **Within North Carolina, only four counties had average annual wages higher than the state average annual wage in 2011.**
- **Average annual wages for STEM (Science, Technology, Engineering, Mathematics) occupations in North Carolina are consistently much higher than the average annual wages for all occupations.**

Indicator Overview

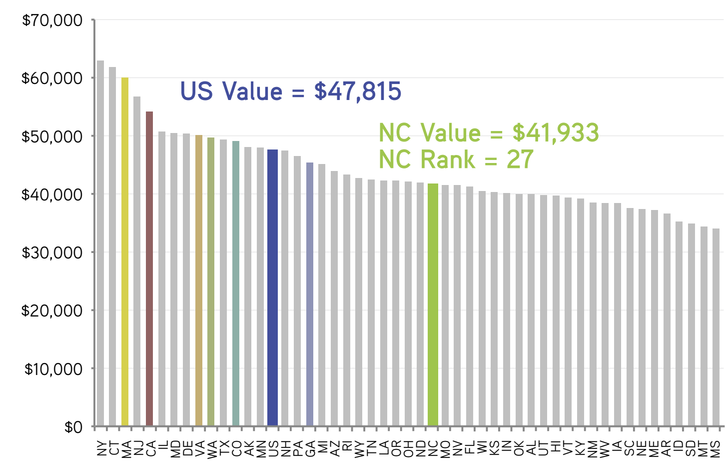
An economy's average annual wage reflects and provides insight into its mix of jobs. Low average annual wages typically indicate that an economy has a high percentage of low-wage jobs that may be in low-technology and labor-intensive economic sectors. High average annual wages typically indicate that a state's industry mix provides a larger share of middle- and high-wage jobs and generates relatively high standards of living. Enhancing North Carolina's innovation-based economy can lead to higher average annual wages, ultimately leading to greater economic well-being and quality of life.

How Does North Carolina Perform?

In 2011, the average annual wage in North Carolina was $41,933, ranking the state 27th highest in the country and well below the national average of $47,815 *[1.3a]*. All six comparison states had higher average wages than North Carolina; Georgia is the only other comparison state with an average wage lower than the national average. North Carolina's modest performance results primarily from the industry mix of its economy, which continues to depend—more than most other states do—on low-technology industries that are sensitive to labor costs. From 2001 to 2011, the inflation–adjusted average annual wage in North Carolina grew by 3.5 percent, which is lower than the national growth rate (4.1 percent) and the rate for all comparison states, except Georgia and Colorado *[1.3b]*. In 2012, the average annual wage for STEM workers in North Carolina was $73,513, more than $30,000 greater than average wages for all occupations *[1.3c]*.

This pattern reflects national patterns, in which the STEM occupation average wage of $78,561 is 58 percent greater than the average wage for all occupations. Within North Carolina, the vast majority of counties have an average annual wage lower than the state average. Only four counties—Durham, Mecklenburg, Wake and

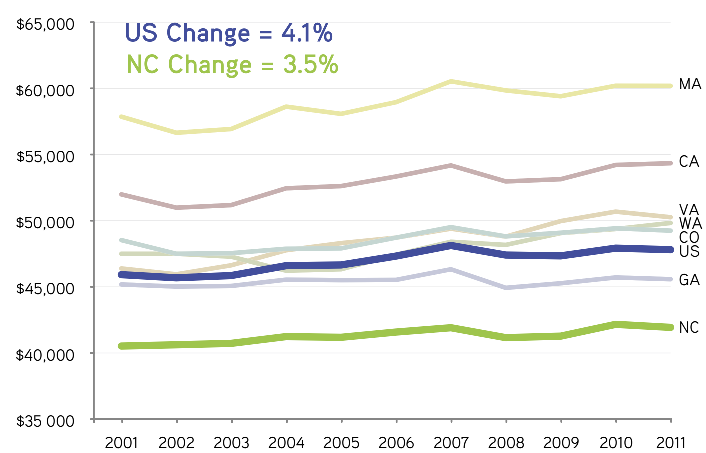
1.3a–Average Annual Wage, All U.S. States, 2011



Source: Bureau of Labor Statistics, U.S. Department of Labor

1.3b–Average Annual Wage, Comparison States, 2001–2011

Adjusted for Inflation (2011 Dollars)



Source: Bureau of Labor Statistics, U.S. Department of Labor

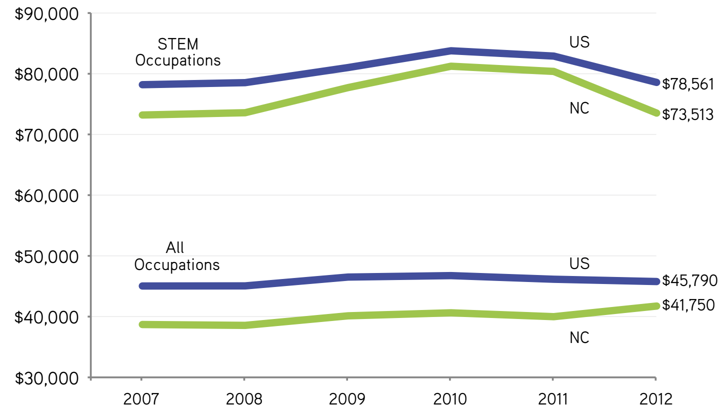
Forsyth—had a 2011 average wage higher than the state average *[1.3d]*. This pattern reflects the fact that high-wage, innovation-based jobs typically are concentrated in a few, typically urban, counties.

What Does This Mean for North Carolina?

North Carolina's average annual wage in 2011 was below the average annual wage for the nation as a whole and for all comparison states. Moreover, while average wages in North Carolina have increased over time, this increase has been slower than the growth experienced by the country as a whole. Overall, the wage picture in North Carolina has significant room to improve. A key way to increase wages is to increase the number of workers employed in STEM and other knowledge-based occupations. Growth in these occupations will lead to higher standards of living for North Carolinians, increased consumer spending, and economic growth across the state.

1.3c–Average Annual Wage, STEM Occupations and All Occupations, U.S. and N.C., 2007-2012[1]

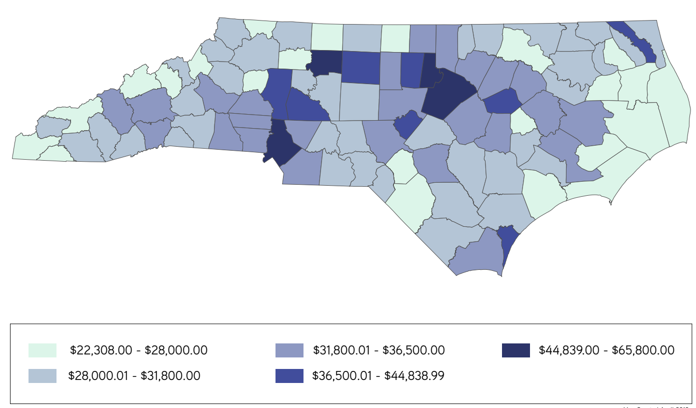
Adjusted for Inflation (2012 Dollars)



Source: Bureau of Labor Statistics, U.S. Department of Labor

[1] The U.S. Bureau of Labor Statistics (BLS) defines STEM-related occupations as those that are related to science (such as agriculture and food scientists, biological and chemical technicians), technology (often primarily related to computing and information technology), engineering (including the design of physical facilities or products as well as the related drafting activities), and math fields (including statistician, actuaries, accountants, and bookkeepers). This distinction is important because not all jobs within high-technology industries, for instance, are STEM-related jobs, just as not all STEM-related jobs are found in high-technology industries. A complete listing of the occupations defined as STEM occupations can be found at: http://www.online.onetcenter.org/find/stem. For more information regarding the importance of STEM occupations, see the *2011 State of the North Carolina Workforce* report, available at http://www.nccommerce.com/workforce/about-us/plans-policies-reportsinitiatives/reports.

1.3d–Average Annual Wage, N.C. Counties, 2011



Source: Bureau of Labor Statistics, U.S. Department of Labor

Indicator 1.4: *Unemployment*

Key Findings

- **North Carolina's unemployment rate ranks higher than the U.S. average, has since 2001, and has risen at a rate faster than the national rate since 2000.**
- **In comparison with top foreign countries, North Carolina's unemployment rate is considerably higher.**
- **A large majority of North Carolina counties have unemployment rates higher than the state average.**

Indicator Overview

The unemployment rate is the percentage of labor force participants who are unemployed but actively seeking and available for work. Unemployment is generally viewed as a lagging indicator that reflects the performance of an economy. Unemployment rates indicate the degree to which an economy provides sufficient jobs to its labor force; higher rates show a relative inability to generate job opportunities.

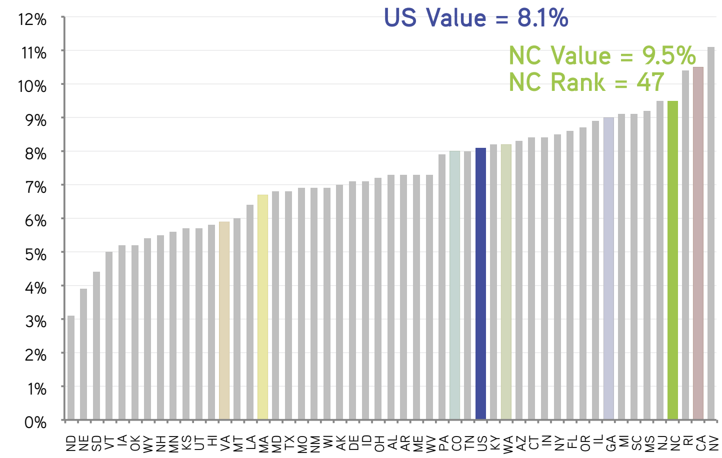
How Does North Carolina Perform?

The average unemployment rate for North Carolina in 2012 was 9.5 percent *[1.4a]*. This unemployment rate compares unfavorably to the national unemployment rate of 8.1 percent and is the fourth-highest rate of all states in the country. Among comparison states, only California had a higher average unemployment rate in 2012. Virginia, Massachusetts, and Colorado all had average unemployment rates lower than the national average. Over time, the North Carolina unemployment rate has risen faster than the national rate; North Carolina's unemployment rate increased by 157 percent from 2000 to 2012. This increase was greater than the national increase (103 percent) and the increase in all comparison states *[1.4b]*.

Internationally, the U.S. had the 68th lowest unemployment rate in the world in 2011 *[1.4c]*. Turkey is the only comparison country with a higher unemployment rate. Relative to the comparison countries, North Carolina's unemployment rate is considerably higher, with virtually all the comparison countries having much lower unemployment rates.

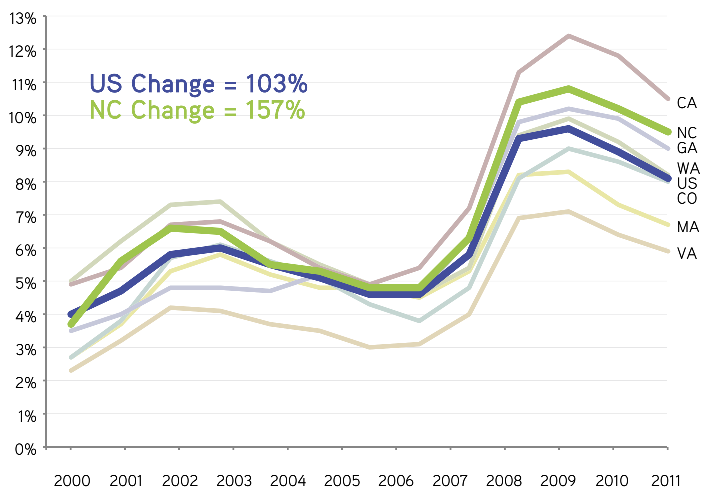
Since 2000, the unemployment rate of each of the 20 comparison countries has risen at a much slower rate (an average of 18 percent across the countries) than that of the U.S. (140 percent percent) and North Carolina (192 percent) *[1.4d]*. Additionally, while the unemployment rate in most of the 20 comparison countries was considerably higher than that of the U.S. and North Carolina in 2000, by 2011 the unemployment rate in all the comparison countries except Turkey was lower than the U.S.'s and North Carolina's. In large part, this change in relative rankings—with the U.S. and North

1.4a–Unemployment Rate, All U.S. States, 2012



Source: Bureau of Labor Statistics, U.S. Department of Labor

1.4b–Unemployment Rate, Comparison States, 2000–2012



Source: Bureau of Labor Statistics, U.S. Department of Labor

Indicator 1.4: *Unemployment, continued*

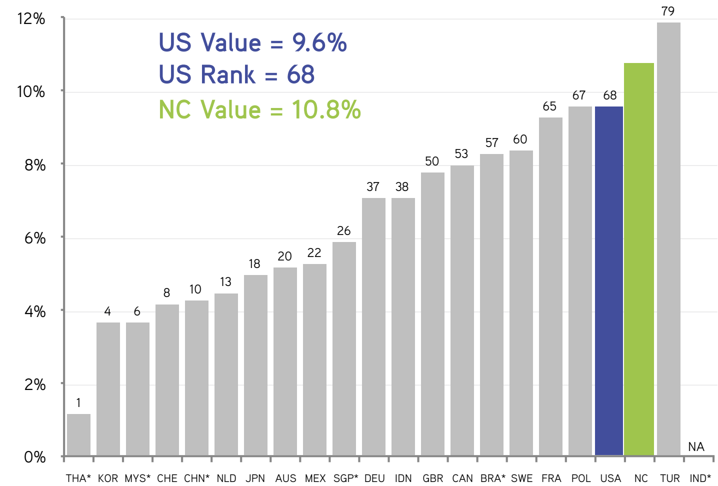
Carolina experiencing higher unemployment rates in recent years—results from the economic downturn in the U.S. economy beginning in 2008. This downturn hit North Carolina especially hard, due primarily to its disproportionate unemployment impact on sectors such as Financial Services and Manufacturing, in which North Carolina has a higher-than-average presence.

Within North Carolina, there is significant variability in unemployment across counties *[1.4e]*. Unemployment rates were lower than the state average in 31 counties in 2011; at 6.7 percent, Orange County had the lowest unemployment rate of all counties. The remaining 69 counties possessed unemployment rates higher than the state average. Scotland County, with unemployment at 17.5 percent, possessed the highest rate in the state.

What Does This Mean for North Carolina?

In terms of unemployment, North Carolina compares unfavorably with other states and the comparison countries. High unemployment in North Carolina indicates that the North Carolina economy is relatively ineffective at providing job opportunities for its labor force. Growing the innovation economy would serve to increase employment in STEM fields, and would also have strong multiplier effects in industries seemingly unrelated to technology and innovation. As the North Carolina economy continues to shift, the job creation potential of the innovation economy could help the state to replace jobs in declining industries.

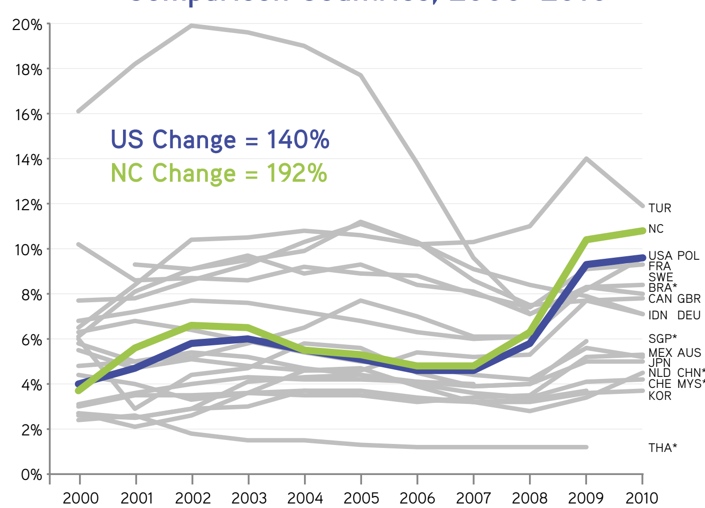
1.4c–Unemployment Rate, Comparison Countries, 2010



Source: International Labour Organization

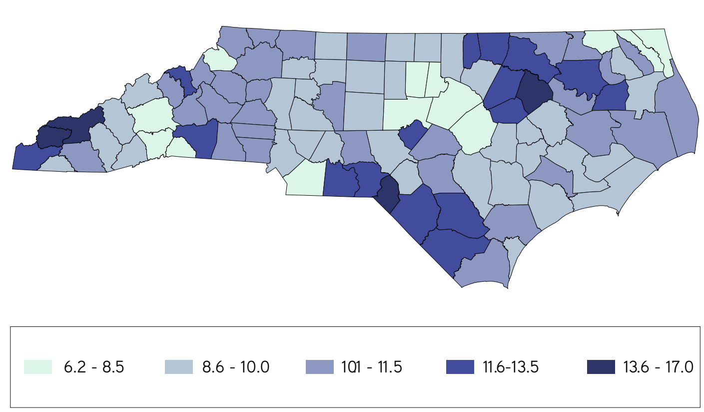
* Indicates an unemployment rate taken from 2009 because 2010 data were unavailable.

1.4d–Unemployment Rate, Comparison Countries, 2000–2010



Source: International Labour Organization

1.4e–Unemployment Rate, N.C. Counties, 2011



Source: Bureau of Labor Statistics, U.S. Department of Labor

Indicator 1.5: *Poverty*

Key Findings

- **The percentage of North Carolinians in poverty ranks above the U.S. average and has since at least 2005.**
- **Within North Carolina, the percentage of the population living in poverty varies greatly; the majority of counties had higher average poverty levels than the state average.**

Indicator Overview

This indicator explores the extent to which the North Carolina innovation economy provides opportunities for the entire state workforce. Monitoring poverty is important for examining the effects of the state economic shift from a low-skill manufacturing-based economy to one based on knowledge use and production. High or widespread poverty levels indicate that advances in the innovation economy are failing to translate into greater opportunity for all North Carolinians. On the other hand, low or improving poverty levels may suggest that the high-wage jobs associated with the knowledge-based economy are leading to the improved economic standing of all North Carolinians.

How Does North Carolina Perform?

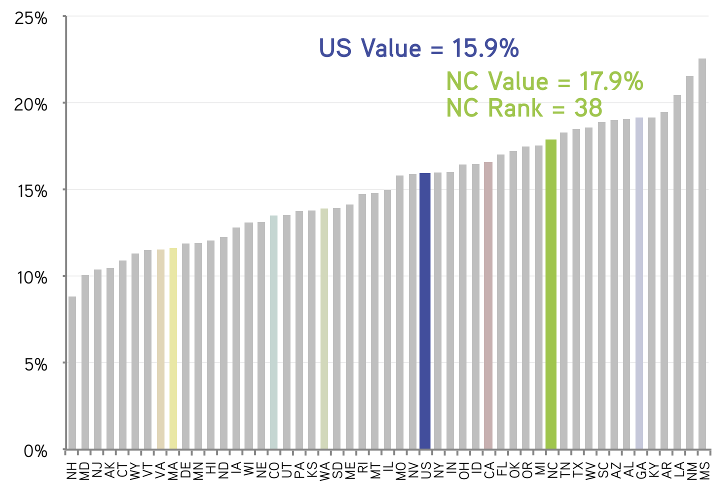
In 2011, 17.9 percent of North Carolinians lived in poverty *[1.5a]*. This is above the national poverty percentage of 15.9 percent and makes North Carolina the 13th-poorest performing state in the country in terms of poverty. North Carolina's rank places it below all comparison states except Georgia. The majority of comparison states possessed a poverty percentage below the national average. Over time, North Carolina's poverty percentage has increased by 2.8 percent from 2005 to 2011 *[1.5b]*. This percentage increase is slightly larger than the national increase (2.6 percent) and all comparison states except California (3.3 percent) and Georgia (4.7 percent).

Five-year average poverty within North Carolina (2007–2011) ranged from 7.8 percent in Currituck County to 30.6 percent in Robeson County, with a state average of 16.2 percent *[1.5c]*. Thirty-five counties had an average poverty level lower than the state five-year average; sixty-five counties had an average poverty level higher than the state five-year average.

What Does This Mean for North Carolina?

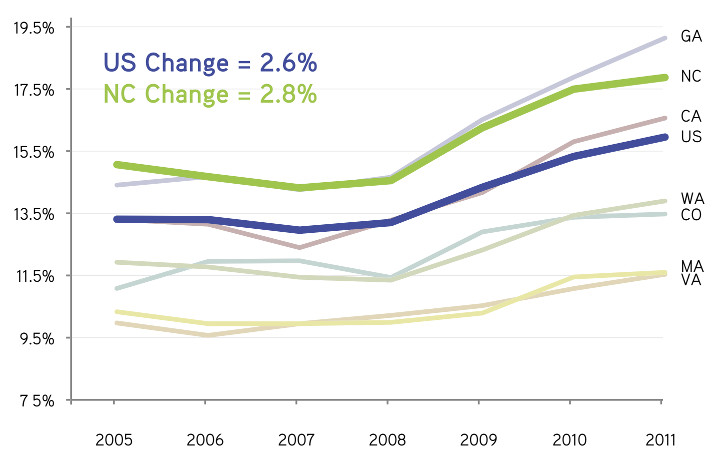
Current levels and over-time trends related to poverty in North Carolina are negative. As the North Carolina economy becomes increasingly reliant on knowledge-based jobs, it will be vitally important that no segment of the population be isolated without means of generating income. North Carolina policy should seek to reduce poverty, and income inequality more generally, to

1.5a–Percentage of Citizens in Poverty, All U.S. States, 2011



Source: U.S. Census Bureau

1.5b–Percentage of Citizens in Poverty, Comparison States, 2005–2011

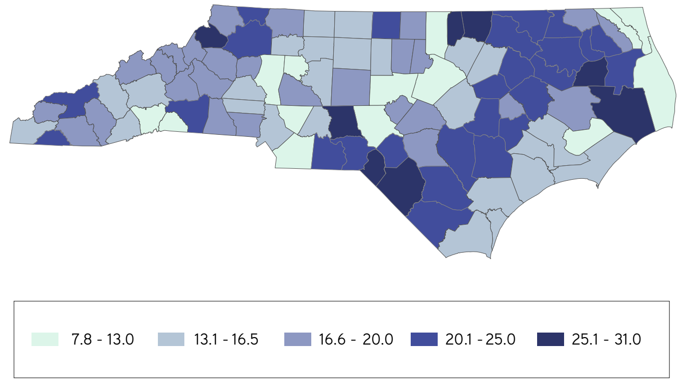


Source: U.S. Census Bureau

Indicator 1.5: *Poverty, continued*

ensure that the economy of the future, highly reliant on innovation and knowledge production, generates economic opportunities for all citizens.

1.5c–Percentage of Population Below Poverty Level, N.C. Counties, 2007–2011 Average



Source: U.S. Census Bureau

Indicator 1.6: *Population Growth*

Key Findings

- **Since 2000, North Carolina's population has grown nearly twice as fast as the U.S. average.**
- **Within North Carolina, the location and growth of the population are highly concentrated in a small number of counties.**

Indicator Overview

This indicator measures the extent to which North Carolina's total population is growing over time. For a given state, three components make up population growth: (1) natural growth—the excess of births over deaths; (2) in-migration—the movement of people from another state; and (3) immigration—the movement of people from outside the country to the state. Changes in population have social and economic implications that influence business-location decisions, infrastructure demands, and service requirements. Population growth is also considered an indicator of economic and social opportunities, as people often move to regions where there are job opportunities or a high quality of life.

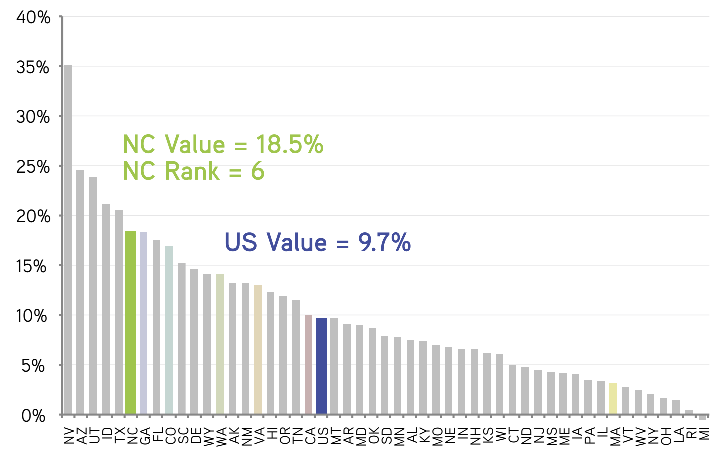
How Does North Carolina Perform?

In 2010, North Carolina ranked as the 10th most populous state in the country, with a total resident population of 9,535,483. In terms of percentage change in population between 2000 and 2010, North Carolina ranks sixth in the nation, with a value that is 190 percent of the U.S. value and 53 percent of the value of the top-ranking state, Nevada *[1.6a]*.[1] Among the comparison states, North Carolina ranks first, slightly ahead of Georgia and Colorado, and well ahead of Washington, Virginia, and California, all of which are growing faster than the U.S. average. Massachusetts is the only comparison state whose rate of population growth is below the U.S. average.

Within North Carolina, the location and growth of the population are highly concentrated in a small number of counties *[1.6b]*. In terms of location, the three most populous counties account for nearly 25 percent of the state's population—Mecklenburg (9.6 percent), Wake (9.4 percent), and Guilford (5.1 percent). Together, the 11 next most populous counties—Forsyth (3.7 percent), Cumberland (3.3 percent), Durham (2.8 percent), Buncombe (2.5 percent), Gaston (2.2 percent), New Hanover (2.1 percent), Union (2.1 percent), Cabarrus (1.9 percent), Onslow (1.9 percent), Johnston (1.8 percent), and Pitt (1.8 percent)—account for nearly 26 percent of the state's population. In total, this means that 14 of the state's 100 counties account for slightly more than half the state's population.

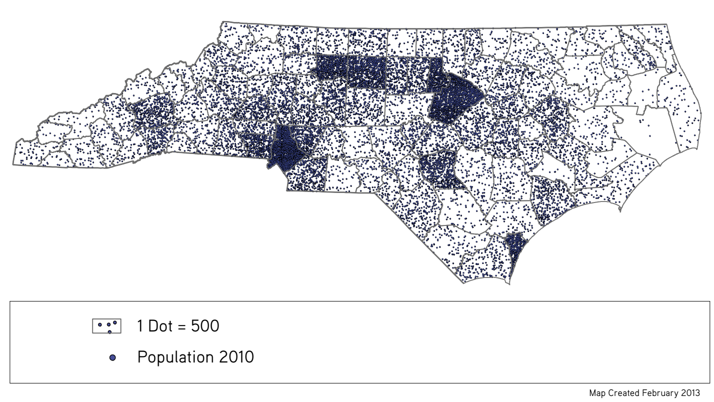
[1] Fifty percent of this growth is attributable to in-migration, and 16 percent is attributable to immigration (*2011 North Carolina Economic Index* available at http://www.nccommerce.com/lead/research-publications/current-publications/ economic-reports).

1.6a–Percentage Change in Population, All U.S. States, 2000–2010



Source: U.S. Census Bureau

1.6b–Location of Population in N.C., 2010



Source: U.S. Census Bureau

Indicator 1.6: *Population Growth, continued*

Each of the 16 next most populous counties—Davidson, Iredell, Catawba, Alamance, Randolph, Rowan, Robeson, Orange, Wayne, Harnett, Brunswick, Henderson, Craven, Cleveland, Nash, and Rockingham—has between 1.7 and 1.0 percent of the state's population, a percentage greater than or equal to each county's respective share (1 percent) of the total number of counties (100). These 16 counties, plus the 14 more populous ones, account for 72.3 percent, or nearly three-fourths of the state's total population. Each of the remaining 70 counties has less than one percent of the state's total population, and together they account for 27.7 percent of the state's total population.

In terms of growth, the level of concentration is even greater than the distribution of population *[1.6c]*. Two counties account for 33 percent of the population growth between 2000 and 2010—Wake (18.4 percent) and Mecklenburg (15.1 percent). Together, the next five counties—Union (5.2 percent), Guilford (4.5 percent), Cabarrus (3.2 percent), and Johnston (3.2 percent), and Forsyth (3.0 percent)—account for another 16.1 percent of the state's population growth. In total, this means that seven of the state's 100 counties account for slightly more than half the state's population growth between the two most recent decennial censuses. To reach 75 percent of the state's population growth, only 11 more counties (for a total of 18) are needed—Forsyth (3 percent), Durham (3 percent), New Hanover (2.9 percent), Iredell (2.5 percent), Pitt (2.3 percent), Brunswick (2.3 percent), Buncombe (2.2 percent), Onslow (1.8 percent), Harnett (1.6 percent), Alamance (1.4 percent), Henderson (1.2 percent), and Cumberland (1.1 percent). Each of the remaining 82 counties has one percent or less of the state's total population growth[2], and together they account for 25.3 percent of the state's total population growth.

What Does this Mean for North Carolina?

The relationship between population growth and economic well-being is strong and positive, as evidenced by high rates of population growth in counties and regions ranking high on the indicators of economic well-being (see indicators 1.1–1.5). North Carolina will continue to experience population growth from in-migrants and immigrants into those locales having high economic output, employment opportunities, and high wages. To the extent state leaders want that growth to continue, and to the extent that it actually does continue, the need to enhance and grow infrastructure (schools, utilities, roads/transit, broadband, water/sewer, etc.) will increase as well.

1.6c - Population Change, North Carolina Counties, 2000-2010

County	Population 2000	Population 2010	Absolute Change	Percent of Total Change	Cumulative Percent of Total Change
Wake	627,846	900,993	273,147	18.4%	18.4%
Mecklenburg	695,454	919,628	224,174	15.1%	33.5%
Union	123,677	201,292	77,615	5.2%	38.7%
Guilford	421,048	488,406	67,358	4.5%	43.2%
Cabarrus	131,063	178,011	46,948	3.2%	46.4%
Johnston	121,965	168,878	46,913	3.2%	49.5%
Forsyth	306,067	350,670	44,603	3.0%	52.5%
Durham	223,314	267,587	44,273	3.0%	55.5%
New Hanover	160,307	202,667	42,360	2.9%	58.4%
Iredell	122,660	159,437	36,777	2.5%	60.8%
Pitt	133,798	168,148	34,350	2.3%	63.2%
Brunswick	73,143	107,431	34,288	2.3%	65.5%
Buncombe	206,330	238,318	31,988	2.2%	67.6%
Onslow	150,355	177,772	27,417	1.8%	69.5%
Harnett	91,025	114,678	23,653	1.6%	71.0%
Alamance	130,800	151,131	20,331	1.4%	72.4%
Henderson	89,173	106,740	17,567	1.2%	73.6%
Cumberland	302,963	319,431	16,468	1.1%	74.7%
82 Other	3,938,325	4,314,265	375,940	25.3%	100.0%
Total	8,049,313	9,535,483	1,486,170	100.0%	100.0%

Source: U.S. Census Bureau

[2] Six counties had negative population growth.

Indicator 2.1: *Total Research & Development (R&D)*

Key Findings

- **North Carolina's total R&D expenditures as a percentage of gross domestic product (GDP) ranks below the U.S. average and has since at least the early 2000s, but is increasing at a rate faster than the U.S. average.**
- **In comparison with top foreign countries, North Carolina's total R&D expenditures as a percentage of GDP ranks approximately 14th overall and is increasing at a faster-than-average rate.**
- **Businesses perform nearly three-fourths of the R&D in North Carolina and are most concentrated in metropolitan regions; more than 80 percent of the university R&D is concentrated in the Research Triangle region.**

Indicator Overview

R&D expenditures refer to R&D activities funded by businesses, universities, nonprofit organizations, and federal and state agencies. R&D is the driving force behind innovation and sustained economic growth. Organizations performing R&D create new product or process innovations, thus expanding markets and sales, stimulating investment, and ultimately creating jobs. Companies located near R&D centers benefit from shared knowledge and expertise and are often the first to adopt new product and production technologies.

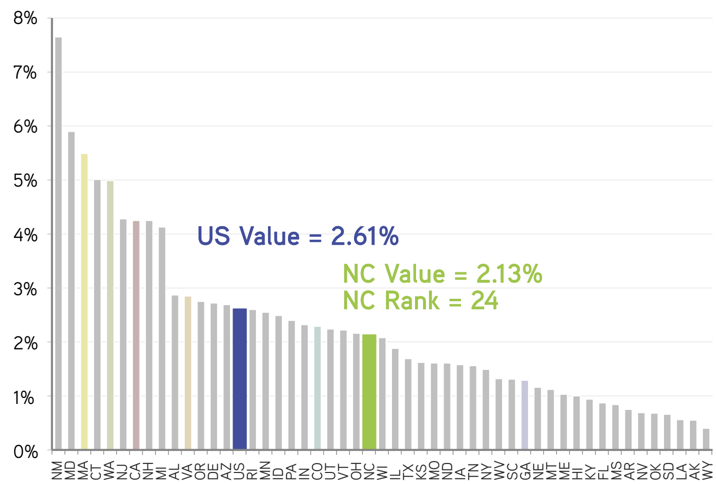
How Does North Carolina Perform?

In terms of total R&D (industry + academic + all other) as a percentage of gross state product, North Carolina's value ranks 24th in the nation, with a level that is 82 percent of the U.S. value *[2.1a]*. In other words, the total amount of R&D in North Carolina is only 82 percent of what we would expect based on national levels of R&D. Moreover, the value of its total R&D is only one-fourth the value of the top-ranking state, New Mexico.

This modest ranking reflects the relative distribution of academic R&D to industry R&D within North Carolina and nationally. Specifically, North Carolina's academic R&D level per state GDP (see indicator 2.3) is more than 136 percent of the U.S. level, while its industry R&D level per industry output (see indicator 2.2) is only 84 percent of the U.S. level and one-third of the leading state's (Connecticut). Nationwide and in North Carolina, industry R&D accounts for more than 70 percent of total R&D, meaning that North Carolina's low rate of industry R&D puts it at a competitive disadvantage in total R&D. Since 2000, however, North Carolina's total R&D rate has been growing more than three times faster than the U.S. rate, narrowing the gap between the two *[2.1b]*.

Internationally, the U.S. was the 8th most R&D-intensive country in 2011, 72 percent the intensity of the leading country, Sweden *[2.1c]*. In comparison with top foreign countries, North Carolina's R&D intensity ranks approximately 14th overall, between that of Australia and

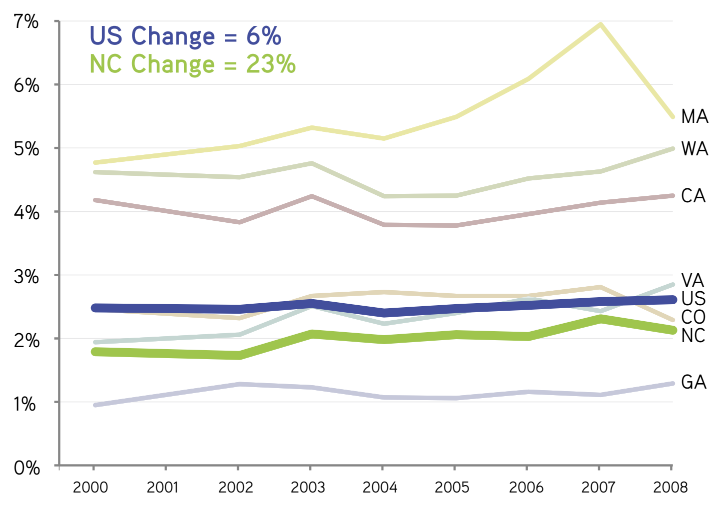
2.1a–Total R&D Expenditures as Percentage of GDP, All U.S. States, 2008



Source: National Science Board

The high values for NM and MD result primarily from the activity of large federal labs — Los Alamos and Sandia National Laboratory in NM, and Department of Defense laboratories and NASA's Goddard Space Flight Center in MD. Other states with large federal facilities, such as AL, RI, and VA, also rank high in R&D.

2.1b–Total R&D Expenditures a Percentage of GDP, Comparison States, 2000–2008



Source: National Science Board

Indicator 2.1: *Total R&D, continued*

France. Since 2000, however, the R&D intensity of many of the most R&D-intensive countries has risen steadily, and often at a much higher rate than in the U.S. and North Carolina *[2.1d]*. These other countries increasingly are making larger investments in R&D to fuel their economies.

Within North Carolina, R&D is highly concentrated in a pattern that reflects the location of the state's population and research universities. Data indicating the location and level of all R&D within North Carolina are not available[1], but mapping the location of all manufacturing businesses (which conduct approximately 70 percent of all industry R&D) and universities in North Carolina provides a rough approximation *[2.1e]*. While it is reasonable to assume more balanced rates of R&D across industries, the rate of R&D across universities is not equal, with more than 80 percent occurring in the Research Triangle Region[2]. In general, this pattern suggests that R&D is most concentrated in metropolitan regions, particularly those with major research universities.

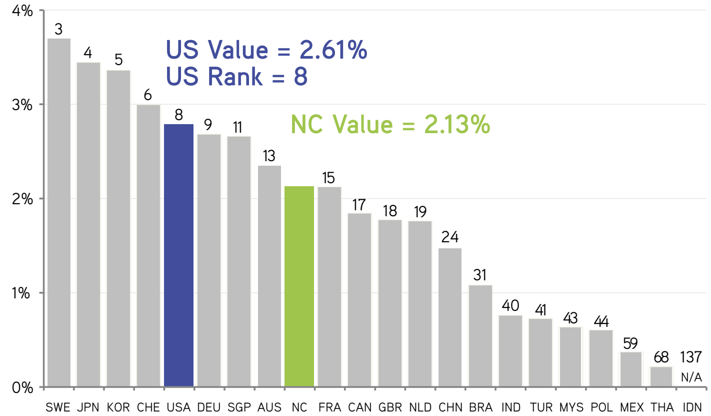
What Does This Mean for North Carolina?

For North Carolina to grow its economy significantly in both the short term and long term, it needs to increase the volume and intensity of its R&D efforts relative to other U.S. states and to leading R&D-intensive countries. In the near term it should, at a minimum, strive to be at parity with the U.S. value. Given the R&D strengths of its universities, an efficient and effective way NC industry could achieve this goal is by tighter and more frequent R&D partnerships with the state's universities, which have above-average research expenditures.

[1] Business-performed R&D information is proprietary to the businesses and not currently available in a systematic, accurate form. However, in 2008 the National Science Foundation (NSF) launched a new Business R&D and Innovation Survey (BRDIS) to better understand and measure how R&D is conducted in today's innovation-and global-based economy. Data from the pilot survey and subsequent surveys are beginning to be incorporated into NSF's reports and statistics. Based on those data, future releases of the *Tracking Innovation in North Carolina* report will provide more precise measures of industry R&D in North Carolina.

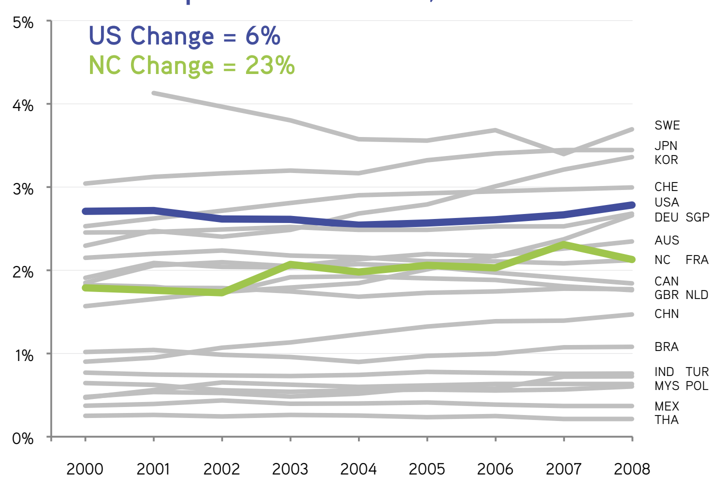
[2] The extent to which this approximation is accurate depends on the size of the businesses and the industry mix across the states. In general, large companies conduct more research than small companies do. Moreover, the NSF BRDIS survey indicates that four manufacturing industry groups—Chemicals, Computer and Electronic Products, Aerospace and Defense, and Automotive—account for more than half the business-performed R&D.

2.1c–Total R&D Expenditures as Percentage of GDP, Comparison Countries, 2008



Source: National Science Board

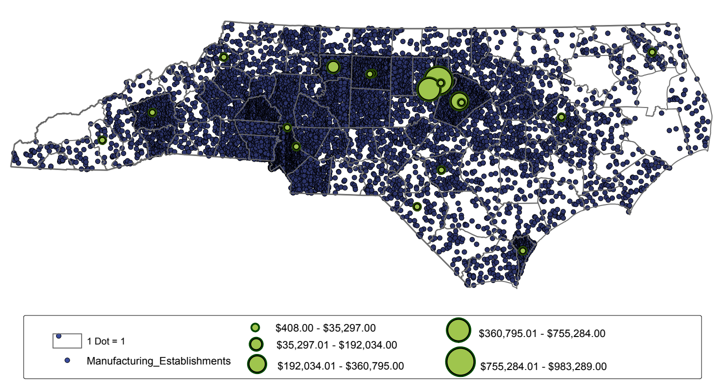
2.1d–Total R&D Expenditures as Percentage of GDP, Comparison Countries, 2000–2008



Source: National Science Board

2.1e–Location of R&D Expenditures in N.C., 2010

Businesses establishments perform 73% of R&D in NC; of that, Mfg. establishments perform 70%; universities perform 23% of R&D in NC



Source: Quarterly Census of Employment and Wages, Labor & Economic Analysis Division, NC Department of Commerce

Indicator 2.2: *Industry R&D*

Key Findings

- **North Carolina's business-performed R&D as a percentage of private-industry output ranks below the U.S. average and has exhibited little overall change since 2000.**
- **Within North Carolina, business-performed R&D is highly concentrated in a pattern that reflects the location of the state's population.**

Indicator Overview

The business sector is the largest performer of U.S. R&D. Nationwide, business-performed R&D accounts for more than half of all U.S. applied research funding and more than 80 percent of all development funding. For a given state, a high value for this indicator shows that businesses within the state are making a large investment in their R&D activities. Across states, this indicator reflects state differences in industrial structure as well as the behavior or priorities of individual businesses. Private-industry output, against which the level of business-performed R&D is normalized for this indicator, is the portion of state gross domestic product contributed by state businesses.

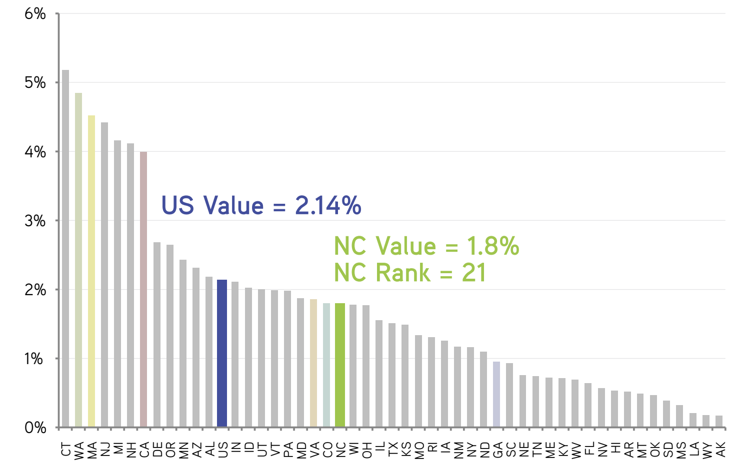
How Does North Carolina Perform?

In terms of business-performed R&D as a percentage of private-industry output, North Carolina's value ranks 21st in the nation, with a level that is 84 percent of the U.S. value *[2.2a]*. In other words, the level of business-performed R&D in North Carolina is only 84 percent of what we would expect based on national levels of business-performed R&D. Moreover, the value of North Carolina's business-performed R&D as a percentage of private-industry output is only slightly less than half the value of the top-ranking state, Connecticut.

This modest ranking reflects North Carolina's economic history, which is heavily based in agricultural, industrial, and branch-plant operations. Because of this, comparatively few companies within the state have significant research operations, which typically locate at or near company headquarters, often located outside of North Carolina. Since 2000, North Carolina's business-performed R&D rate has remained relatively flat, as has the rate for the U.S. overall *[2.2b]*.

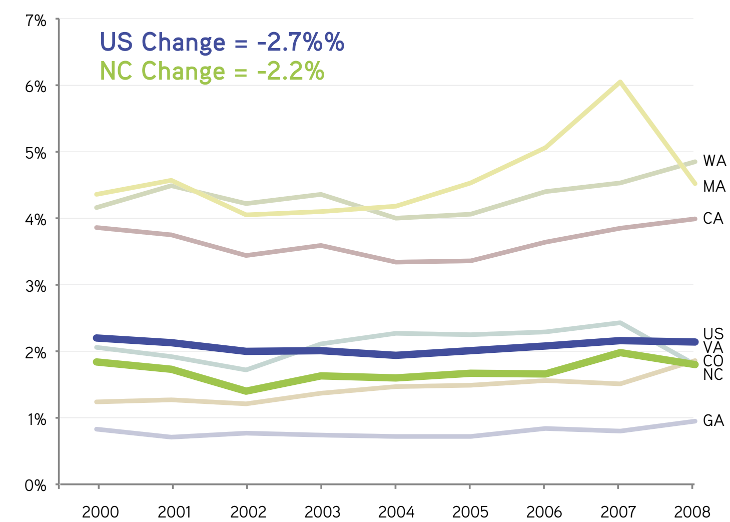
Within North Carolina, business-performed R&D is highly concentrated in a pattern that reflects the location of the state's population *[2.2c]*. Data indicating the location and level of business-performed R&D within North

2.2a–Business-Performed R&D as a Percentage of Private-Industry Output, All U.S. States, 2008



Source: National Science Board

2.2b–Business-Performed R&D as Percentage of Private-Industry Output, Comparison States, 2000–2008



Source: National Science Board

Indicator 2.2: *Industry R&D, continued*

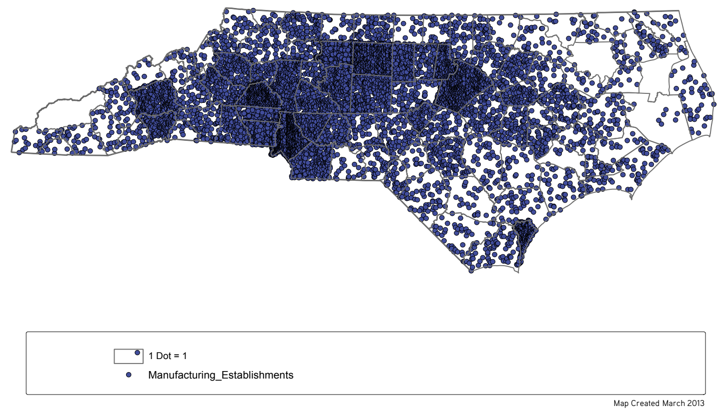
Carolina are not available,[1] but mapping the location of all manufacturing businesses (which conduct approximately 70 percent of all business-performed R&D) in North Carolina provides a fair approximation. Assuming roughly equal rates of R&D across the businesses, the distribution of manufacturing businesses across the state gives an approximation of the distribution of industry R&D across the state.[2] In general, the pattern suggests that business-performed R&D is most concentrated in metropolitan regions, which are the home to the majority of the state's manufacturing businesses.

What Does This Mean for North Carolina?

For North Carolina to grow its economy significantly in both the short term and long term, it needs to increase the level and intensity of business-performed R&D relative to that in other U.S. states. In the short term, an efficient and effective way the state's businesses could achieve this goal is by tighter and more frequent R&D partnerships with the state's universities, which have above-average R&D expenditures and can serve as strong R&D partners with the businesses. This approach may also prove useful in the longer term, as trends over the past several decades reveal that businesses increasingly partner with universities to conduct R&D, which often requires facilities, equipment, and expertise beyond the scope and budgets of most businesses. The largest determinant of North Carolina's level of business-performed R&D is its industrial structure, however, which currently exhibits a lower-than-average share of high-tech establishments (see, e.g., indicators 4.1–4.3 and 6.4). For North Carolina to increase its business-performed R&D appreciably, it will need to increase the share of high-tech, innovation-focused businesses in its economy.

2.2c–Location of Business R&D Expenditures in N.C., 2010

Business establishments perform 73% of R&D in NC; of that, Mfg. establishments perform 70%



Source: Quarterly Census of Employment and Wages, Labor & Economic Analysis Division, NC Department of Commerce

[1] Business-performed R&D information is proprietary to the businesses and not currently available in a systematic, accurate form. However, in 2008 the National Science Foundation (NSF) launched a new Business R&D and Innovation Survey (BRDIS) to better understand and measure how R&D is conducted in today's innovation-and global-based economy. Data from the pilot survey and subsequent surveys are beginning to be incorporated into NSF's reports and statistics. Based on those data, future releases of the Tracking Innovation in North Carolina report will provide more precise measures of industry R&D in North Carolina.

[2] The extent to which this approximation is accurate depends on the size of the businesses and the industry mix across the states. In general, large companies conduct more research than small companies do. Moreover, the NSF BRDIS survey indicates that four manufacturing industry groups—Chemicals, Computer and Electronic Products, Aerospace and Defense, and Automotive—account for more than half the business-performed R&D.

Indicator 2.3: *Academic Science & Engineering R&D*

Key Findings

- **North Carolina's academic R&D spending as a share of state GDP ranks well above the U.S. average, has since at least the early 2000s, and is increasing at a rate significantly faster than the U.S. average.**
- **North Carolina's academic R&D is highly concentrated in a small number of universities located primarily in the Research Triangle region.**
- **The federal government funds the majority of North Carolina's academic R&D, but some universities also receive significant funding from state and local government and business.**

Indicator Overview

R&D is the driving force behind innovation and sustained economic growth. The ratio of R&D expenditures at a state's colleges and universities relative to the size of the state's economy measures the intensity of the state's academic R&D. Across the U.S., academic R&D performers account for slightly more than half of the U.S. basic research, about a third of total research (basic plus applied), and roughly 10 percent of all R&D conducted in the U.S. While industry performs more than 70 percent of all U.S. R&D, academic R&D serves as a valuable foundation for industry R&D and future economic development.

How Does North Carolina Perform?

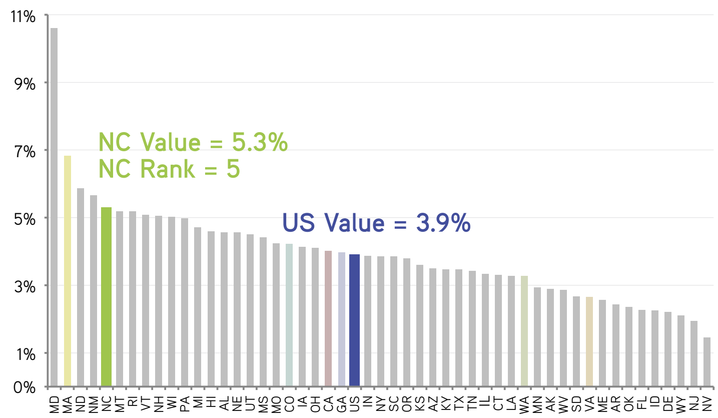
In terms of the level of North Carolina's academic R&D expenditures relative to the size of its economy, North Carolina ranks fifth in the nation, behind only Maryland, Massachusetts, North Dakota, and New Mexico *[2.3a]*.[1] North Carolina's academic R&D intensity is 136 percent of the U.S. value, meaning that the amount of academic R&D in North Carolina is more than one-third higher than what we would expect based on the levels of academic R&D in all other states.

This strong ranking reflects a long-standing pattern in North Carolina: The core strength of North Carolina's R&D activities is in its colleges and universities. North Carolina has a comparatively large number of colleges and universities for its population, and several are national leaders in the sciences and engineering. Thus, a large proportion of research conducted in North Carolina is basic in nature and, therefore, not heavily focused on industry requirements or direct economic outcomes. This fact underlies North Carolina's lower-than expected performance on many of the commercially focused indicators discussed elsewhere in this report.

Since 2000, North Carolina's academic R&D intensity has been growing at a rate 50 percent faster than the U.S. rate, further increasing the gap between the two

[1] Academic R&D is reported for institutions with R&D more than $150,000.

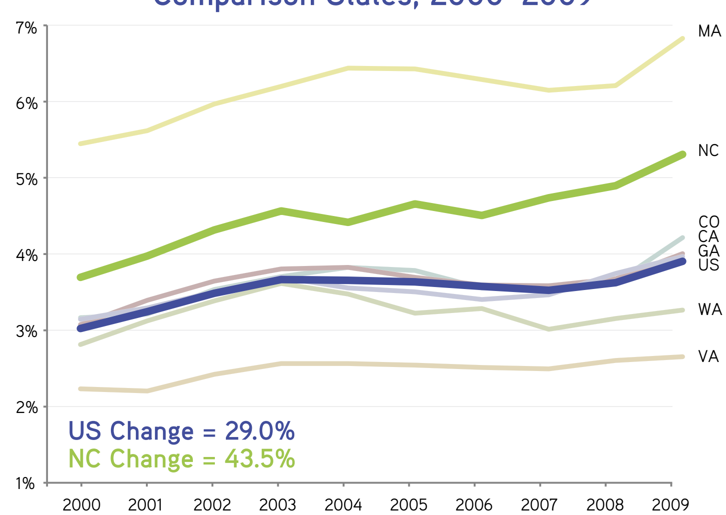
2.3a–Academic Science & Engineering R&D per $1,000 of State GDP, All U.S. States, 2009



Source: National Science Board

The high value for MD results primarily from the considerable R&D activities of Johns Hopkins University. ND's higher-than-expected academic R&D intensity results primarily from the relatively small size of its economy, coupled with the fact that it is an EPSCoR (Experimental Program to Stimulate Competitive Research) state. EPSCoR is a National Science Foundation (NSF) program designed to avoid an undue concentration of research and education.

2.3b–Academic Science & Engineering R&D per $1,000 of State GDP, Comparison States, 2000–2009



Source: National Science Board

Indicator 2.3: *Academic Science & Engineering R&D, cont.*

[2.3b]. This rate of increase is also significantly faster than the rate of increase in any of the comparison states.

Within North Carolina, academic R&D is highly concentrated in the Research Triangle region. The three largest universities located in that region—Duke University, UNC-Chapel Hill, and North Carolina State University—account for 85 percent of all academic R&D expenditures within the state *[2.3c and 2.3d]*. Wake Forest University in Winston-Salem also has significant academic R&D, while 14 other public and private universities conduct the state's remaining academic R&D across the state.

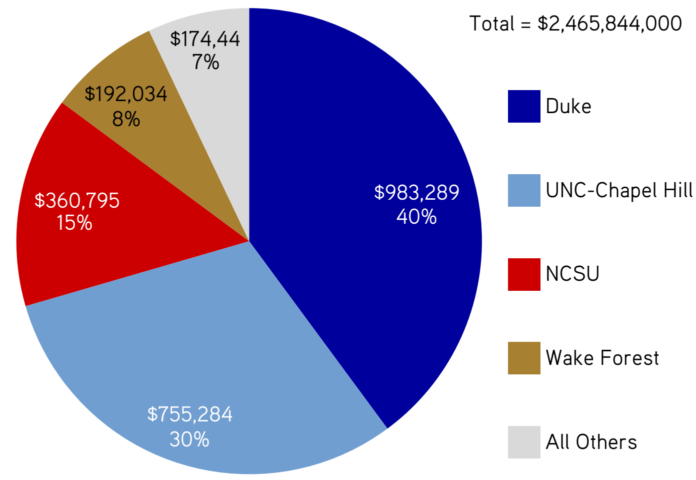
The source of funds for academic R&D reflects, to some extent, the nature of the R&D, and varies considerably across the U.S. and North Carolina's academic institutions *[2.3e]*. Nationwide and across North Carolina, the federal government is the largest supporter of academic R&D, in most cases funding a significant majority of that R&D. Within North Carolina, NC State University is the only academic institution that receives less than 50 percent of its academic R&D funding from the federal government. This lower share of federal funding reflects the fact that, as a land-grant university with a historical focus on agricultural and mechanical arts, as well as material science, NC State University receives a significant and much higher than average share (30 percent) of its funding from state and local government.

While business also funds a substantial share of academic R&D, for most institutions that share is 11 percent or less, with the exception in North Carolina being Duke University, which receives 22 percent of its funding from business. This larger-than-average share results from the activities of the Duke Clinical Research Institute (DCRI), which conducts medically focused clinical trials for industry.[2]

What Does This Mean for North Carolina?

North Carolina's academic research, the majority of which focuses on basic fundamental science, is important for producing new knowledge and scientific stature. Industry R&D is more often the engine that translates the basic research discoveries into commercial products. This suggests that attention

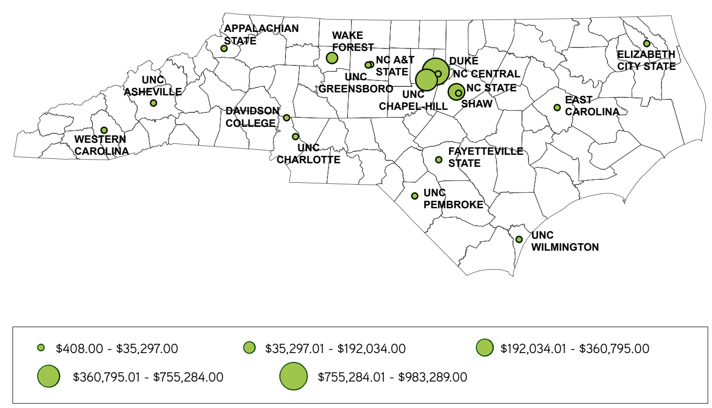
2.3c–N.C. University R&D Expenditures, 2010



Source: National Science Foundation

2.3d–N.C. University R&D Expenditures, 2010

Universities perform 23% of R&D in NC



Source: National Science Foundation

[2] UNC Charlotte, which is within the "14 Other N.C. institutions" group in Table 2.3e, also receives a much larger-than-average share (23 percent) of its R&D funded by business, reflecting the applied nature of UNCC's R&D and its close collaborations with industry, particularly in its region.

Indicator 2.3: *Academic Science & Engineering R&D, cont.*

should be given to continuing to strengthen both academic R&D and academic-industry collaborative R&D. Strengths in both, particularly across a wider range of North Carolina's geography, will help improve the economic well-being and quality of life across the state.

2.3e–University R&D Expenditures by Source of Funds, U.S. Average and N.C. Institutions, 2008–2010

Higher Education Institution	Source of Funds				
	Federal Govt	State & Local Govt	Business /Industry	Institution Funds	All Other
US Average	60%	6%	6%	20%	8%
Duke	55%	3%	22%	12%	8%
UNC-Chapel Hill	70%	5%	2%	20%	3%
NC State	37%	30%	11%	23%	0%
Wake Forest	76%	7%	8%	4%	6%
14 Other NC Institutions	68%	7%	8%	16%	2%

Source: National Science Foundation

Indicator 2.4: *Federal R&D*

Key Findings

- **North Carolina's ratio of federal R&D obligations per employed worker ranks well below the U.S. average.**
- **While North Carolina's ratio of federal R&D obligations to employed worker has increased significantly since 2000, it is not keeping pace with the U.S. ratio overall.**

Indicator Overview

This indicator represents how federal R&D obligations are disbursed geographically relative to the size of a state's employed civilian workforce. Federal R&D obligations are a binding financial commitment in a congressional budget appropriation and include contracts, staff employment, and purchases of goods and services. For the purposes of this indicator, federal R&D obligations are attributed to the states in which the prime recipients of federal obligations are located.[1] While this funding comes from 11 federal agencies, the Department of Defense (DoD) disburses the most funding, approximately 50 percent of the total. States with a high value on this indicator typically have a number of large prime contractors or major federally funded R&D facilities in state.

How Does North Carolina Perform?

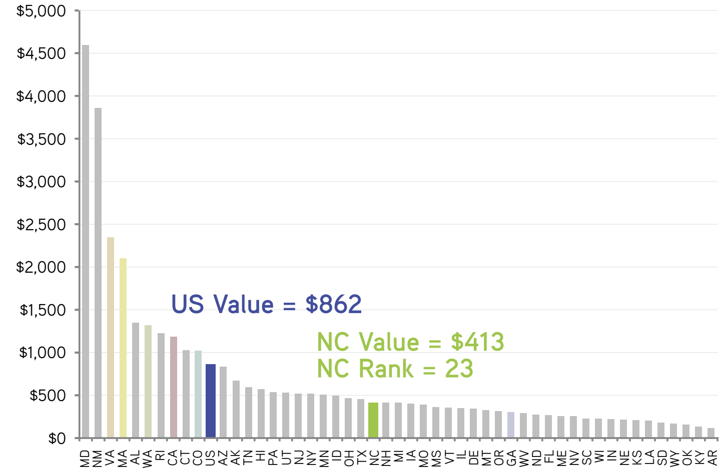
The value of North Carolina's federal R&D obligations per employed worker ranks 23rd in the nation, with a level that is 48 percent of the U.S. value and nine percent of the value of the top-ranking state, Maryland *[2.4a]*. North Carolina's low ranking reflects the fact that it has a relatively small number of federal prime contractors and federally funded R&D centers.

Since 2000, North Carolina's federal R&D obligations per employed worker have risen significantly, at a rate of 54 percent *[2.4b]*. While impressive, this gain is not keeping pace with the rate of increase for the U.S. overall (59 percent). Among the comparison states, North Carolina's increase in federal R&D obligations per employed worker ranks in the middle of the pack, roughly equal with Massachusetts and above California, and Georgia, but considerably below Virginia, Colorado, and Washington.

What Does This Mean for North Carolina?

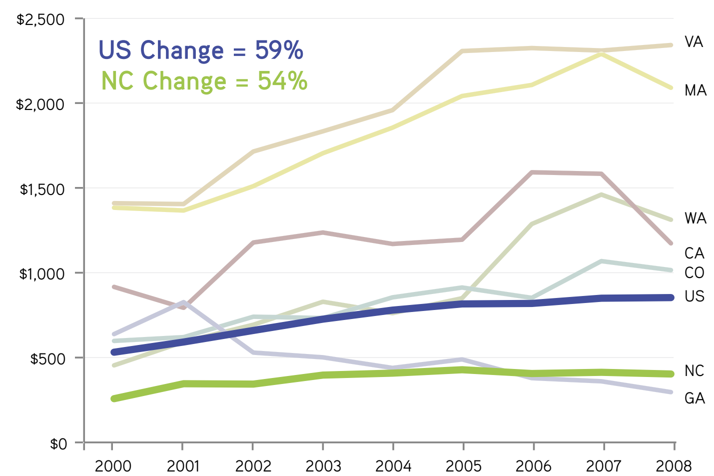
Federal R&D obligations to all U.S. states amounted to $125 billion in 2008. Although this amount represents less than half the amount of industry R&D in 2008 ($276 billion), it is substantial and drives a considerable amount of innovation. In 2008, only 10 states and the District of Columbia exceeded the national average of $862 in federal R&D obligations per worker, meaning that these states received the majority of federal R&D obligations. North Carolina should strive to remain competitive on this front by working to increase its number of prime federal contractors. It should also work to increase its number of subcontractors to prime federal contractors.[2]

2.4a–Federal R&D Obligations per Employed Worker, All U.S. States, 2008



Source: National Science Board

2.4b–Federal R&D Obligations per Employed Worker, Comparison States, 2000–2008



Source: National Science Board

[1] Tracking federal R&D obligations below the prime contractor level is beyond the scope of the data sources used in this report.

[2] While this will not explicitly improve North Carolina's performance on this particular indicator, it may be a more likely means by which the state can continue to advance innovation with federal support.

Indicator 2.5: *Academic Articles*

Key Findings

- **North Carolina's academic science & engineering (S&E) article output per 1,000 S&E doctorate holders in academia ranks slightly above the U.S. average, and since 2000 has increased at roughly the same rate as the U.S average.**
- **North Carolina's academic S&E articles are highly concentrated in a small number of universities and other R&D-focused organizations located primarily in the Research Triangle region.**

Indicator Overview

The publication of academic articles is a primary measure of academic productivity, which includes, among other outputs, research & development (R&D) activities and funding (see indicator 2.3); patents (see indicator 3.2); and trademarks, copyrights, and licenses (see indicator 3.5). The volume of peer-reviewed S&E articles per 1,000 academic S&E doctorate holders is an approximate measure of their contribution to scientific knowledge. A high value on this indicator shows that the S&E faculty in a state's academic institutions are generating a high volume of publications relative to other states. Academic institutions include two-year colleges, four-year colleges and universities, medical schools, and university-affiliated research centers. S&E doctorates include those in computer sciences; mathematics; the biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields.

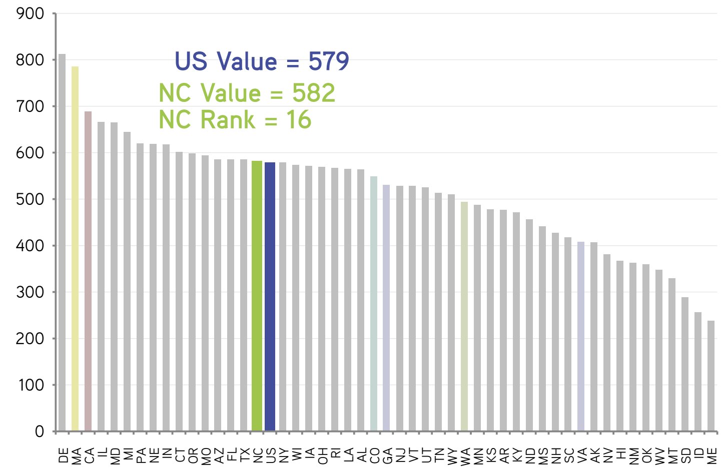
How Does North Carolina Perform?

The value of North Carolina's academic S&E article output per 1,000 S&E doctorate holders in academia ranks 16th in the nation, a level that is 101 percent of the U.S. value and 74 percent of the value of the top-ranking state, Delaware *[2.5a]*. Among the comparison states, California and Massachusetts are the only other states that top North Carolina on this indicator, and North Carolina ranks well above the remaining four comparison states. As with S&E R&D (see indicator 2.3), this strong ranking reflects a long-standing pattern in North Carolina: The core strength of North Carolina's innovation ecosystem is its colleges and universities.

[1] Research is more central to the mission of some of these institutions than others. As used in this indicator, publication counts are based on the number of articles that appear in a set of journals tracked by Thomson Reuters in the Science Citation Index and Social Sciences Citation Index. Academic article output is based on the most recent journal set; data for earlier years may differ slightly from previous publications due to changes in the journal set. Articles with authors from different institutions were counted fractionally. For instance, for a publication with authors at N institutions, each institution would be credited with 1/N of the article.

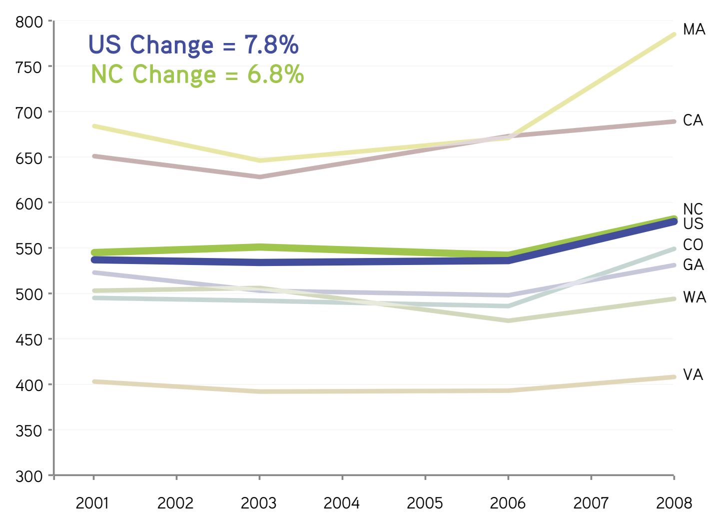
[2] S&E doctorate data are estimates and exclude those with doctorates from foreign institutions and those above the age of 75. Estimates for states with smaller populations of S&E doctorate holders are generally less precise than estimates for states with larger populations. Data for S&E doctorate holders in academia are presented by employment location regardless of residence.

2.5a–Academic Science & Engineering Article Output per 1,000 S&E Doctorate Holders in Academia, All U.S. States, 2008



Source: National Science Board

2.5b–Academic Science & Engineering Article Output per 1,000 S&E Doctorate Holders in Academia, Comparison States, 2001–2008



Source: National Science Board

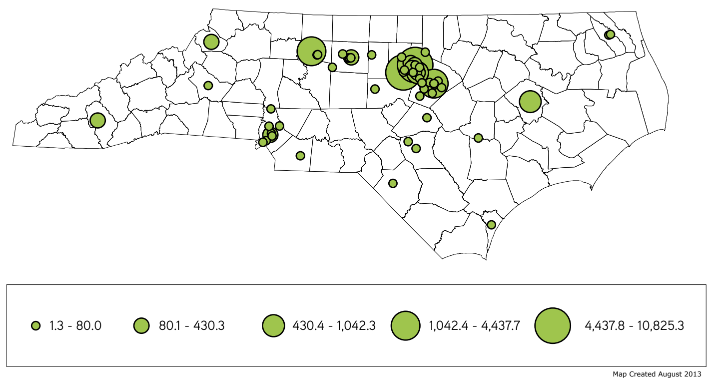
Since 2000, North Carolina's S&E article output per 1,000 S&E doctorate holders in academia has grown by 6.8 percent, a rate that is slightly less than, but not significantly different from, the U.S. rate of increase *[2.5b]*. Among the comparison states, North Carolina's rate of growth ranks slightly above the middle, below Massachusetts and Colorado, but ahead of California, Georgia, Virginia, and Washington.

Within North Carolina, S&E articles are highly concentrated in the Research Triangle (RT) region. Together, the three largest universities located in that region account for 76 percent of all academic S&E articles produced within the state—UNC-Chapel Hill (31.9 percent), Duke University (30.6 percent), and North Carolina State University (13.1 percent) *[2.5c]*. Wake Forest University in Winston-Salem also produces a significant share of the state's S&E articles (8.1 percent), as does East Carolina University in the eastern part of the state (3.1 percent), and RTI International (2.3 percent), the National Institute of Environmental Health Sciences (2.1 percent), and GlaxoSmithKline (1.3 percent) in the Research Triangle Park. The remaining seven percent of the state's S&E articles is spread across 59 other organizations, none of which produces more than one percent of the state's S&E articles.

What Does This Mean for North Carolina?

North Carolina has considerable strengths in academic S&E, as evidenced by its higher-than-average performance on academic S&E articles per 1,000 S&E doctorate holders in academia. These strengths, however, are highly concentrated in a small number of universities and other R&D-focused organizations located primarily in the Research Triangle region and other metropolitan areas, such as the Piedmont Triad. As evidenced in the Economic Well-Being indicators in Section 1 and the Innovative Organizations indicators in Section 4, these academic S&E strengths are benefiting a less-than-optimal share and geographic distribution of North Carolina's citizens and companies. North Carolina's academic, corporate, and policy leaders should increase their efforts designed to spread the benefits of the state's academic S&E strengths throughout all regions of the state.

2.5c–Average Annual Number of Science & Engineering Articles, N.C. Organizations, 2010–2012



Source: Science Citation Index and Social Sciences Citation Index

[3] While university faculty publish the vast majority of academic S&E articles, researchers in companies and nonprofits also publish academic S&E articles.

[4] Unlike the state-level data above, for the institution-level data, articles with authors from different institutions were not counted fractionally. For instance, for a publication with authors at multiple institutions, each contributing institution would be credited once for the article. The National Science Foundation (NSF) collected the state-level data; the Office of Science & Technology staff in the NC Department of Commerce collected the institution-level data.

Indicator 3.1: *SBIR and STTR Funding*

Key Findings

- **North Carolina's SBIR/STTR funding as a share of state GDP ranks below the U.S. average and has since at least the early 2000s, but is increasing at a rate considerably faster than the U.S. average, which is decreasing.**
- **North Carolina's SBIR/STTR funding is highly concentrated in a small number of cities and regions in the state.**

Indicator Overview

Funds awarded through the highly competitive federal Small Business Innovation Research (SBIR) grant program support technological innovation in companies with 500 or fewer employees.The awards enable the small businesses to evaluate the feasibility and scientific merit of new technology (Phase I – up to $150,000) and to develop the technology to a point where it can be commercialized (Phase II – up to $1,000,000). Small Business Technology Transfer (STTR) is a similar but smaller program; its unique feature is the requirement for the small business to collaborate with a nonprofit research institution.[1]

SBIR and STTR grants are the single largest source of early-stage technology development and commercialization funding for small businesses (more than $2 billion annually). Success in the SBIR/STTR programs attracts additional outside capital investment, and companies that receive SBIR Phase II funding typically out-perform similar companies that do not receive such support.[2] The amount of SBIR/STTR funding in a state strongly correlates with successful technology-based economic development.

How Does North Carolina Perform?[3]

In terms of the level of SBIR/STTR funding relative to the size of its economy, North Carolina ranks 20th in the nation but below the national average *[3.1a]*.[4] Specifically, the ratio of North Carolina's SBIR/STTR funding relative to the size of its total GDP is 85 percent of the U.S. value, meaning that the amount of SBIR/STTR funding in North Carolina is one-sixth lower than what we would expect based on the levels of such funding in other states. Moreover, its per-GDP level

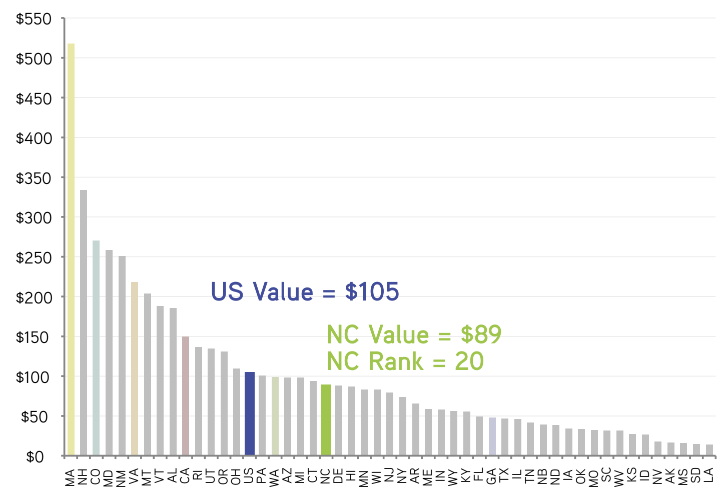
[1] Eleven federal agencies participate in the SBIR program and five in the STTR program.

[2] See, e.g., National Research Council. 2008. *An Assessment of the SBIR Program.* Washington, DC: The National Academies Press.

[3] The total award dollars reported here include both Phase I and Phase II SBIR/STTR awards.

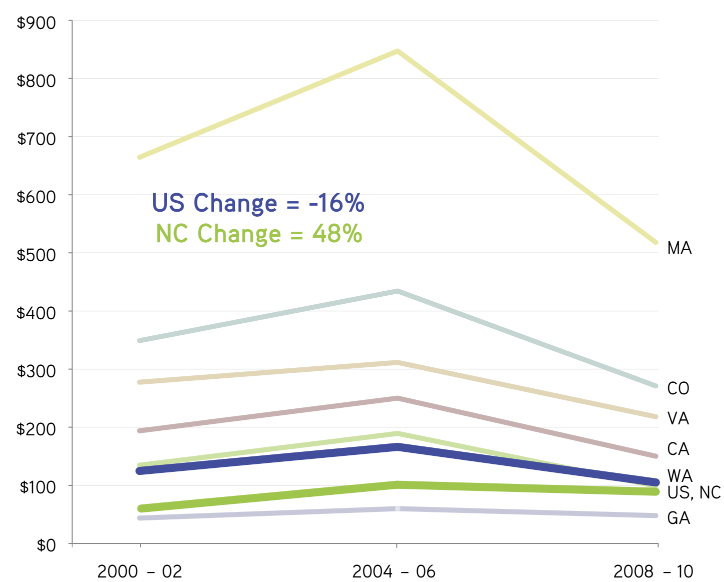
[4] The high average U.S. value results primarily from the high concentration of SBIR/STTR awards in MA, which has well-recognized academic research institutions from which innovative small businesses have emerged. In addition, many of the states with the highest rankings on this indicator are locations of federal laboratories.

3.1a–Average Annual SBIR & STTR Funding per $1 Million of GDP, All U.S. States, 2008–2010



Source: National Science Board and SBIR.gov

3.1b–Average Annual SBIR & STTR Funding per $1 Million of GDP, Comparison States, 2000–2010



Source: National Science Board and SBIR.gov

Indicator 3.1: *SBIR and STTR Funding, continued*

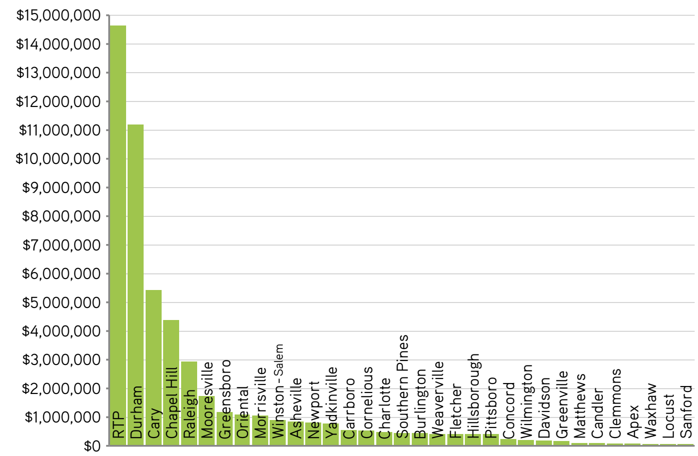
of SBIR/STTR funding is only 17 percent of the leading state's (Massachusetts) level. This relatively low level of early stage funding suggests that North Carolina is potentially missing out on opportunities to fund and commercialize its innovative discoveries.

It is important to note, however, that a large percentage of the small tech-based businesses in North Carolina focus on the pharmaceuticals and medical technology sectors, which are among the state's strengths. Those businesses, in fact, have a high success rate in receiving SBIR grants from the National Institutes of Health. However, the interests of other large SBIR-granting agencies—such as the Department of Defense, the National Aeronautics and Space Administration, and the Department of Energy—either do not align as well with the majority of North Carolina businesses' commercialization interests, or companies lack knowledge about these other agencies and the goals they are trying to achieve. This misalignment and lack of knowledge, in part, accounts for North Carolina's lower-than-expected award rate for SBIR/STTR grants.

Since 2000, the ratio of North Carolina's SBIR & STTR funding relative to its GDP has grown by nearly 50 percent, compared to a decrease of 16 percent for the U.S. overall *[3.1b]*. Additionally, the ratio of SBIR/STTR funding to GDP has been decreasing by at least 20 percent in all of the comparison states except Georgia, whose ratio increased by 10 percent. Thus, over time, North Carolina is improving its rate of SBIR and STTR funding. This is due, in part, to two steps taken to improve North Carolina's SBIR/STTR award rate: (1) the creation in 2001 of an SBIR program specialist position at the North Carolina Small Business and Technology Development Center (STBDC) and (2) the creation in 2006 of the state's SBIR/STTR matching fund program, the One North Carolina Small Business Program. The former provides assistance to small businesses to help them identify and apply for SBIR/STTR proposal opportunities; the latter awards matching grants to small businesses in North Carolina that have received SBIR/STTR grants. These state matching grants supplement and leverage the federal grants and make North Carolina small businesses better investment opportunities in the eyes of federal funding agencies.

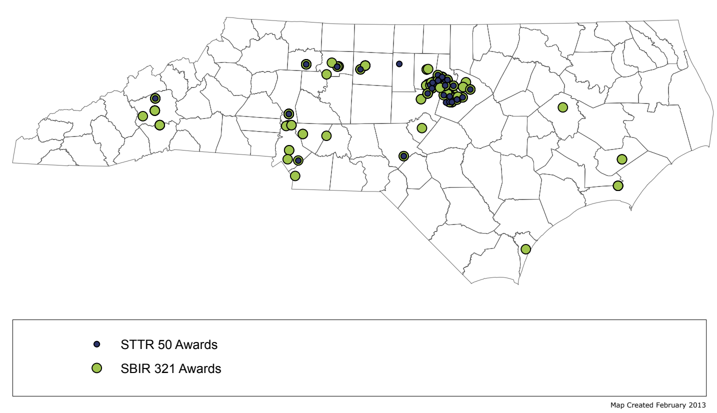
Within North Carolina, SBIR/STTR funding is highly concentrated in the Research Triangle Park (RTP) and the surrounding counties containing the cities of Durham, Cary, Chapel Hill, Raleigh, and Morrisville *[3.1c,*

3.1c–Average Annual SBIR & STTR Funding, N.C. Cities, 2008–2010



Source: SBIR.gov

3.1d–Location of SBIR & STTR Funding in N.C., 2008–2010



Source: SBIR.gov

Indicator 3.1: *SBIR and STTR Funding, continued*

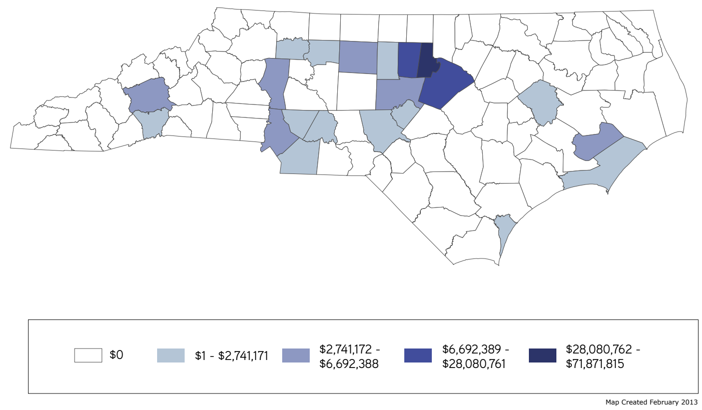
3.1d, and 3.1e]. Combined, these five locales receive nearly 80 percent of the state's SBIR/STTR funding. The next 10 percent goes primarily to cities in the Piedmont Triad (e.g., Greensboro and Winston-Salem) and Charlotte (e.g., Charlotte and Mooresville) regions, with the remaining 10 percent dispersed across 23 other cities. Overall, this highly concentrated SBIR/STTR award activity reflects the level of concentration in North Carolina's R&D activity, particularly its academic R&D, as well as its population.

What Does This Mean for North Carolina?

North Carolina's funding under the SBIR/STTR programs indicates both how aggressive the state's small businesses are in pursuing federal support for innovation activity, as well as their competitiveness in developing and commercializing innovative ideas, technologies, and products.

Given the importance of such funding, emphasis should be placed on improving the state's position in this category. Continued funding for the One North Carolina Small Business Program, which provides state grants to match the SBIR/STTR grants, is critical on this front.[5] Additionally, proposal opportunity identification and counseling services, such as those provided by North Carolina's Small Business and Technology Development Center (SBTDC), should be continued and enhanced to ensure that North Carolina businesses are maximizing their ability to receive SBIR/STTR grants.

3.1e–Average Annual Amount of SBIR & STTR Awards, N.C. Counties, 2008–2010



Source: SBIR.gov

[5] This program was started after the *2003 Tracking Innovation in NC* report (available at: http://www.nccommerce.com/scitech/resources/innovation-reports) indicated that NC ranked 34th in terms of SBIR funding per capita and had a value 41 percent of the U.S. value. While all of the top-performing states were increasing in the 2000-2004 timeframe, only NC continued to increase in the latter part of the decade. This coincides with the One NC Small Business Program beginning in 2006.

Indicator 3.2: *Academic Patents*

Key Findings

- **The ratio of North Carolina's academic patents per 1,000 science & engineering doctorate holders in academia ranks below the U.S. average, decreasing significantly from a ratio higher than the U.S average in 2000.**
- **North Carolina's academic patenting activity is highly concentrated in a small number of universities located primarily in the Research Triangle region.**

Indicator Overview

This indicator relates the number of academic-owned utility patents to the size of the doctoral science & engineering (S&E) workforce in academia. Academia includes two-year colleges, four-year colleges and universities, medical schools, and university-affiliated research centers. S&E doctorates include those in computer sciences; mathematics; biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields.[1] Utility patents, commonly known as patents for inventions, include any new, useful, or improved method, process, machine, device, manufactured item, or chemical compound, and represent a key measure of intellectual property. As such, academic patents are one approximate measure of the degree to which the doctoral academic workforce generates results with perceived economic value.[2]

How Does North Carolina Perform?

The value of North Carolina's academic patents per 1,000 S&E doctorate holders in academia ranks 17th in the nation, with a level that is 92 percent of the U.S. value and 51 percent of the value of the top-ranking state, California *[3.2a]*. North Carolina's upper-to-mid-range ranking reflects the fact that it has stronger than average academic institutions, many of which have offices dedicated to patenting.[3]

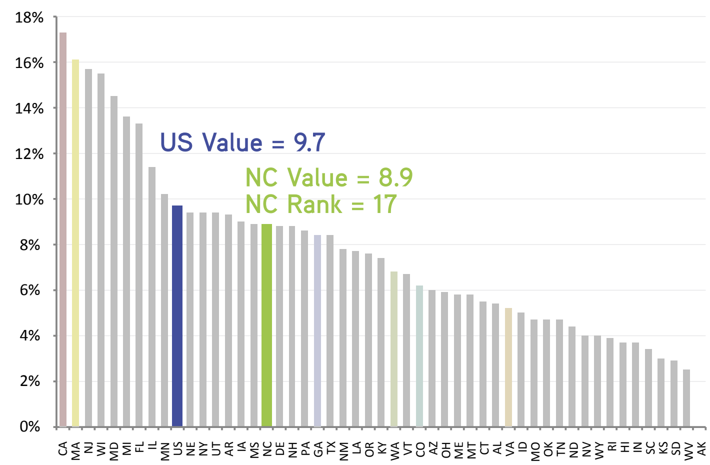
Since 2000, the ratio of North Carolina's academic patents relative to S&E doctorate holders in academia decreased significantly, at a rate of 46 percent *[3.2b]*. This ratio also decreased for the U.S. overall (22 percent), a rate that doesn't differ significantly from North Carolina's decrease. Yet for all comparison states except Colorado (whose patent intensity level increased by 2 percent), North Carolina's rate of decrease is the largest, and is typically more than twice as large as the average rate of decrease for the comparison states, which is 15 percent.

[1] S&E doctorate data exclude those with doctorates from foreign institutions and those above the age of 75.

[2] Another measure of academic economic value is the actual or expected revenue derived from academic patents. However, because actual revenue accrues over time and expected revenue is difficult to estimate with a reasonable level of accuracy, revenue data are not presented for this indicator. License income, which depends heavily on patent activity, is presented in Indicator 3.5.

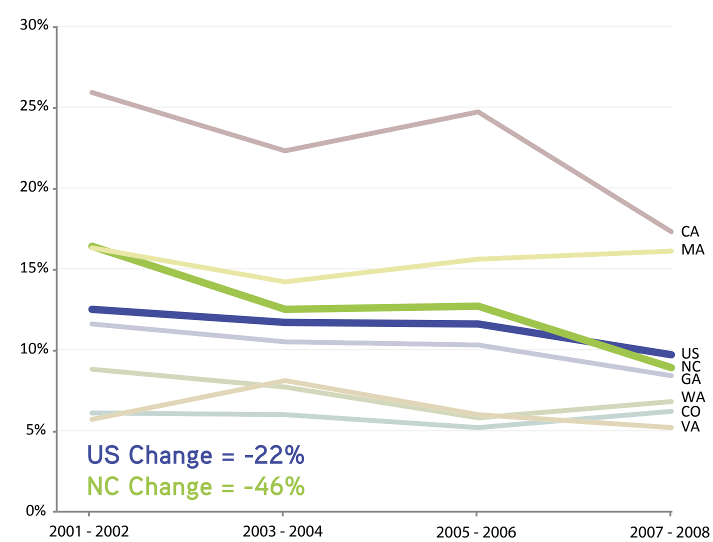
[3] The offices go by different names (e.g. Office of Technology Transfer; Office of Technology Commercialization) at different institutions, but all have patenting academic discoveries as one of their primary activities.

3.2a–Academic Patents Awarded per 1,000 Science & Engineering Doctorate Holders in Academia, All U.S. States, 2008



Source: National Science Board

3.2b–Academic Patents Awarded per 1,000 Science & Engineering Doctorate Holders in Academia, Comparison States, 2001–2008



Source: National Science Board

Indicator 3.2: *Academic Patents, continued*

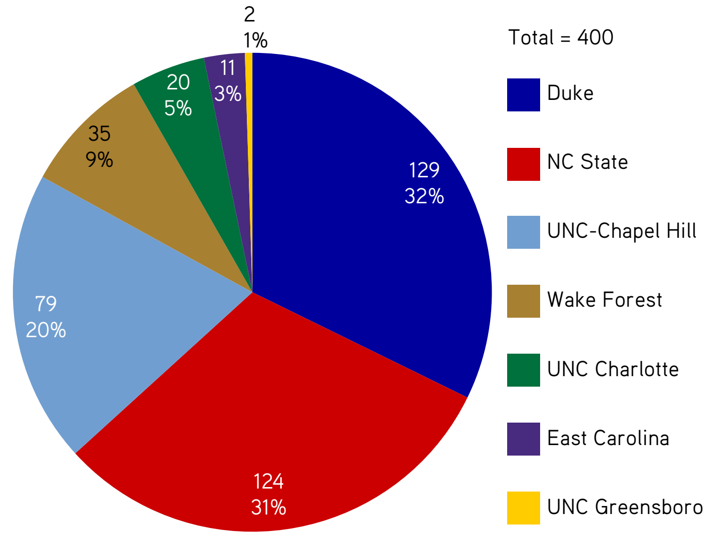
Within North Carolina, academic patenting activity is highly concentrated in the Research Triangle region and reflects both the nature and size of that region's universities' R&D activities, as well as the resources devoted to their patenting offices *[3.2c and 3.2d]*. The three largest universities in that region—Duke University, UNC-Chapel Hill, and North Carolina State University—account for 83 percent of all academic patenting activity within the state, a pattern very similar to the pattern for academic R&D expenditures (see Indicator 2.3). Wake Forest University in Winston-Salem also has significant academic patenting activity (9 percent of the state total), while UNC-Charlotte, East Carolina University, and UNC Greensboro account for 5 percent, 3, percent and 1 percent of the state total, respectively.

What Does This Mean for North Carolina?

While one of North Carolina's innovation-related strengths is its academic R&D (see indicator 2.3, on which NC ranks in the top 10 percent and has a value significantly greater than the U.S. value), it fares less well on academic patenting, one of the key measures of the economic value of its academic discoveries. Its 17th-place ranking on academic patenting puts it ahead of nearly two-third of the U.S. states, but the ratio of its academic patenting activity relative to S&E doctorate holders in academia ranks slightly lower than the U.S. average ratio. Moreover, rather than improving over time, North Carolina's academic patenting activity relative to that of the comparison states and the U.S. average is decreasing.

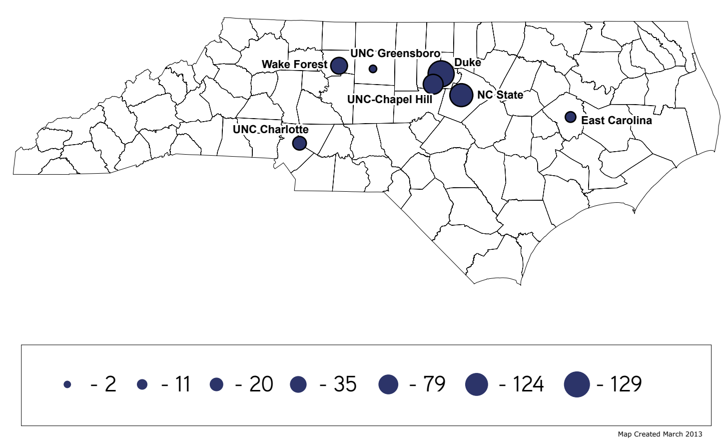
To reverse this trend and bring the level of its academic patenting activity in line with the level of its academic R&D, North Carolina's universities should focus attention on their offices and activities that generate patents. This would not necessarily entail a large increase in resources. For example, the University of North Carolina's 2013–2018 strategic directions[4] include establishing and supporting a "scout team" and core support staff that any campus could utilize for market assessment, legal assistance, new venture services, and other operational support, such as patenting for commercialization. Initiatives such as these and others focused on increasing the commercial impact of academic discoveries should be a high priority for state and university policy makers.

3.2c–Academic Patents Awarded to N.C. Universities, 2009–2011



Source: Association of University Technology Managers

3.2d–Academic Patents Awarded to N.C. Universities, 2009–2011



Source: Association of University Technology Managers

[4] *Our Time, Our Future: The UNC Compact with North Carolina, Strategic Directions 2013–2018*, available at http://www.northcarolina.edu.

Indicator 3.3: *Patents*

Key Findings

- **The ratio of North Carolina's patents awarded per 1,000 individuals in science & engineering occupations ranks below the U.S. average, and since 2003 has been increasing at a rate roughly equal to the U.S. average.**
- **North Carolina's patenting activity ranks above that of most comparison countries but well behind that of leading countries.**
- **North Carolina's patenting activity is highly concentrated in a small number of counties located primarily in the Research Triangle region.**

Indicator Overview

This indicator represents state patent activity normalized to the size of a locale's science & engineering workforce and its economy. For the state-by-state charts (3.3a and 3.3b), utility patents—commonly known as patents for inventions—are used.[1] The science & engineering workforce includes engineers and computer, mathematical, life, physical, and social scientists.[2] For the comparison country charts (3.3c and 3.3d), grants for direct patent applications are used. These grants are conferred by a country's intellectual property office to applicants who apply directly to that office.[3] GDP is a measure of the total value of goods and services produced by an economy.

Patents are the leading form of legal codification and ownership of innovative thinking and its application. As such, they are a key indicator of the rate of new product and process innovation. There are considerable differences in the propensity of different industries to patent new ideas, and thus the industry mix partially explains differences in patenting rates across locales. Patents are particularly important for companies whose success depends on their ability to protect their innovative products.

How Does North Carolina Perform?

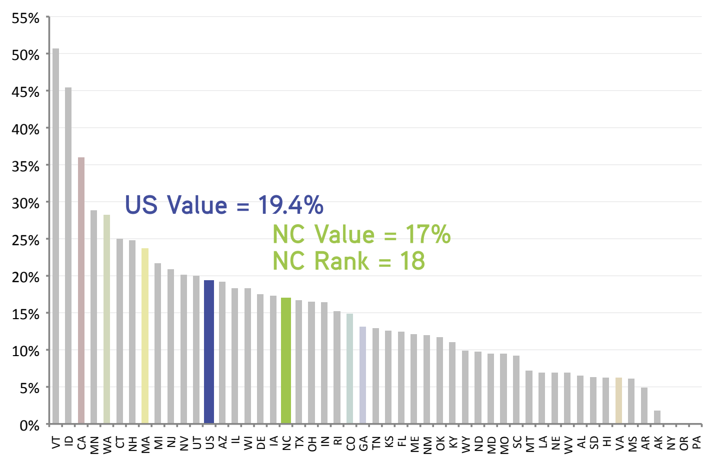
The value of North Carolina's patents per 1,000 individuals in science & engineering occupations ranks 18th in the nation, with a level that is 88 percent of the U.S. value and 34 percent of the value of the top-ranking state, Vermont *[3.3a]*. Among the comparison states, North Carolina's rate of patenting ranks in the middle

[1] See indictor 3.2 for a more detailed description of utility patents. The U.S. Patent and Trademark Office (USPTO) classifies patents geographically according to the residence of the first-named inventor. Only U.S.-origin patents are included.

[2] Managers, technicians, elementary and secondary schoolteachers, and medical personnel are not included.

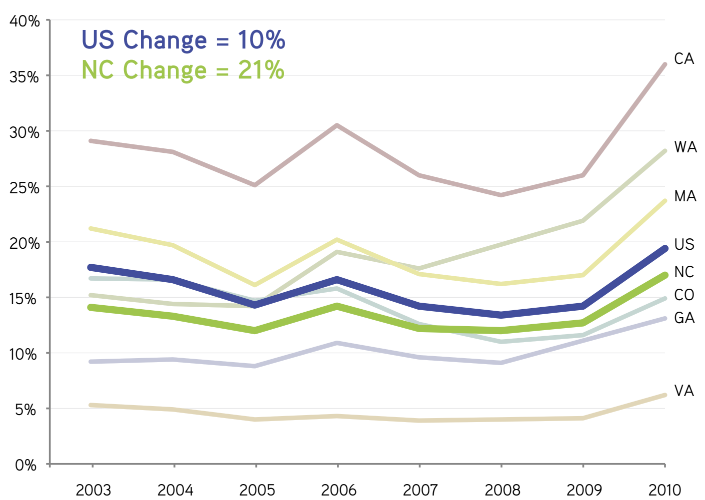
[3] Direct applications exclude Patent Cooperation Treaty (PCT) applications and are therefore most comparable to the NSF data used for charts 3.3a and 3.3b. PCT, an international treaty administered by WIPO, facilitates the acquisition of patent rights in a large number of jurisdictions.

3.3a–Patents Awarded per 1,000 Individuals in Science & Engineering Occupations, All U.S. States, 2010



Source: National Science Board

3.3b–Patents Awarded per 1,000 Individuals in Science & Engineering Occupations, Comparison States, 2003–2010



Source: National Science Board

Indicator 3.3: *Patents, continued*

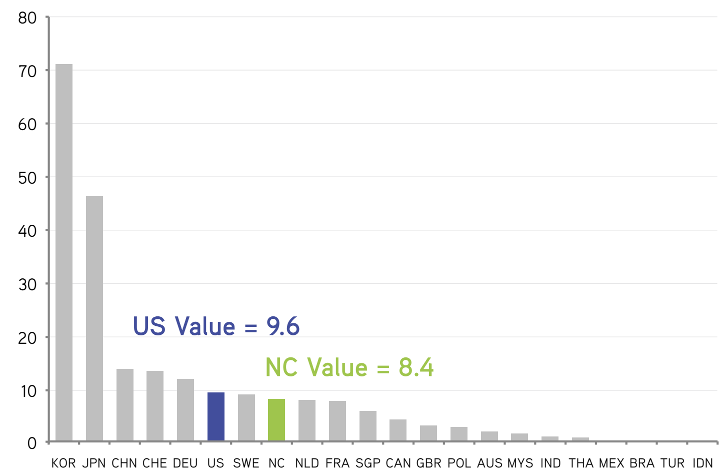
of the pack, ahead of Colorado, Georgia, and Virginia but behind California, Washington, and Massachusetts. Overall, North Carolina's rate of patents compares less favorably than its rate of academic patents, reflecting, in part, its lower level of industry R&D (see indicator 2.2) as well as its relatively low number of high-tech business establishments (see indicator 4.1). As a broad indicator of nonacademic innovative activity within a state, this indicator suggests that North Carolina's nonacademic private sector is not as strong as its academic sector at initial discovery and protection of innovative ideas. Since 2003, however, the ratio of North Carolina's patents to individuals in science & engineering occupations increased at a rate of 21 percent, which is a marginal improvement but doesn't differ significantly from the 10 percent rate of increase for the U.S. overall *[3.3b]*. Among the comparison states, North Carolina's rate of increase falls in the middle, ahead of Virginia, Massachusetts, and Colorado but behind Washington, Georgia, and California. Combined, the comparison states' patenting activity increased 25 percent, which is only slightly higher than North Carolina's increase.

While ranking the U.S. patent activity internationally among all countries isn't possible due to data limitations, among the comparison countries, the U.S. ranks sixth but well behind the leading countries, South Korea and Japan *[3.3c]*. It ranks behind but much closer to countries such as China, Switzerland, and Germany, and well ahead of most of the other comparison countries. Since 2003, the patent activity of Korea and Japan have risen considerably (38 percent and 119 percent, respectively) and much faster than the rate for all other comparison countries, whose combined average is 6 percent and much closer to the rates for the U.S. and North Carolina *[3.3d]*. Most of the comparison countries decreased their rate of patenting activity over time.[4]

Within North Carolina, patenting activity is highly concentrated in a small number of counties, with more than 80 percent of all patents being awarded in six counties [3.3e and 3.3f]. Wake County, with 47 percent of all the state's patents, has the largest share, followed by Durham (10 percent), Orange (8 percent), Mecklenburg (7 percent), Guilford (4 percent) and Forsyth (3 percent). The next nine counties account for 10 percent of the state's patents, while the remaining 85 counties account

[4] While difficult to see in chart 3.3d, the raw data indicate that all but four of the comparison countries decreased over time.

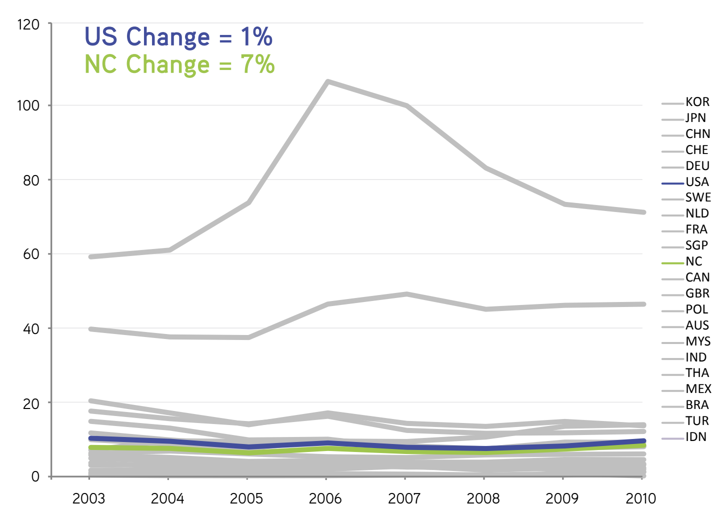
3.3c – Grants for Direct Patent Applications Per Billion Dollars in GDP, Comparison Countries, 2010



Sources: World Intellectual Property Organization, World Bank, National Science Foundation, and U.S. Bureau of Economic Analysis.

Data for this chart are available only at the country level. Thus, NC's value in this chart (8.4) is an approximation, derived by multiplying NC's value in chart 3.3a (17) by .49, which is the ratio of the US value in this chart (9.6) to the U.S. value in chart 3.3a (19.4). In addition, country ranks are not shown because data were unavailable for all countries.

3.3d – Grants for Direct Patent Applications Per Billion Dollars in GDP, Comparison Countries, 2003-2010



Sources: World Intellectual Property Organization, World Bank, National Science Foundation, and U.S. Bureau of Economic Analysis

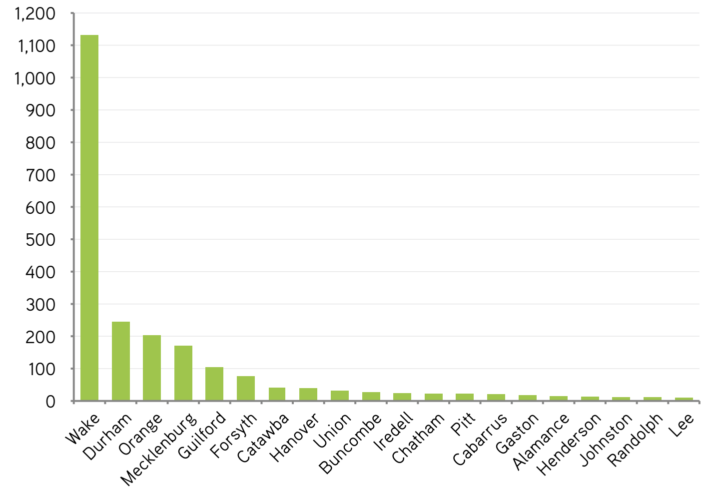
Data for this chart are available only at the country level. Data for this chart are available only at the country level. Thus, NC's values in this chart are approximations, derived using the methodology outlined above in chart 3.3c.

for the final 10 percent of the state's patents. This high concentration of patents reflects a combination of the state's population (see indicator 1.6), the location and mix of its companies (see indicators 4.1, 4.2, and 6.4), the location and mix of its academic and business R&D (see indicator 2.2 and 3.1), the location of its academic patents (see indicator 3.2), and the educational attainment levels of its citizens (see indicator 5.6).

What Does This Mean for North Carolina?

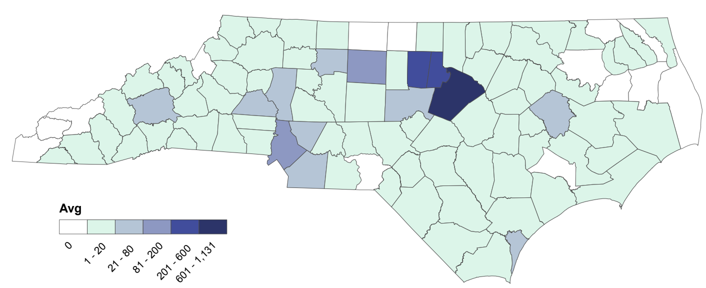
Academic institutions own less than 10 percent of North Carolina's patents,[5] meaning businesses and individuals hold the vast majority of legally protected intellectual property in the state. Although North Carolina's patenting rate ranks slightly below the U.S. average, its rate is above that of most states and is growing slightly faster than the U.S. average. Together, these facts suggest that North Carolina has a considerable and growing amount of intellectual property with the potential to yield new, as well as enhanced, products and services to improve the economic well-being and quality of life of its citizens. The extent to which that potential is realized ultimately depends on the ability of the state's businesses and individuals to capitalize on their intellectual property in ways that allow them to appropriate economic and social value from it. The state should work to enhance the conditions that facilitate the commercialization of intellectual property.

3.3e–Average Annual Number of Patents, N.C. Counties, 2009–2011



Source: U.S. Patent and Trademark Office

3.3f–Average Annual Number of Patents, N.C. Counties, 2009–2011



Source: U.S. Patent and Trademark Office

[5] This percentage is derived from National Science Foundation data, specifically by dividing the total number of patents by the number of academic patents for recent years for which both total patent and academic patent data were available.

Indicator 3.4: *Venture Capital*

Key Findings

- The ratio of North Carolina's venture capital dollars to state GDP ranks below the U.S. average, decreasing significantly since 2000, similar to the trend for the U.S. overall.
- The number of North Carolina's venture capital deals as a percentage of high-technology business establishments ranks well below the U.S. average and has decreased since 2003.
- North Carolina's venture capital investments are highly concentrated in a small number of urban ZIP codes and ZIP codes containing universities.

Indicator Overview

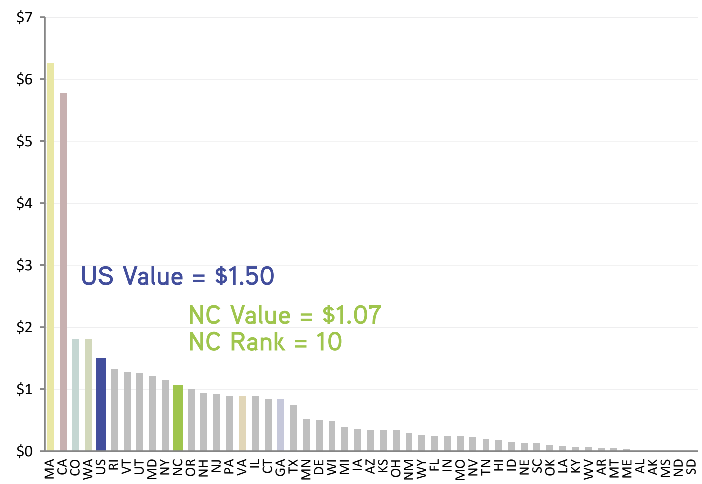
Venture capital dollars disbursed per $1,000 in state gross domestic product (GDP) is a measure of the magnitude of venture capital investment, adjusting for the size of a state economy. Venture capital is financial capital provided to early-stage, high-potential, high-risk, growth startup companies. The typical venture capital investment occurs as growth funding after the seed funding round in the interest of generating a return through an event, such as an Initial Public Offering (IPO) or sale of the company. Venture capital is especially important to startup companies in the early stages of development; these companies often need financing to get a project off the ground, but are unable to access traditional financing because of an insufficient cash flow history. States that rank well in this measure possess companies that have been successful in attracting venture capital investment. Positive trends in this measure may be predictors of new products and services, job creation, and revenue growth.

How Does North Carolina Perform?

In terms of venture capital investment adjusted for state economy size, North Carolina ranks 10th in the nation, with a value that is 71 percent of the U.S. value *[3.4a]*. This paradoxical high-ranking but below-average value is the result of very high concentrations of venture capital investment in Massachusetts and California, which skew the national average upward. More than 61 percent of all venture capital disbursements are made in Massachusetts and California alone, and only four states possess averages higher than the national average. North Carolina accounted for just over 2 percent of total venture capital in 2010, but its share of the national total increased from 1.7 percent in 2000.

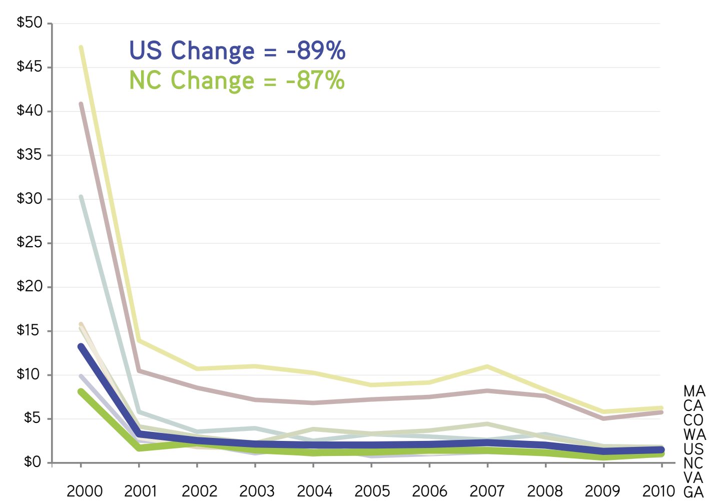
Between 2000 and 2010, venture capital investment in North Carolina firms decreased by 87 percent, from $8.12/$1,000 GDP to $1.07/$1,000 GDP *[3.4b]*. Although this decline is significant, it parallels declines across the nation. Over the same period, the U.S. average decreased by 89 percent and all comparison states experienced similar declines. This across-the-board

3.4a–Venture Capital Dispersed per $1,000 GDP, All U.S. States, 2010



Source: National Science Board

3.4b–Venture Capital Dispersed per $1,000 GDP, Comparison States, 2000–2010



Source: National Science Board

Indicator 3.4: *Venture Capital, continued*

decline is explained by high venture capital investment in 2000—all states had their highest venture capital values in that year, the peak of the dot-com bubble and the first year in this analysis. Since 2001, North Carolina venture capital per $1,000 GDP has fluctuated between $2.29 and $0.67.

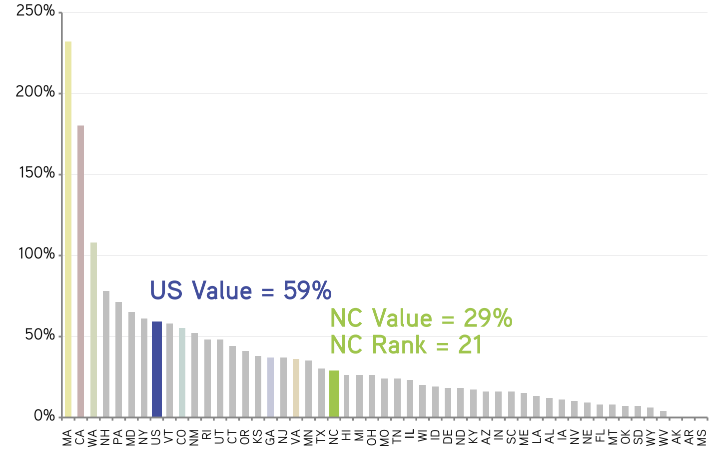
North Carolina performs similarly but slightly less well in terms of the number of venture capital deals as a percentage of high-technology business establishments *[3.4c]*. On this measure, North Carolina ranks 21st in the nation and has a value that is 49 percent of the U.S. value. Between 2003 and 2008, North Carolina's performance on this measure decreased by 43 percent; during that same period, the U.S. increased by 20 percent on this measure and all comparison states except Virginia (which decreased by 15 percent) increased on this measure, by an average of 31 percent [*3.4d]*. This pattern, combined with the pattern for charts 3.4a and 3.4b, indicates that both the number and the size of venture capital deals in North Carolina is decreasing over time, particularly relative to the number of high-technology establishments.

Within North Carolina, venture capital investment is highly concentrated. Only 45 (4.2 percent) out of North Carolina's 1,080 ZIP codes possessed a company that received venture capital between 2010 and 2012. As might be expected, ZIP codes with companies receiving venture capital investment are highly concentrated close to universities and in urban areas. Only six counties—Durham, Wake, Mecklenburg, Forsyth, Orange, Chatham—contain the 14 ZIP codes in which companies received more than $10 million in venture capital financing annually.

What Does This Mean for North Carolina?

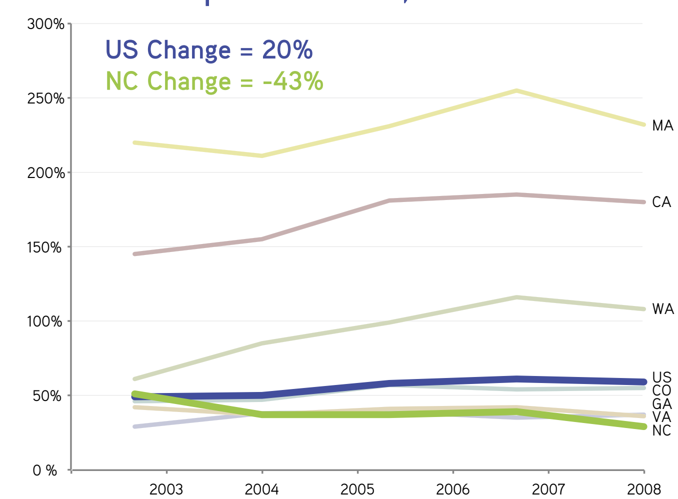
Innovative companies often need venture capital to realize their growth potential. If they are unable to access venture capital in North Carolina, entrepreneurs may need to relocate to venture capital rich parts of the country—for example, Silicon Valley in California and the Boston metro area—in order to develop and expand. To the extent that venture capital investments in North Carolina are able to retain innovative companies spun off from North Carolina businesses, universities, and innovation infrastructure, the state will receive benefits such as job growth and income increases. Increasing access to venture capital is vitally important, but the direct impact of increased venture capital in North Carolina may not be uniformly felt across the state.

3.4c–Venture Capital Deals as a Percentage of High-Technology Business Establishments, All U.S. States, 2008



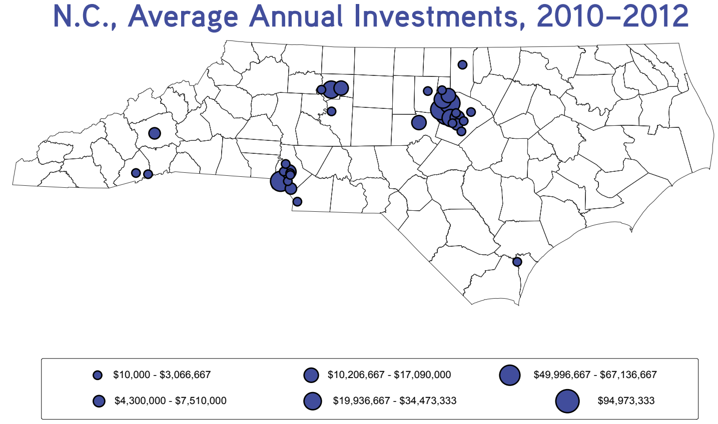
Source: National Science Board

3.4d–Venture Capital Deals as a Percentage of High-Technology Business Establishments, Comparison States, 2003–2008



Source: National Science Board

3.4e–Location of Venture Capital Investments in N.C., Average Annual Investments, 2010–2012



Source: Dow Jones VensureSource

Indicator 3.5: *Technology License Income*

Key Findings

- **North Carolina's gross income received from technology licenses ranks above the U.S average.**
- **North Carolina's running royalties received from technology licenses ranks above the U.S average, increasing significantly from a level below the U.S. average in the early 2000s.**
- **Within North Carolina, at least seven universities have significant technology license income.**

Indicator Overview

Universities and nonprofit research organizations use technology license agreements to transfer codified knowledge in the form of innovative intellectual property (IP) to companies and entrepreneurs seeking to commercialize the technology. The income generated from license agreements is a key measure of the value of that IP. In addition, net licensing income can be used to support subsequent R&D and education activities, as well as patenting and other commercialization-related costs.

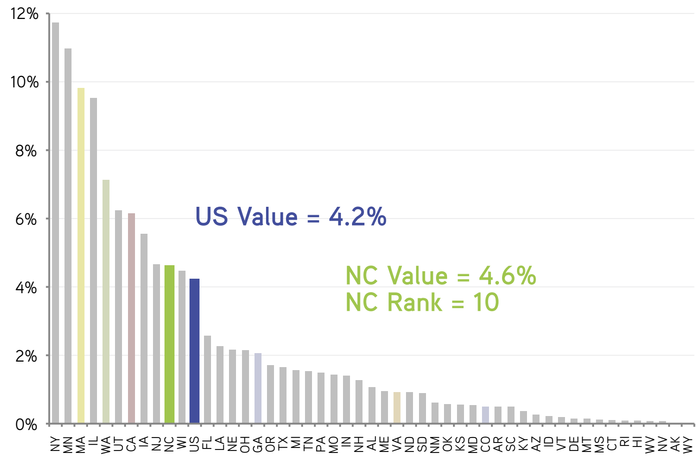
This indicator measures technology license income two ways: gross income received, and running royalties received, each measured as a percentage of academic science & engineering R&D expenditures. Gross income is the more inclusive measure, and it includes license issue fees, payments under options, annual minimums, running royalties, termination payments, the amount of equity received when cashed-in, and software and biological material end-user license fees equal to $1,000 or more. Running royalties, a subset of the more inclusive gross income measure, are usage-based payments made by the licensee to the licensor for ongoing use of an asset or IP right. As such, running royalties are evidence of the perceived value of IP in the marketplace or the achievement of milestones on the path toward commercialization.

How Does North Carolina Perform?

In terms of gross income received as a percentage of academic science & engineering R&D expenditures, North Carolina ranks 10th in the nation, with a value that is 110 percent of the U.S. value and 40 percent of the value of the top-ranking state, New York *[3.5a]*. Among the comparison states, North Carolina ranks behind Massachusetts, Washington, and California, but ahead of Georgia, Virginia, and Colorado.

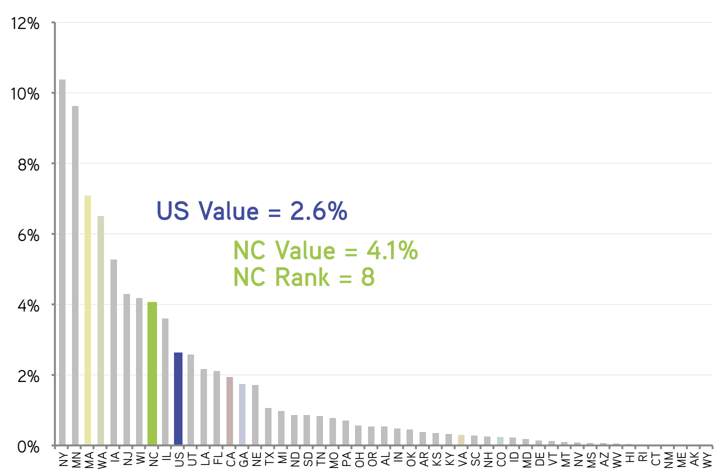
North Carolina fares similarly well for running royalties as a percentage of academic science & engineering R&D expenditures, ranking 8th in the nation, with a value that is 157 percent of the U.S. value and 39 percent of the value of the top-ranking state, New York *[3.5b]*. Among the comparison states, North Carolina ranks behind Massachusetts and Washington, but ahead of California, Georgia, Virginia, and Colorado. Since 2000, North Carolina's running royalties as a percentage of academic science & engineering R&D expenditures have increased by 246 percent, which is

3.5a–Academic License Income (Gross Received) as a Percentage of Academic Science & Engineeering R&D Expenditures, All U.S. States, 2009–2011 Average



Source: Association of University Technology Managers and National Science Foundation

3.5b–Academic License Income (Running Royalties) as a Percentage of Academic Science & Engineeering R&D Expenditures, All U.S. States, 2009–2011 Average



Source: Association of University Technology Managers and National Science Foundation significantly faster than the rate of increase for the U.S. or for any of the comparison states *[3.5c]*.[1] Together, Washington, Massachusetts, Colorado, and Georgia had an average increase of 54 percent, while California and Virginia together had an average decrease of 52 percent.

Within North Carolina, seven universities report significant technology license income—Duke, East Carolina, NC State, UNC Charlotte, UNC Greensboro, UNC-Chapel Hill, and Wake Forest *[3.5d and 3.5e]*.[2] Between 2009 and 2011, together the universities received, on average, more than $102 million in licensing income. Wake Forest University accounts for nearly 75 percent of this income.[3]

What Does This Mean for North Carolina?

One of North Carolina's core innovation-related strengths is its academic R&D (see indicator 2.3), which is a key reason it ranks high on income from university technology license agreements as a percentage of academic science & engineering R&D expenditures. The level of license income varies considerably across the state's universities, however, and is concentrated in a relatively small number of universities overall. To maximize the value of the state's strong academic R&D, a larger number of North Carolina's universities should focus increased attention on their offices and activities that generate patents and other forms of IP that can be licensed. This would not necessarily entail a large increase in resources. For example, the University of North Carolina's 2013–2018 strategic directions include establishing and supporting a "scout team" and core support staff that any campus could utilize for market assessment, legal assistance, new venture services, and other operational support, such as patenting and copyrighting, for commercialization.[4] Initiatives such as these and others focused on increasing the commercial impact of academic discoveries should be a high priority for state and university policy makers.

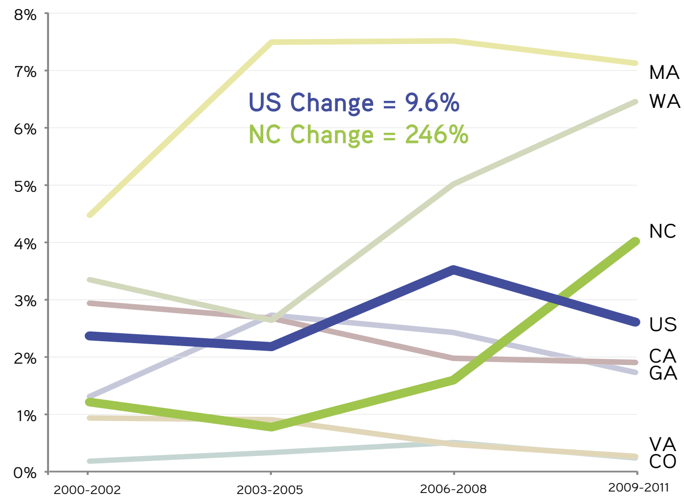
[1] As indicated in table 3.5d, Wake Forest University accounts for nearly three-fourths of these running royalties. Several medical devices and diagnostics have generated these royalties. Examples include negative pressure wound therapy devices, neurosurgical fixation tools and devices, virtual endoscopy technologies, and other imaging software.

[2] These seven universities are the same ones that have offices focusing on technology patenting and commercialization and that appear in indicator 3.2: Academic Patents. All data are self-reported by the universities to the Association of University Technology Managers (AUTM) via its Annual Licensing Survey. While it is possible that some NC universities have technology license income not reported to AUTM, the likelihood and amount are very low and not likely to change the findings presented here significantly.

[3] Wake Forest is the only North Carolina university with running royalties considerably higher than the U.S. average. Duke also has running royalties higher than the U.S. average, though not considerably so. The remaining five universities have running royalties significantly lower than the U.S. average.

[4] *Our Time, Our Future: The UNC Compact with North Carolina, Strategic Directions 2013-2018*, available at http://www.northcarolina.edu.

3.5c–Academic License Income (Running Royalties) as a Percentage of Academic Science & Engineering R&D Expenditures, Comparison States, Three-Year Averages, 2000-2011



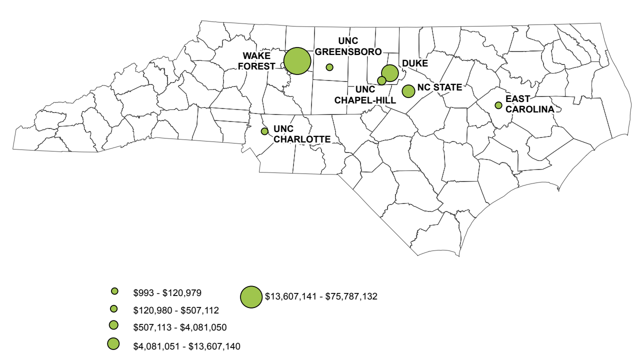
Source: Association of University Technology Managers and National Science Foundation

3.5d–Academic License Income, U.S. Average and N.C. Institutions, 2009–2011 Annual Average

Higher Education Institution	Gross Received	Running Royalties
US Average	$13,370,974	$8,686,526
Duke	$23,087,749	$13,607,140
East Carolina	$563,115	$120,979
NC State	$5,078,076	$4,081,050
UNC Charlotte	$54,562	$993
UNC Greensboro	$108,050	$36,884
UNC-Chapel Hill	$2,381,436	$507,112
Wake Forest	$75,787,132	$75,787,132

Source: Association of University Technology Managers

3.5e–Location of Academic License Income (Running Royalties) in N.C., Average Annual Income, 2009–2011



Source: Association of University Technology Managers

Indicator 4.1: *High-Tech. Establishments and Formations*

Key Findings

- **The percentage of North Carolina's business establishments classified as high-technology ranks below the U.S. average, and since 2004 has been increasing at a rate roughly equal to the U.S. average rate.**
- **The number of net business formations in high-technology industries as a percentage of the total number of business establishments is slightly negative and roughly equal to the U.S. average.**
- **North Carolina's high technology business establishments are highly concentrated in a small number of urban counties.**

Indicator Overview

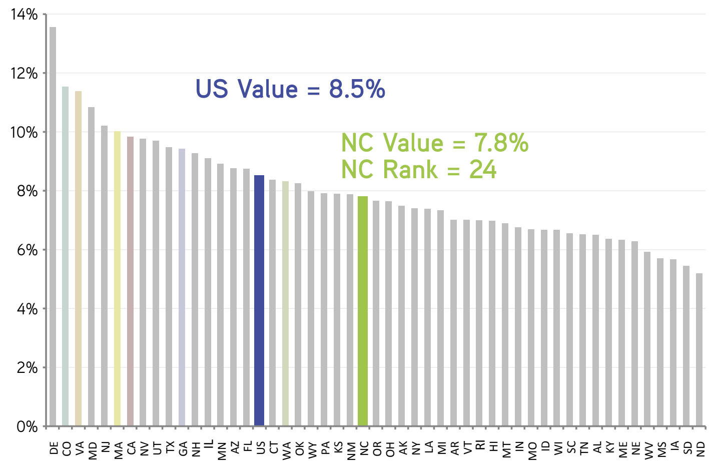
This indicator measures high-technology establishments two ways: the percentage of a state's business establishments that are classified as being part of high-technology industries, and the number of net business formations that occur in high-technology industries as a percentage of the total number of business establishments in a state. High-technology industries are defined as those in which the proportion of employees in technology-oriented occupations is at least twice the average proportion for all industries. High-technology occupations include scientific, engineering, and technician occupations that employ workers who generally possess in-depth knowledge of the theories and principles of science, engineering, and mathematics at a postsecondary level[1].

States often consider high-technology industries desirable, in part because they typically compensate workers better than other industries do. Moreover, because the business base of a state is constantly changing as new businesses form and others cease to function, a high percentage of high-technology business formations indicates an increasingly prominent role for these industries.

How Does North Carolina Perform?

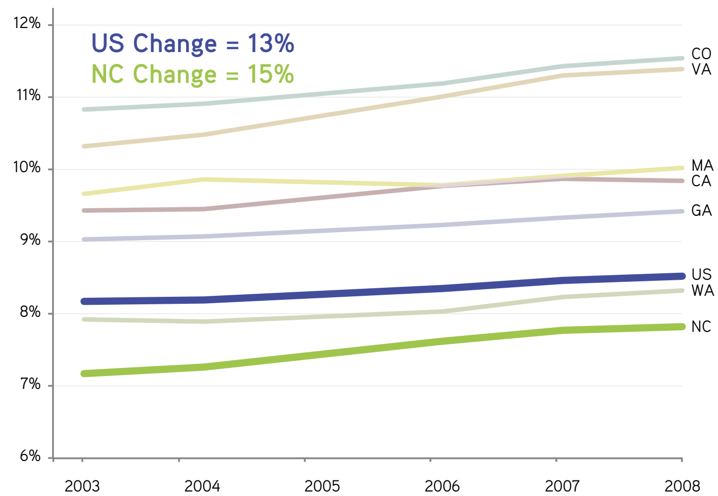
North Carolina's high-technology establishments represent 7.8 percent of all business establishments in the state, with a value that ranks 24th in the nation and is 92 percent of the U.S. value and 57 percent of the value of the top-ranking state, Delaware *[4.1a]*. Among the comparison states, North Carolina's percentage of high-technology establishments ranks last, two percentage points lower than the next highest state, Washington. The percentage of high-technology business establishments in North Carolina has increased by 15 percent since 2003. This rate of increase is higher than, but not significantly different from, the rate of increase for the U.S., 13 percent, and the rates of all the comparison states, which average 11 percent *[4.1b]*.

4.1a–High-Technology Establishments as a Percentage of Total Establishments, All U.S. States, 2008



Source: National Science Board

4.1b–High-Technology Establishments as a Percentage of Total Establishments, Comparison States, 2003–2008



Source: National Science Board

[1] The data pertaining to establishments are based on their classification according to the 2002 edition of the North American Industry Classification System (NAICS). See the Appendix for a list of the 46 industries (by 4-digit NAICS code) that are defined as high technology.

Indicator 4.1: *High-Tech. Establishments and Formations, cont.*

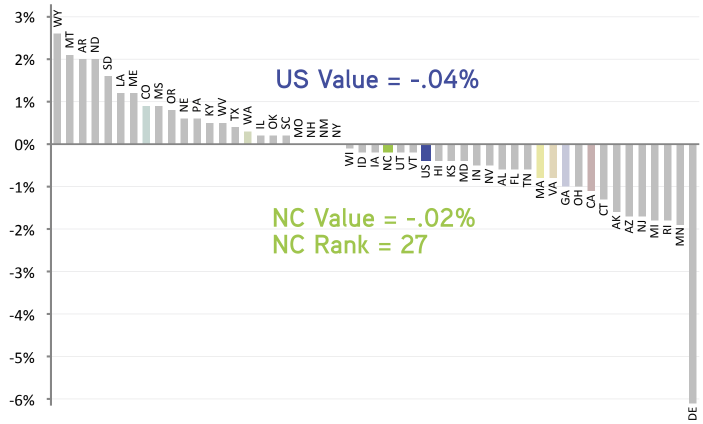
In terms of high-technology business formations as a percentage of all business establishments, North Carolina's value of -.02 percent is slightly higher than the U.S. value of -.04 percent but considerably lower than the 26 percent value of the highest state, Wyoming *[4.1c]*. Among comparison states, North Carolina ranks behind Colorado and Washington but ahead of Massachusetts, Virginia, Georgia, and California. The percentage of high-technology business formations in North Carolina has decreased by 108 percent since 2004. This rate of decrease is less than, but not significantly different from, the rate of decrease for the U.S., -125 percent, and the average rate for the comparison states, 118 percent *[4.1d]*.

Although high-technology companies are located in each of North Carolina's 100 counties, nearly half (48.3 percent) of those companies are located in just five counties—Mecklenburg (17.4 percent), Wake (16.1 percent), Guilford (7 percent), Durham (4 percent), and Forsyth (3.8 percent) *[4.1e]*. The next three counties combined—Buncombe (3.4 percent), New Hanover (3.2 percent), and Cumberland (2.4 percent)—account for another nine percent of the state's high-technology companies. This means that eight of the state's 100 counties contain nearly 60 percent of the state's high-technology companies. Of the remaining 92 counties, 12 account for between one and two percent of the state's high-technology companies each, whereas each of the remaining 80 counties has less than one percent of the state's high-technology companies.

What Does This Mean for North Carolina?

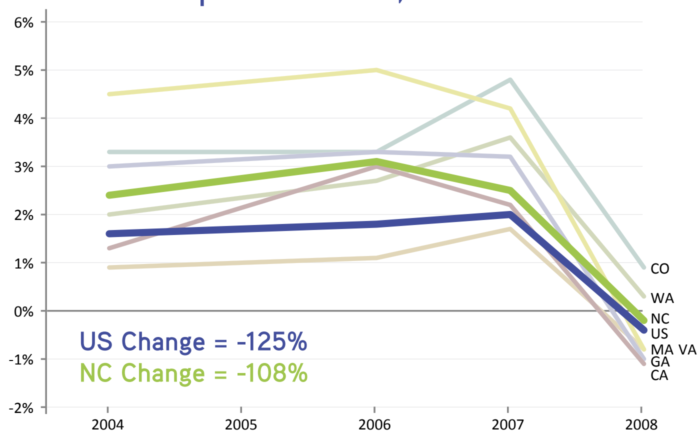
Together, North Carolina's below-average level of high-technology establishments and below-average rate of high-technology formations reflect the dual facts that a large proportion of North Carolina remains rural in nature, and maintains a higher-than-average share of companies in lower-technology manufacturing industries and agriculture. To the extent that new companies are forming in North Carolina, more often than not they are low-technology companies. In the innovation-driven economy, the presence and formation of high-technology companies indicates the degree to which a state's economy is dynamic, innovative, and a positive environment for economic growth and job creation. To compete in this economy, North Carolina must actively work to increase the technology levels of its existing companies and to start and grow new high-technology companies.

4.1c–High-Technology Business Formations as a Percentage of all Business Establishments, All U.S. States, 2008



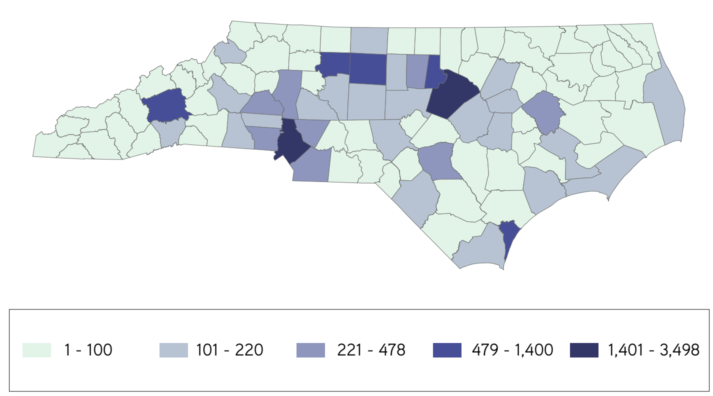
Source: National Science Board

4.1d–High-Technology Business Formations as a Percentage of all Business Establishments, Comparison States, 2004–2008



Source: National Science Board

4.1e–Number of High-Technology Business Establishments, N.C. Counties, 2010



Source: Economic Modeling Specialists, Inc.

Indicator 4.2: *High-Tech. Employment*

Key Findings

- **The percentage of North Carolina's workforce employed in high-technology business establishments ranks below the U.S. average, has since at least the early 2000s, and is decreasing at a rate roughly equal to the U.S. average.**
- **North Carolina's employment in high-technology business establishments is highly concentrated in a small number of urban counties.**

Indicator Overview

This indicator represents the extent to which a state's workforce is employed in high-technology business establishments.[1] High-technology business establishments are defined as those in which the proportion of employees in technology-oriented occupations is at least twice the average proportion for all establishments. High-technology occupations include scientific, engineering, and technician occupations that employ workers who generally possess in-depth knowledge of the theories and principles of science, engineering, and mathematics at a postsecondary level.[2]

States often consider high-technology industries and occupations desirable, in part because they typically compensate workers better than other industries and occupations do. High-technology occupations tend to be managerial, professional and technical positions held by individuals with at least two years of college education. Skilled and educated workers are the core drivers of states' most important industries, from research and development, to high-value-added manufacturing, to high-wage traded services.

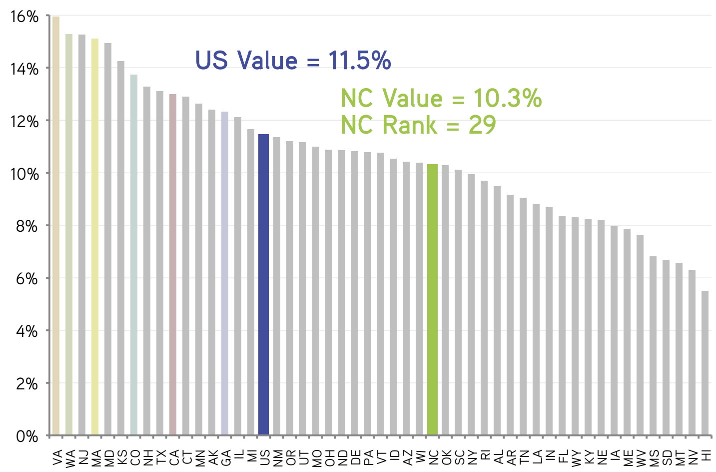
How Does North Carolina Perform?

North Carolina's employment in high-technology establishments is 10.3 percent of the state's total employment, a value that ranks 29th in the nation and is 90 percent of the U.S. average value and 64 percent of the value of the top-ranking state, Virginia *[4.2a]*. Among the comparison states, North Carolina's employment in high-technology establishments as a percentage of total employment ranks last, two percentage points lower than the next highest state, Georgia. The percentage of North Carolina's employment in high-technology establishments has decreased by one percent since 2003.

[1] Total employment refers to all U.S. business establishments with paid employees, but does not include crop and animal production, rail transportation, the postal service, public administration, or most government employees.

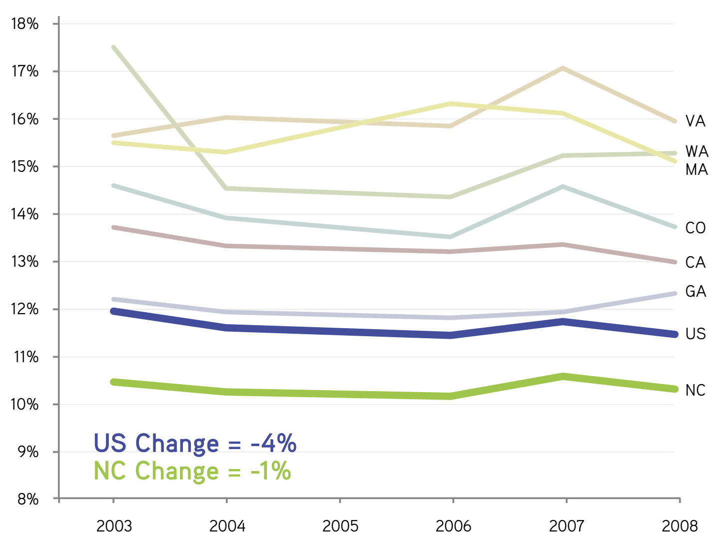
[2] The data pertaining to establishments are based on their classification according to the 2002 edition of the North American Industry Classification System (NAICS). See the Appendix for a list of the 46 industries (by 4-digit NAICS code) that are defined as high technology. Data on total employment and NAICS industry establishment employment are provided by the U.S. Census Bureau and differ from workforce data provided by the U.S. Bureau of Labor Statistics (BLS).

4.2a–Employment in High-Technology Establishments as Percentage of Total Employment, All U.S. States, 2008



Source: National Science Board

4.2b–Employment in High-Technology Establishments as Percentage of Total Employment, Comparison States, 2003–2008



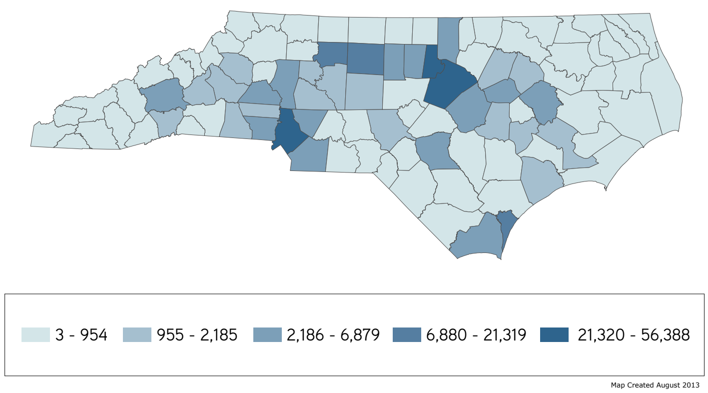
Source: National Science Board

Indicator 4.2: *High-Tech. Employment, continued*

This rate of decrease is lower than, but not significantly different from, the four percent rate of decrease for the U.S. and the rates of all the comparison states, which decreased, on average, also by four percent *[4.2b]*.

Although high-technology establishments employ workers in each of North Carolina's 100 counties, nearly half (48.2 percent) of those employees work in just three urban counties—Mecklenburg (19.8 percent), Wake (16.4 percent), and Durham (12 percent) *[4.2c]*. Establishments located in the next four counties combined—Guilford (7.5 percent), Forsyth (3.5 percent), New Hannover (3.3 percent) and Buncombe (2.4 percent)—account for another 16.7 percent of the state's high-technology workers. This means that establishments located in seven percent of the state's counties employ nearly 66 percent of the state's high-technology workers. Of the remaining 93 counties, 12 account for between one and two percent of the state's high-technology workers each, whereas each of the remaining 81 counties has less than one percent of the state's high-technology employment.

4.2c–Employment in High-Technology Establishments, N.C. Counties, 2012



Source: Quarterly Census of Employment and Wages, Labor and Economic Analysis Division, NC Department of Commerce

What Does This Mean for North Carolina?

As with high-technology establishments (see indicator 4.1), North Carolina's below-average level of high-technology employment reflects the dual facts that a large proportion of North Carolina remains rural in nature and has a higher-than-average share of companies in lower-technology manufacturing industries and agriculture. Moreover, looking across the state, the distribution of high-technology workers is more concentrated than the distribution of high-technology establishments. This pattern of geographically concentrated high-technology establishments and high-technology workers is considerably more concentrated than the state's population (see indicator 1.6). Together, these patterns suggest that more factors than just the location of the state's population influence where people work and the types of establishments in which they work. These other factors include, among others, the location of research and development assets and activities (see indicators in Section 2) and the education attainment levels of the population across the state (see indicator 5.6). For North Carolina to increase the percentage of its workforce in high-technology establishments, it must not only increase the technology levels of its existing companies and start and grow new high-technology companies. It must also ensure that a greater share and range of its population has the educational requirements and training to work in high-technology establishments.

Indicator 4.3: *Entrepreneurial Activity*

Key Findings

- **North Carolina's monthly rate of new business creation ranks slightly below the U.S. average.**
- **While North Carolina's monthly rate of new business creation has remained fairly constant since 2000, it is not keeping pace with the U.S. rate overall.**

Indicator Overview

This indicator measures the state of entrepreneurial activity in North Carolina. Entrepreneurs provide expertise in transforming innovative ideas into valuable innovations. Strong entrepreneurial activity will help advance North Carolina's transition to a knowledge-based, technology-driven economy. It will also create new jobs for the state workforce. Data for entrepreneurial activity are drawn from the Kauffman Foundation, which uses the Current Population Survey (CPS) to measure the monthly rate of business creation to approximate entrepreneurial activity.[1]

How Does North Carolina Perform?

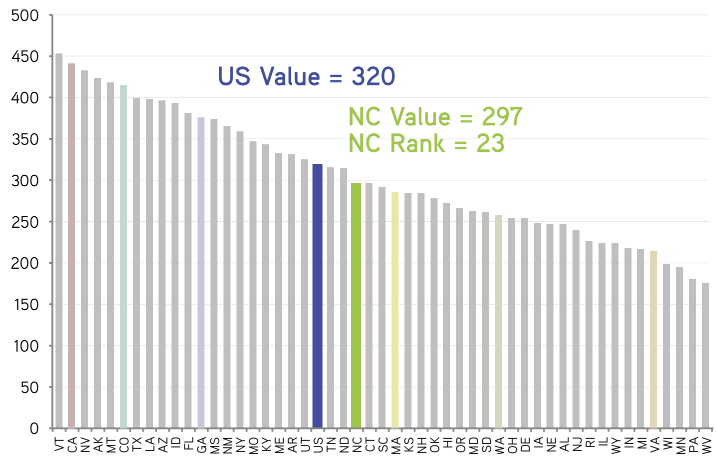
North Carolina's monthly rate of business creation ranks 23rd in the nation, with a level that is 93 percent of the U.S. value and 66 percent of the value of the top-ranking state, Vermont[2] *[4.3a]*. Specifically, North Carolina's monthly rate of business creation is 0.297 percent; in other words, entrepreneurs in North Carolina started 297 businesses each month for every 100,000 adults living in the state. Among comparison states, North Carolina's monthly rate is in the middle of the pack—lower than California, Colorado and Georgia, and higher than Massachusetts, Washington, and Virginia.

Since 2001, North Carolina's three-year entrepreneurship index average has remained fairly constant, dipping during the 2004–2006 period, but rising during both the 2007–2009 and 2010–2012 periods *[4.3b]*. Overall, North Carolina's index decreased by 1.3 percent from 2001–2012, a change that is not significant. However, during that same period of time, the U.S. index increased by 12.9 percent, which is significantly larger than North Carolina's change. Three of the comparison states—California, Georgia, and Massachusetts—experienced significant increases over time, and two states—Washington and Virginia—experienced declines significantly greater than North Carolina's decline.

What Does This Mean for North Carolina?

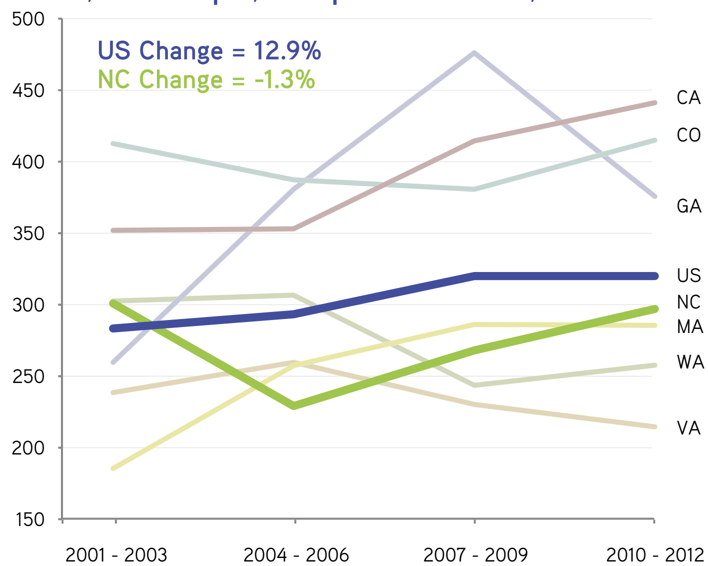
Several factors—such as economic and labor market conditions, industry mix, education, and culture—affect rates of entrepreneurship across states. Thus, while it is difficult to pinpoint causes of the different business creation rate scores across states, this indicator provides important insight into how quickly North Carolina's economy is changing to provide new opportunities and employment in economic sectors of the future. In general, North Carolina's performance is average; more can be done to improve state conditions for, and levels of, entrepreneurial activities.

4.3a–Average Annual Number of Entrepreneurs Per 100,000 People, All U.S. States, 2010–2012



Source: Kauffman Foundation

4.3b–Average Annual Number of Entrepreneurs Per 100,000 People, Comparison States, 2001–2012



Source: Kauffman Foundation

[1] The Kauffman Index of Entrepreneurial Activity (KIEA) measures the rate of business creation at the individual owner level. Presenting the percentage of the adult, non-business owner population that starts a business each month, the Kauffman Index captures all new business owners, including those who own incorporated or unincorporated businesses, and those who are employers or non-employers. The Kauffman Index is calculated from matched data from the Current Population Survey (CPS), a monthly survey conducted by the U.S. Bureau of the Census and the Bureau of Labor Statistics (BLS). For more information, see http://www.kauffman.org/what-we-do/research/kauffman-index-of-entrepreneurial-activity.

[2] To increase sample sizes and precision, monthly entrepreneurial activity rates for each state are averaged over a three-year period to calculate an average monthly estimate for the period. Year-to-year estimates are not presented here because of the lack of precision in entrepreneurship rates, especially for smaller states.

Indicator 4.4: *Exports*

Key Findings

- **The value of North Carolina's exports as a percentage of state Gross Domestic Product (GDP)[1] ranks below the U.S. average, has since at least the early 2000s, and has remained relatively constant over that period.**
- **In comparison with top foreign countries, the value of North Carolina's exports as a percentage of GDP ranks low and has remained relatively constant since the early 2000s.**

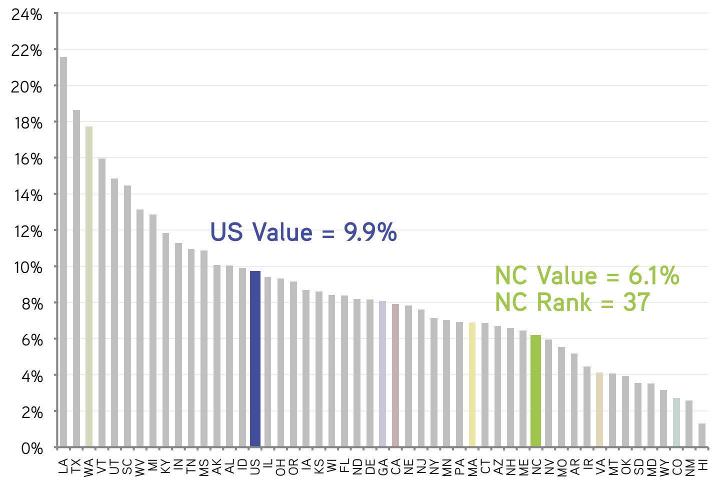
Indicator Overview

This indicator measures the dollar value of each state's international exports as a percentage of its GDP. Export statistics are based on the state from which the merchandise starts its journey to the port of export; that is, the data reflect the transportation origin of exports.[2] Exports are an important indicator of a state's potential for generating income and increasing the competitiveness of businesses in the state. More than 95 percent of the world's population lives outside the U.S., and money brought into the state from export businesses allows for the purchase of local goods and services and thus improves the state's local economy.[3] On average, exports contribute an additional 18 percent to workers' earnings in U.S. manufacturing.[4] Export-based companies also are frequently required to adapt products in unique ways for foreign consumers. They may be called upon to negotiate trade restrictions and certification requirements, to work with foreign suppliers, and/or to manage expansive distribution channels, all of which create the flexibility and determination that result in greater competitiveness in home markets.

How Does North Carolina Perform?

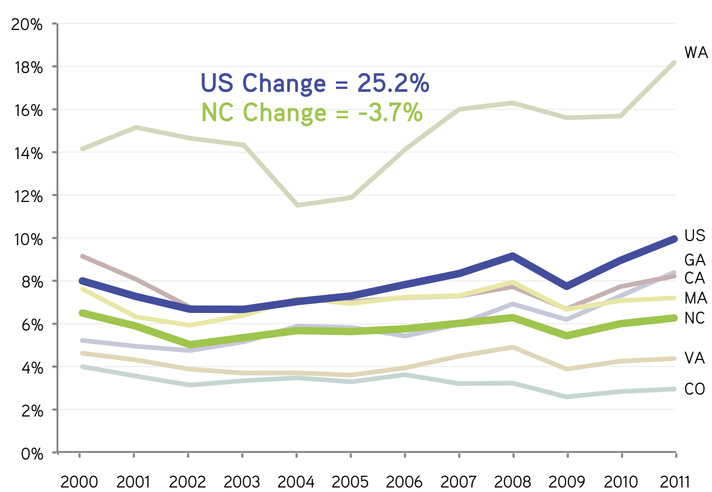
In terms of exports as a percentage of state GDP, North Carolina ranks 37th in the nation, with a value that is 62 percent of the U.S. value and 28 percent of the value of the top-ranking state, Louisiana *[4.4a]*. Among the comparison states, North Carolina's exports as a percentage of state GDP ranks behind Washington, Georgia, California, and Massachusetts, but ahead of Virginia and Colorado. Between 2000 and 2011, North Carolina's exports as a percentage of state GDP decreased slightly by 3.7 percent, a rate that is not significant and also is not significantly different than the rate of the change for the U.S. overall, 25.2 percent *[4.4b]*. While North Carolina's rate of decrease ranks it lower than Georgia and Washington, whose exports as a percentage of state GDP increased significantly, its rate of decrease is slightly less than the rates for Virginia, Massachusetts, California,

4.4a–Exports as a Percentage of GDP, All U.S. States, 2011



Source: WISERTrade and U.S. Bureau of Economic Analysis

4.4b–Exports as a Percentage of GDP, Comparison States, 2000–2011



Source: WISERTrade and U.S. Bureau of Economic Analysis

[1] When used in the context of states, "domestic" refers to the state level. When used as the context of "nations," domestic refers to the national level.

[2] The data come from the Origin of Movement (OM) series, available since 1987 from the U.S. Census Bureau, Foreign Trade Division. OM data cover exports of goods only. There are no comparable statistics for exports of services at the state level.

[3] Export income is considered "new" money introduced into a state's economy. This "new" money can be spent on local goods and services, resulting in an income multiplier effect.

[4] Riker, David. 2010. "Do Jobs in Export Industries Still Pay More? And Why?" Washington, DC: International Trade Administration.

[5] As evidenced by the trends for the U.S., N.C., and the comparison states in chart 4.4b, much of the decrease resulted from the global recession that began in 2008 and negatively impacted economic and trade activity in 2009 and 2010. Since 2010, export levels for the U.S., N.C., and the comparison states have trended upward.

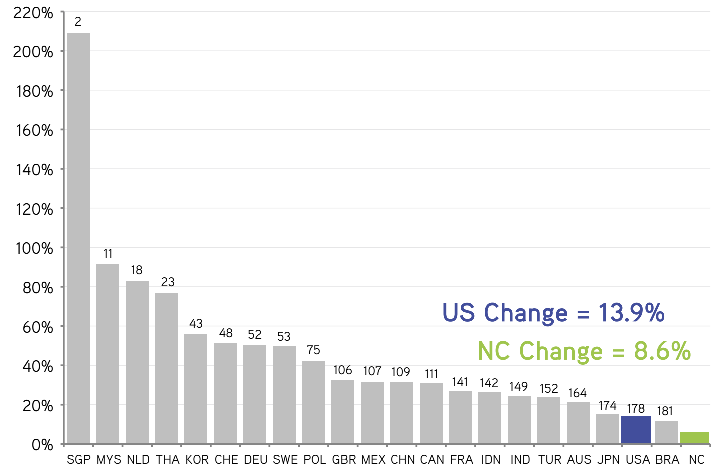
and Colorado; none of these differences is significant, however.[5]

Internationally, the U.S. ranks as the 178th most export-intensive country, making its export intensity seven percent of the rate of the most export-intensive country, Singapore *[4.4c]*.[6] North Carolina's export intensity ranks behind that of all the comparison countries. Since 2000, the export intensity of most of the comparison countries has risen at roughly the same rate as the U.S. rate or, in some cases, at a considerably higher rate (e.g., India at 92.1 percent, Poland at 55.7 percent, and Germany at 5.3 percent) *[4.4d]*. A small number of countries saw their export intensities decrease (e.g., Malaysia at -23.6 percent, Canada at -31.6 percent, and Indonesia at -35.8 percent).

What Does This Mean for North Carolina?

Exports continue to be one of the key drivers for North Carolina's economic development. In 2010, for example, North Carolina exported more than $24.8 billion in products and services to international markets. Exporting helps companies in North Carolina diversify their business portfolios and become more profitable and resilient in the global market. Exports are also critical in employment growth; nearly one out of every 10 jobs in the state is supported by exports.[7] For North Carolina to remain competitive in the global economy, it must continue to explore new markets for the goods and services it produces. Such efforts require focus in strengthening and expanding relationships with overseas trading partners and understanding how North Carolina industries fit within global commodity value chains. Infrastructure investment in highways, inland terminals, and port facilities is needed to improve the ability to efficiently move goods. Enhanced export assistance and increased availability of financial credits to small and medium-sized companies seeking to export are crucial in connecting businesses to the global economy.[8]

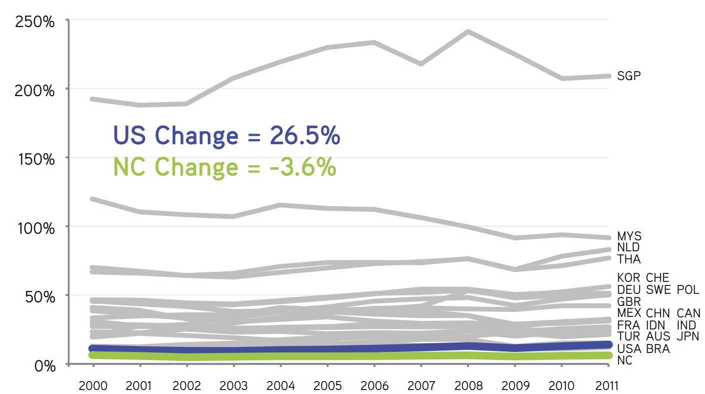
4.4c–Exports as a Percentage of GDP, Comparison Countries, 2011



Source: World Bank*

Data for this chart are available only at the country level. Thus NC's value in this chart (8.6%) is an approximation, derived by multiplying NC's value in chart 4.4a (6.1%) by 1.4%, which is the ratio of the US value in this chart (13.9%) to the US value is chart 4.4a (9.9%).

4.4d–Exports as a Percentage of GDP, Comparison Countries, 2000–2011



Source: World Bank

Data for this chart are available only at the country level. Thus, NC's values in this chart are approximations, derived using the methodology outlined above for chart 4.4c.

[6] Countries with especially high export intensities have highly developed trade-oriented economies and high capacity ports (e.g., Singapore), or are large producers and exporters of widely used high-tech products like semiconductor devices, electrical goods, and information and communication technology products (e.g., Malaysia), or have abundant supplies of natural resources, such as natural gas, that comprise a large share of their exports (e.g., Netherlands).

[7] Based on the 2010 IMPLAN analysis performed by the N.C. Department of Commerce to estimate export contribution to the state's economy.

[8] In addition to the U.S. Department of Commerce's presence across the globe, the International Trade Division of N.C.'s Department of Commerce has staff in the state and in seven locations around the globe to facilitate export growth.

Indicator 5.1: *Science & Engineering Workforce*

Key Findings

- **The percentage of North Carolina's workforce in science & engineering (S&E) occupations ranks slightly below the U.S average and has since at least the early 2000s, but is increasing at a rate equal to or slightly faster than the U.S. average.**

Indicator Overview

This indicator represents the extent to which a state's workforce is employed in S&E occupations. A high value indicates that a state's economy has a high percentage of technical jobs relative to other states. As such, it reflects the labor pool's interests, its level of skill development, and the nature of the employment opportunities in the state. Occupations for S&E are defined by Standard Occupational Classification (SOC) codes[1] and include engineers and computer, mathematical, life, physical, and social scientists. Managers, technicians, elementary and secondary schoolteachers, faculty teaching in S&E fields, and medical personnel are not included.[2]

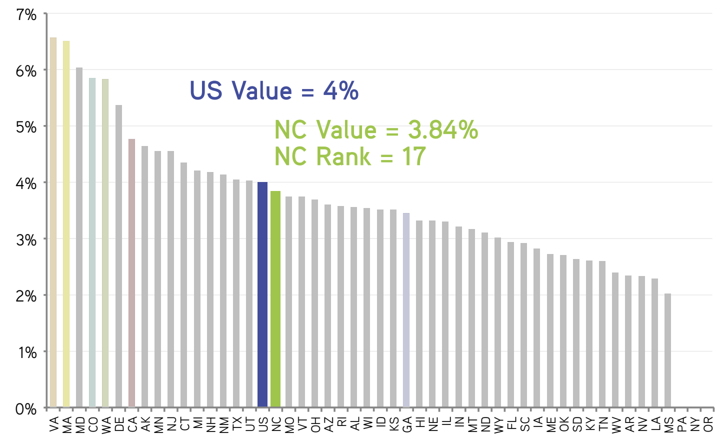
How Does North Carolina Perform?

In terms of individuals in S&E occupations as a percentage of the workforce, North Carolina ranks 17th in the nation, with a level that is 96 percent of the U.S. average value and 58 percent of the value of the top-ranking state, Virginia *[5.1a].* With the exception of Georgia, all of the comparison states rank well ahead of North Carolina and are within the top 10 among all states. From 2003 to 2010, the percentage of North Carolina's workforce in S&E occupations increased significantly, by 15 percent. This rate is slightly faster than the rate of increase for each of the comparison states and the U.S. overall, but not to a significant degree *[5.1b].*

What Does This Mean for North Carolina?

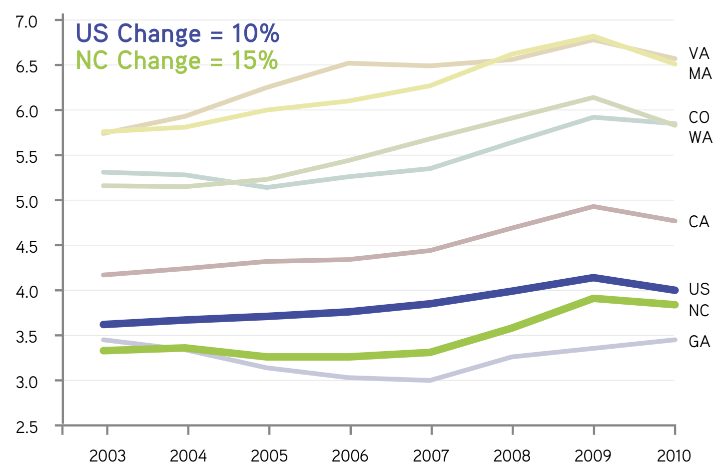
North Carolina's high rate of growth in S&E occupations indicates that it is keeping pace and potentially gaining relative to other states. The share of the state's workers in S&E occupations reflects the share of its establishments that is high-technology (see indicator 4.1) and the share of its employment that works in high-technology establishments (see indicator 4.2). On both these measures, North Carolina ranks slightly below average and at or below the median among all states. For North Carolina to outpace the comparison states and rise above the U.S. average on S&E employment, it would likely also need to increase the technology levels of its existing companies and to start and grow new high-technology companies. The concentrated geographic distribution and employment of the state's high-technology establishments suggest that broadening the distribution of such establishments across North Carolina would help increase the share of the state's employment in S&E occupations.

5.1a–Individuals in Science & Engineering Occupations as a Percentage of the Workforce, All US States, 2010



Source: National Science Board

5.1b–Individuals in Science & Engineering Occupations as a Percentage of the Workforce, Comparison States, 2003–2010



Source: National Science Board

[1] The SOC system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition.

[2] Data on individuals in S&E occupations come from a survey of workplaces that assigns workers to a state based on where they work. Estimates do not include self-employed persons and are developed by the U.S. Bureau of Labor Statistics (BLS) from data provided by state workforce agencies. Data on the size of the workforce are BLS estimates and represent the employed component of the civilian labor force. In these estimates, workers are assigned to a state based on where they live.

Indicator 5.2: *Employed S&E Doctorate Holders*

Key Findings

- **The percentage of North Carolina's workforce holding science & engineering (S&E) doctorates ranks slightly above the U.S average and has since at least the early 2000s, but is increasing at a rate roughly equal to the U.S. average.**

Indicator Overview

This indicator represents a state's ability to attract, retain and grow highly trained scientists and engineers. These individuals often conduct R&D, manage R&D activities, or are otherwise engaged in knowledge-intensive activities. As such, this indicator reflects the labor pool's interests, its level of skill development, and the nature of the employment opportunities in the state. A high value for this indicator in a state suggests employment opportunities for individuals with highly advanced training in S&E fields. Data on employed S&E doctorate holders include those with doctoral degrees in computer and mathematical sciences; the biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields. S&E doctorate data exclude individuals with doctorates from foreign institutions and those above the age of 75.[1]

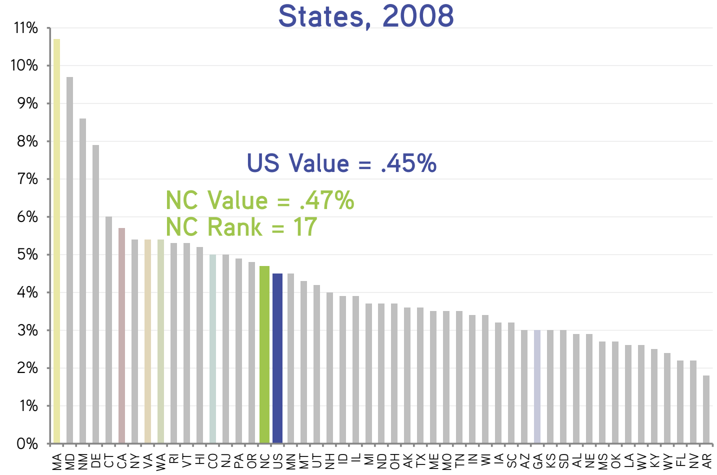
How Does North Carolina Perform?

In terms of employed S&E doctorate holders as a percentage of the workforce, North Carolina ranks 17th in the nation, with a level that is 104 percent of the U.S. average value and 44 percent of the value of the top-ranking state, Massachusetts *[5.2a]*. With the exception of Georgia, all the comparison states rank well ahead of North Carolina, and all but Colorado are within the top 10 among all states. From 2001 to 2008, employed S&E doctorate holders as a percentage of the workforce in North Carolina increased significantly, by nine percent. This rate is slightly slower than the rate of increase for Massachusetts, California, and Virginia, and slightly faster than the rate of increase for Washington, Georgia, Colorado and the U.S. overall, but not to a significant degree *[5.2b]*.

What Does This Mean for North Carolina?

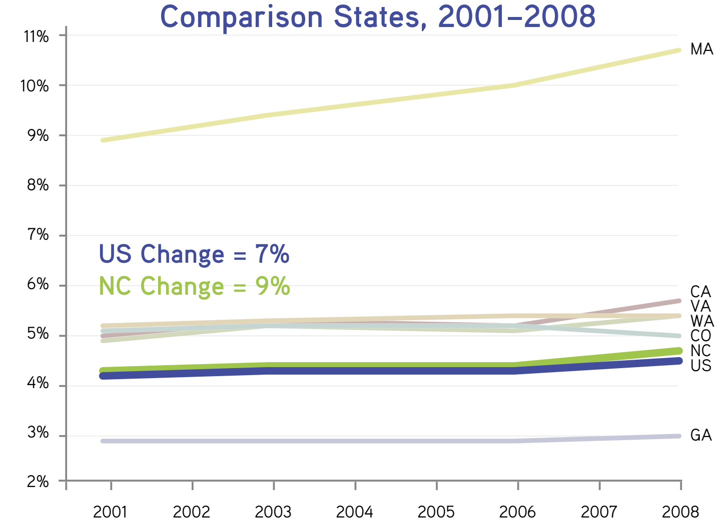
North Carolina's high rate of growth in S&E doctorate holders indicates that it is keeping pace relative to other states and the U.S. overall. As with S&E occupations as a percentage of the workforce (see indicator 5.1), the share of the state's workers holding S&E doctorates reflects the share of its establishments that is high-technology (see indicator 4.1) and the share of its employment that works in high-technology establishments (see indicator 4.2). On both these measures, North Carolina ranks slightly below average and at or below the median among all states. For North Carolina to outpace the comparison states and rise above the U.S. average on employed S&E doctorate holders, it would likely also need to increase the technology levels of its existing companies, start and grow new high-technology companies, or increase its number of other research-intensive organizations. The concentrated geographic distribution and employment of the state's high-technology establishments suggest that broadening the distribution of such establishments across North Carolina would help increase the share of the state's employees holding S&E doctorates.

5.2a–Employed Science & Engineering Doctorate Holders as a Percentage of the Workforce, All U.S. States, 2008



Source: National Science Board

5.2b–Employed Science & Engineering Doctorate Holders as a Percentage of the Workforce, Comparison States, 2001–2008



Source: National Science Board

[1] Employed workforce data are developed by the U.S. Bureau of Labor Statistics (BLS), which assigns workers to a state based on where they live. Workforce data represent annual estimates of the employed civilian labor force; estimates are not seasonally adjusted.

Indicator 5.3: *Engineers as a Percentage of the Workforce*

Key Findings

- **The percentage of trained engineers in North Carolina's workforce ranks well below the U.S average, has since at least the early 2000s, and is increasing at a rate roughly equal to the U.S. average.**

Indicator Overview

This indicator represents the percentage of trained engineers in a state's workforce. Engineers design and operate production processes and create new products and services. This indicator includes the Standard Occupational Classification (SOC) codes for engineering fields:[1] aerospace, agricultural, biomedical, chemical, civil, computer hardware, electrical and electronics, environmental, industrial, marine and naval architectural, materials, mechanical, mining and geological, nuclear, and petroleum.[2] Faculty teaching in science & engineering (S&E) fields are not included as workers in S&E occupations.

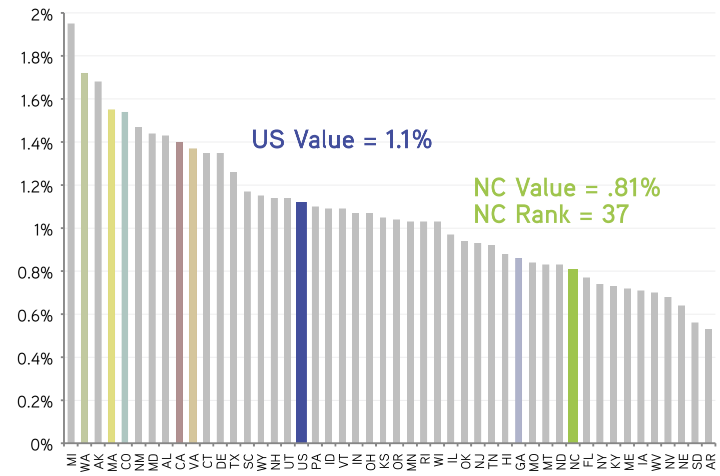
How Does North Carolina Perform?

In terms of the percentage of trained engineers in a state's workforce, North Carolina ranks 37th in the nation, with a level that is 74 percent of the U.S. average value and 42 percent of the value of the top-ranking state, Michigan *[5.3a]*. All of the comparison states rank well ahead of North Carolina and, with the exception of Georgia, are within the top 10 among all states. From 2004 to 2010, the percentage of trained engineers in North Carolina's workforce increased slightly, by five percent, consistent with the rate of increase for the U.S. overall. This rate is slightly slower than the rate of increase for Washington, Georgia, and Colorado, and slightly faster than the rate of increase for Virginia, California, and Massachusetts, but not to a significant degree *[5.3b]*.

What Does This Mean for North Carolina?

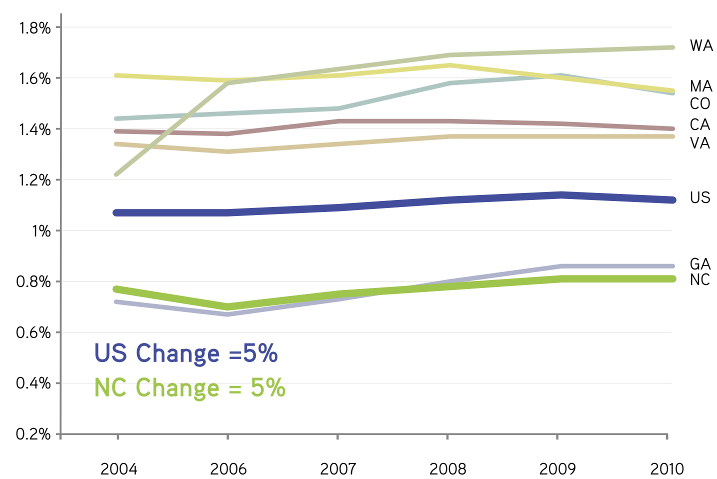
In general, the states with the highest percentage of engineers in their workforce are centers of automobile and aircraft manufacturing, such as Michigan and Washington, or states that rank high on employment in high-technology establishments as share of total employment, such as Massachusetts, California, and Colorado (see indicator 4.2). The relatively low percentage of trained engineers in North Carolina's workforce is a cause for concern, because regions with a high concentration of engineers have a greater capacity for innovation and often lead in key industries.[3] For North Carolina to outpace the comparison states and rise above the U.S. average on the percentage of trained engineers in its workforce, it would also need to increase the technology levels of its existing companies and to start and grow new high-technology companies. The concentrated geographic distribution and employment of the state's high-technology establishments suggest that broadening the distribution of such establishments across North Carolina would help increase the share of the state's employees trained as engineers.

5.3a - Engineers as a Percentage of the Workforce, All U.S. States, 2010



Source: National Science Board

5.3b - Engineers as a Percentage of the Workforce, Comparison States, 2004-2010



Source: National Science Board

[1] The SOC system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition.

[2] Data on individuals in S&E occupations come from a survey of workplaces that assigns workers to a state based on where they work. Estimates do not include self-employed persons and are developed by the U.S. Bureau of Labor Statistics (BLS) from data provided by state workforce agencies. Data on the size of the workforce are BLS estimates and represent the employed component of the civilian labor force. In these estimates, workers are assigned to a state based on where they live.

[3] Notably, San Jose/Silicon Valley's ratio of 45 engineers per 1,000 employees is twice as high as any other big metro area, which is a key reason it is one of the nation's most affluent metro areas.

Indicator 5.4: *B.A. Degrees in Natural S&E*

Key Findings

- **The ratio of new natural sciences & engineering (NS&E) bachelor's degrees to the population ages 18–24 years in North Carolina ranks slightly below the U.S average and has since at least the early 2000s, but is increasing at a rate roughly equal to the U.S. average.**

Indicator Overview

This indicator is the ratio of new NS&E bachelor's degrees to the population ages 18–24 years and represents the extent to which a state prepares young people to enter technology-intensive occupations that are fundamental to a knowledge-based, technology-driven economy. NS&E fields include the physical, earth, ocean, atmospheric, biological, agricultural, and computer sciences; mathematics; and engineering, but do not include social sciences and psychology.[1]

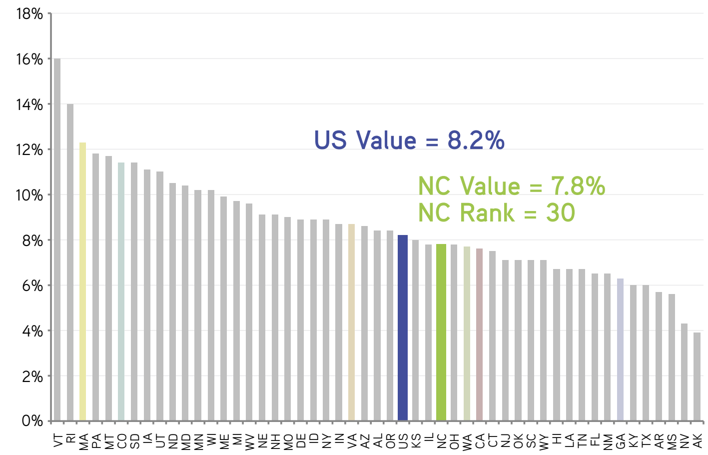
How Does North Carolina Perform?

In terms of the ratio of new NS&E bachelor's degrees to the population ages 18–24 years, North Carolina ranks 30th in the nation, with a level that is 95 percent of the U.S. average value and 49 percent of the value of the top-ranking state, Vermont *[5.4a]*. Relative to the comparison states, North Carolina ranks below Massachusetts, Colorado, and Virginia, but ahead of Washington, California, and Georgia. From 2000 to 2009, the ratio of new NS&E bachelor's degrees to the population ages 18–24 years increased slightly, by 2.6 percent, a rate lower than but not significantly different from the rate of increase for the U.S. overall. North Carolina's rate of increase is slightly slower than the rates of increase for California, Washington, Colorado, and Georgia, and slightly higher than the rates for Massachusetts and Virginia, whose rates decreased; none of these differences is significant, however *[5.4b]*.

What Does This Mean for North Carolina?

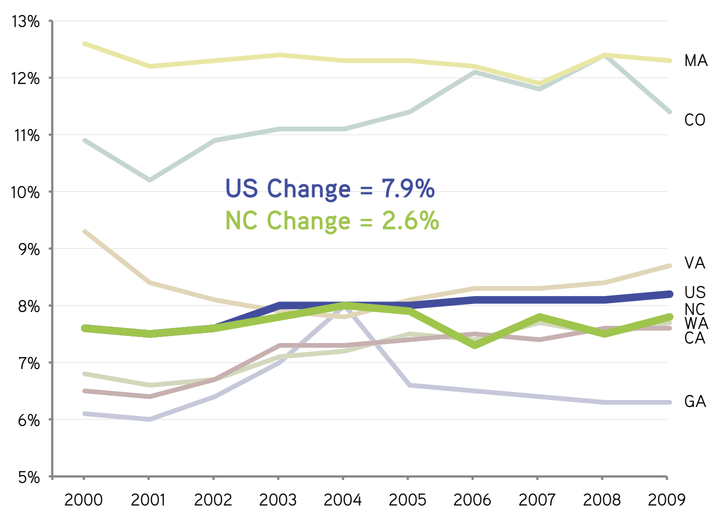
Educational attainment in an NS&E field gives people greater opportunities to work in higher-paying technical jobs than are generally available to those in other fields of study. Earning a bachelor's degree in an NS&E field also prepares an individual for advanced technical education. A high value for this indicator indicates the successful provision of undergraduate training in NS&E fields. North Carolina's slightly below average performance on this indicator suggests room for improvement. While the ratio of new NS&E bachelor's degrees to the population ages 18–24 years in North Carolina is increasing over time, this rate of increase is keeping pace with or slightly slower than the rate for the U.S. overall. For North Carolina to have the skilled workforce necessary to drive the innovation economy, it should work to increase the share of its college-age population earning degrees in NS&E fields. Relocating companies are likely to gravitate to North Carolina if it has the required workforce pool available, and companies already located in North Carolina are more likely to remain here if it has a strong pool of NS&E workers.

5.4a–Bachelor's Degrees in Natural Sciences and Engineering Conferred per 1,000 Individuals 18–24 Years Old, All U.S. States, 2009



Source: National Science Board

5.4b–Bachelor's Degrees in Natural Sciences and Engineering Conferred per 1,000 Individuals 18–24 Years Old, Comparison States, 2000–2009



Source: National Science Board

[1] The number of NS&E bachelor's degrees awarded is based on an actual count provided by the National Center for Education Statistics. Because students often relocate after graduation, this measure does not directly indicates the qualifications of a state's future workforce. A state's value for this indicator maybe high when its higher education system draws a large number of out-of-state students who study NS&E fields or in states with small resident populations.

Indicator 5.5: *Natural S&E Degrees*

Key Findings

- **The percentage of higher education degrees conferred in natural science & engineering (NS&E) fields in North Carolina ranks above the U.S average and has since at least the early 2000s, but is decreasing slightly at a rate roughly equal to the U.S. average.**

Indicator Overview

This indicator represents the extent to which a state's higher education programs are concentrated in NS&E fields, the largest educational pipeline for technology intensive occupations. The indicator is expressed as the percentage of higher education degrees conferred in NS&E fields.[1] NS&E fields include the physical, life, earth, ocean, atmospheric, and computer sciences; mathematics; and engineering. Social sciences, such as anthropology, economics, political science and public administration; psychology; and sociology, are not included.[2]

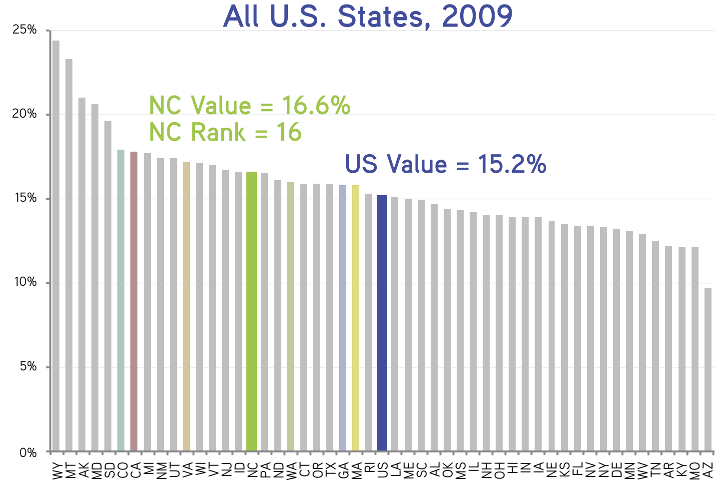
How Does North Carolina Perform?

In terms of NS&E degrees as a percentage of higher education degrees conferred, North Carolina ranks 16th in the nation, with a level that is 109 percent of the U.S. average value and 68 percent of the value of the top-ranking state, Wyoming *[5.5a]*. Relative to the comparison states, North Carolina ranks below Colorado, California, and Virginia, but ahead of Washington, and Georgia, and Massachusetts. From 2000 to 2009, NS&E degrees as a percentage of higher education degrees conferred in North Carolina decreased by 5.1 percent, a rate slower than, but not significantly different from, the rate of decrease for the U.S. overall. North Carolina's rate of decrease is slightly less than the rates of decrease for Virginia, Georgia, and Colorado, and slightly faster than the rates for California and Massachusetts, whose rates decreased; Washington's rate increased slightly. None of these differences is significant, however *[5.5b]*.

What Does This Mean for North Carolina?

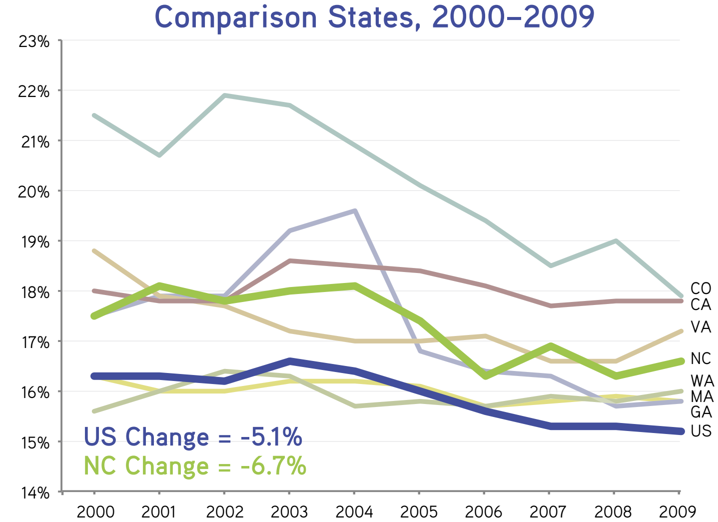
Irrespective of degree level, educational attainment in an NS&E field gives people greater opportunities to work in higher-paying technical jobs than are generally available to those in other fields of study. A high value for this indicator suggests the successful provision of higher education training in NS&E fields at both the undergraduate and graduate levels. North Carolina's above-average performance on this indicator but below-average performance on bachelor's degrees in NS&E fields (see indicator 5.4) suggests that North Carolina's provision of NS&E degrees is stronger at the master's and doctoral level than at the bachelor's level. While the percentage of higher education degrees that were conferred in NS&E fields in North Carolina is decreasing over time, this rate of decrease essentially is the same as the rate of decrease for the U.S. overall. For North Carolina to have the skilled workforce necessary to drive the innovation economy, it should work to increase the share of its undergraduate-level students earning degrees in NS&E fields.

5.5a–Natural S&E Degrees as a Percentage of Total Higher Education Degrees Conferred, All U.S. States, 2009



Source: National Science Board

5.5b–Natural S&E Degrees as a Percentage of Total Higher Education Degrees Conferred, Comparison States, 2000–2009



Source: National Science Board

[1] Counts of both NS&E degrees and higher education degrees conferred include bachelor's, master's, and doctoral degrees; associate's degrees are not included.

[2] Degree data reflect the location of the degree-granting institution, not the state in which degree-earning students permanently reside. The year reflects the end date of the academic year. All degree data are actual counts.

Indicator 5.6: *Educational Attainment*

Key Findings

- **North Carolina's educational attainment composite score ranks below the U.S. average and has since at least the early 2000s, but is increasing at a rate slightly faster than the U.S. average.**
- **Within North Carolina, educational attainment levels vary considerably; only 16 counties, the majority of which are urban, have an educational composite score higher than the U.S. average composite score.**

Indicator Overview

Regardless of industry or occupation, a well-educated, skilled workforce is a prerequisite for success in the innovation economy. The educational attainment of the workforce—measured here as an aggregate using a composite score (see Methodological Note, page 54)—is a fundamental determinant of how well a state can generate and support economic growth centered on innovation. Moreover, the greater the share of well-educated workers within a state, the less the state has to rely on in-migration (see indicator 5.7) to sustain its pool of workers. North Carolina's ability to compete in the innovation economy is heavily dependent on its ability to produce and maintain a well-educated workforce.

How Does North Carolina Perform?

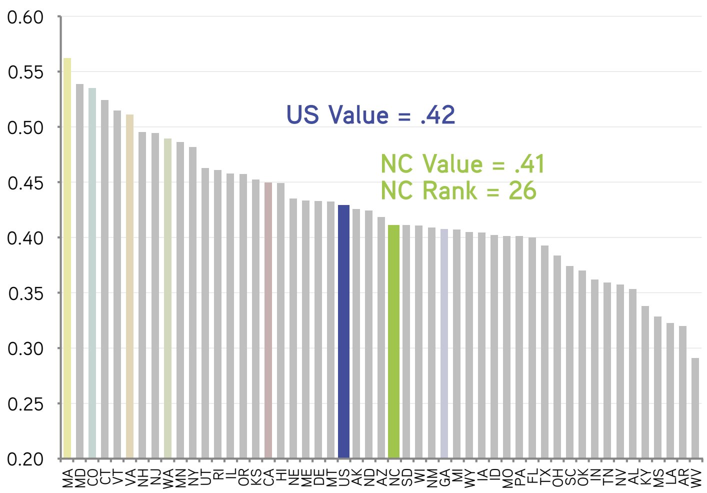
In terms of its educational attainment composite score, North Carolina's value ranks 26th in the nation, with a level that is 98 percent of the U.S. value and 73 percent of the value of the top-ranking state, Massachusetts *[5.6a]*. This composite score derives from the following statistics:[1] 15 percent of North Carolina citizens over 25 years of age have not completed high school, 27 percent completed their education with a high school degree, 22 percent completed with a high school degree and have some college experience, 9 percent completed with an associate degree, 18 percent completed with a bachelor's degree, 8 percent completed with a master's or professional degree, and 1 percent completed with a doctoral degree.

As a group, these statistics indicate that, compared to the U.S. average, North Carolina has a higher percentage of its citizens without a high school diploma, with some college, and with an associate's degree. In all the other educational attainment categories—high school degree, bachelor's degree, master's or professional degree, or doctorate degree—North Carolina's percentage is equal to or lower than the U.S average. And with the exception of Georgia, all comparison states had a higher educational attainment composite score than North Carolina's score.

From 2005 to 2011, North Carolina's composite score increased by 8.9 percent, which was slightly greater than

5.6a–Educational Attainment, All U.S. States, 2011

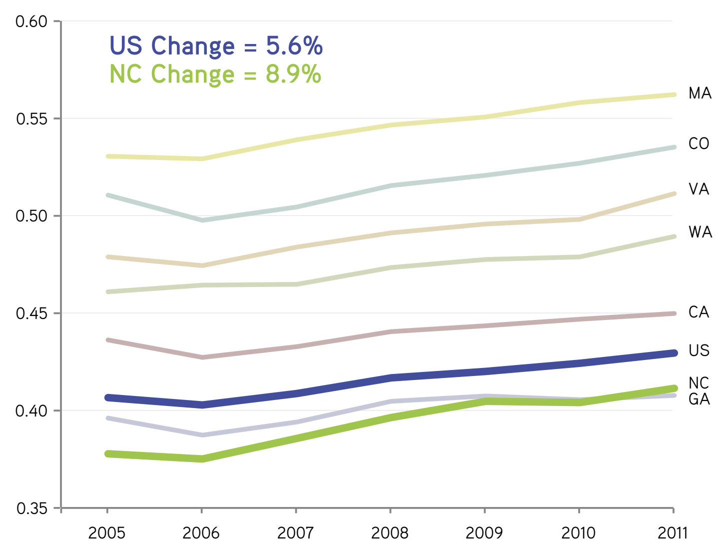
Weighted measure (composite score) of the education attainment of residents aged 25 years and over



Source: U.S. Census Bureau

5.6b–Educational Attainment, Comparison States, 2005–2011

Weighted measure (composite score) of the education attainment of residents aged 25 years and over



Source: U.S. Census Bureau

[1] Using these statistics and the weighted measure methodology described on the next page, North Carolina's composite score for 2011 is calculated as follows .15(-.05) + .22(.25) +. 09(.5) + .18(1) + .08(1.5) +.01(2) = .41 (as shown in charts 5.5a and 5.5b).

the increase for the U.S. average composite score (5.7 percent) and the average of the composite scores for the comparison states (5.0 percent) *[5.6b]*. It was also greater than the increase for any of the comparison states individually.

Within North Carolina, educational attainment is considerably higher in urban counties (e.g., Mecklenburg, Wake, Guilford) and counties with high numbers of retirees (e.g., Buncombe, Dare, New Hanover), military personnel (e.g., Craven, Cumberland, Onslow), or universities (e.g., Orange, Pitt, Watauga) *[5.6c and 5.6d]*. Of the state's 100 counties, only 20 have, for residents 25 years and older, a high-school completion rate of 82 percent or higher, whereas 38 have high school completion rates of 79 percent or lower. In terms of the percentage of residents 25 years and over who have completed a bachelor's degree or more education, only five counties have a completion rate of 38 percent or higher. For the educational attainment composite score, the pattern is similar but considerably more concentrated *[5.6e]*. This is because the composite score includes higher levels of educational attainment and places greater weight on those higher attainment levels.

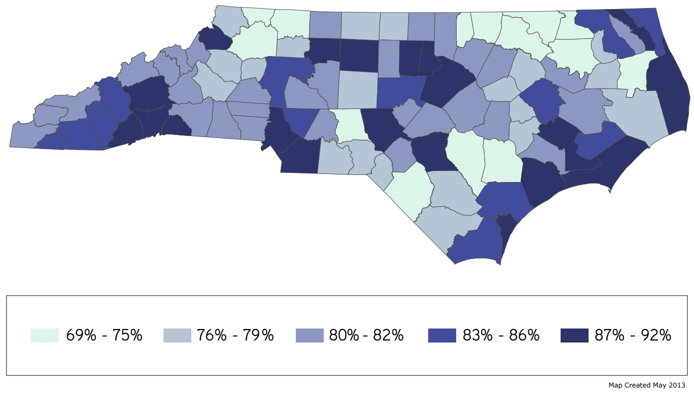
Thus, the overall pattern across North Carolina is that a majority of counties have relatively low educational attainment levels (84 have an educational composite score below the U.S. average composite score) and typically are in rural regions. Of the 16 counties that have an educational composite score higher than the U.S. average composite score, eight are in the top 10 most populous counties in the state; the remaining eight are in less populous counties that are the home to universities or have a large number of retirees.

What Does This Mean for North Carolina?

The *2011 State of the North Carolina Workforce*[2] report highlighted four key facts focused on educational attainment: (1) individuals with a baccalaureate degree were half as likely to be unemployed as the average worker, while individuals without a high school degree were twice as likely as the average worker to be unemployed; (2) workers with a baccalaureate degree can expect to earn $1.5 million more over a 30-year career than a high school dropout; (3) nearly half of the new jobs being created in North Carolina will require, at a minimum, some post-secondary education, many in Science, Technology, Engineering and Math (STEM) disciplines; (4) STEM jobs will constitute an increasing

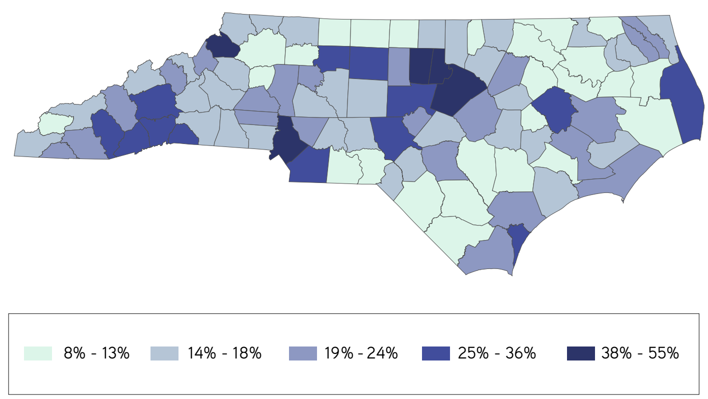
[2] http://www.nccommerce.com/workforce/about-us/plans-policies-reports-initiatives/reports.

5.6c–Percentage of Residents 25 Years and Over Who Have Completed High School or More Education, N.C. Counties, 2007–2011 Estimate



Source: U.S. Census Bureau

5.6d–Percentage of Residents 25 Years and Over Who Have Completed a Bachelor's Degree or More Education, N.C. Counties, 2007–2011 Estimate

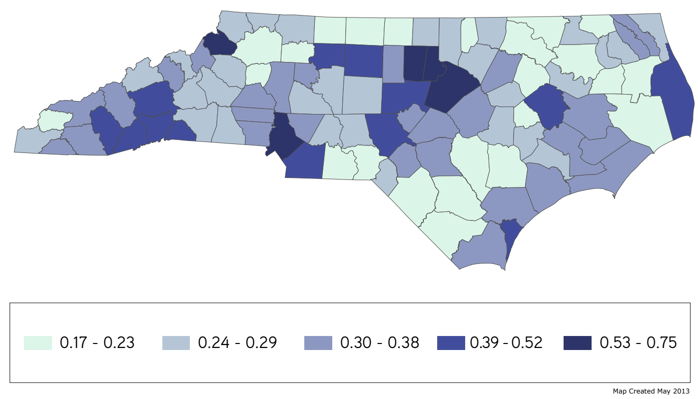


Source: U.S. Census Bureau

Indicator 5.6: *Educational Attainment, continued*

share of higher-and medium-wage jobs, creating significant barriers to employment for unprepared young adults and existing workers. These facts, combined with the educational attainment findings presented above, make it clear that North Carolina must improve the educational attainment levels of it citizens in order to generate innovative ideas, to support the expansion of a knowledge-based economy, and to increase the economic well-being and quality of life of its citizens.

5.6e–Weighted Measure (composite score) of the Education Attainment of Residents Aged 25 Years and Over, N.C. Counties, 2007–2011 Estimate



Source: U.S. Census Bureau

Methodological Note

The weighted measure (composite score) used in charts 5.6a and 5.6b and map 5.6e is identical to the one developed and used by the Information Technology & Innovation Foundation (ITIF) in its *2012 State New Economy Index*[2]. Specifically, it uses U.S. Census Bureau data to determine, for each state, the share of the state's population aged 25 years and older with the following educational attainments: no high school diploma, some college (one or more years, no degree), associate degree, bachelor's degree, master's or professional school degree, and doctorate degree. It then assigns each degree class a weight, as follows:

- -0.05 for no high school diploma
- 0.25 for some college
- 0.5 for associate degree
- 1 for bachelor's degree
- 1.5 for master's or professional degree
- 2 for doctorate degree

Each share is multiplied by its respective weight and the products are summed to arrive at the final score. This composite score is valuable for at least two reasons:

(1) It includes, in a single measure, the full spectrum of relevant degree classes,
(2) It assigns greater weight to higher-level degrees.

Accordingly, it provides an efficient and effective measure of the general educational attainment level of each state.

[2] http://www.itif.org/publications/2012-state-new-economy-index.

Indicator 5.7: *Educational Attainment of In-Migrants*

Key Findings

- **North Carolina's average years of education among in-migrants ranks slightly below the U.S. average, has since at least the mid 2000s, and is increasing at a rate roughly equal to the U.S. average.**
- **North Carolina's in-migration of college-educated adults as a percentage of total state population ranks slightly below the U.S. average, has since at least the mid 2000s, and is decreasing at a rate roughly equal to the U.S. average.**
- **Within North Carolina, the in-migration of individuals with a bachelor's degree or higher is very concentrated in a small number of counties.**

Indicator Overview

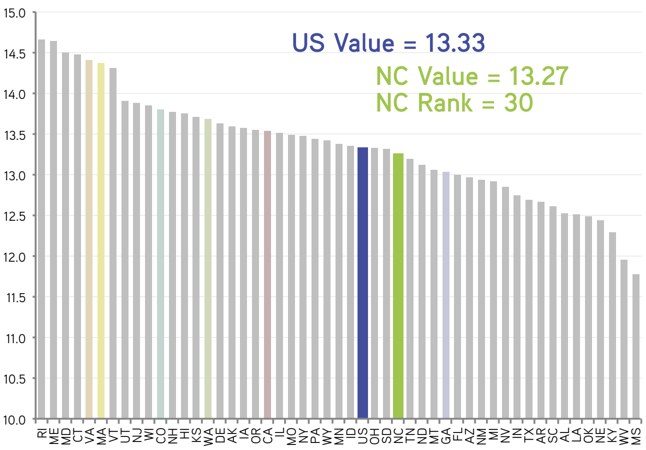
The ability of a state to successfully attract well-educated, skilled individuals to relocate from other states and countries enhances that state's ability to foster an innovation economy. This indicator measures the education attainment of in-migrants in two ways: average years of education among in-migrants, and in-migration of college-educated adults as a percentage of total state population. The first measure is a more comprehensive indicator of the educational attainment of in-migrants, whereas the second measure is a more targeted indicator of the higher-level educational attainment of in-migrants. States better able to attract educated and skilled workers provide organizations in the innovation economy with the skill sets necessary to compete in knowledge-intensive production. Furthermore, attracting outside talent enhances a state's ability to generate new innovative ideas that may have economic impacts in the future.

How Does North Carolina Perform?

In terms of average years of education among in-migrants, North Carolina ranks 30th in the nation, with a value that is 99 percent of the U.S. average value, and 91 percent of the value of the top-ranking state, Rhode Island *[5.7a]*. Among the comparison states, only Georgia ranks lower than North Carolina on this measure. From 2005–2011, the average years of education among in-migrants in North Carolina increased by 4.7 percent, which is not significantly different from the 4.1 percent increase for the U.S. overall *[5.7b]*. North Carolina's rate of increase is slightly less than the rates of increase for California and Georgia, and slightly faster than the rates for Virginia, Massachusetts, Colorado, and Washington. None of these differences is significant, however.

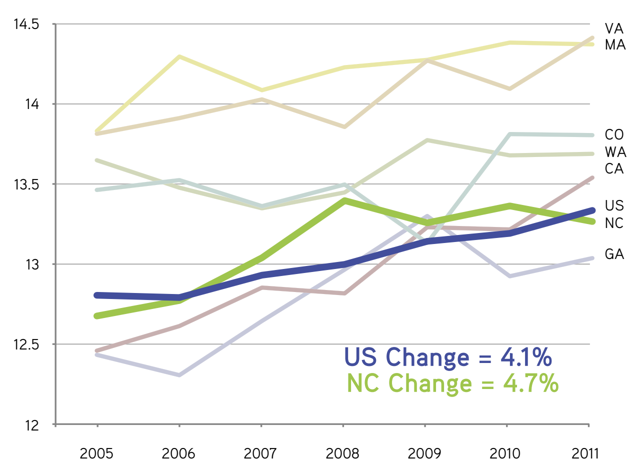
In terms of in-migration of college-educated adults as a percentage of total state population, North Carolina ranks 29th in the nation, with a value that is 96 percent of the U.S. average value, and 49 percent of the value of the top-ranking state, Colorado *[5.7c]*. Among the comparison states, only California ranks lower than North Carolina on this measure. From 2005–2011, the in-migration of college-educated adults as a percentage of total state population decreased by 20.1 percent, which is not significantly different from the 2.1

5.7a–Average Years of Education Among In-Migrants, All U.S. States, 2011



Source: U.S. Census Bureau

5.7b–Average Years of Education Among In-Migrants, Comparison States, 2005–2011



Source: U.S. Census Bureau

Indicator 5.7: *Educational Attainment of In-Migrants, continued*

percent decrease for the U.S. overall *[5.7d]*. North Carolina's rate of decrease is greater than those of Georgia and Washington; the rates for Massachusetts, California, Virginia, and Colorado increased during that period. None of these differences across states is significant, however.

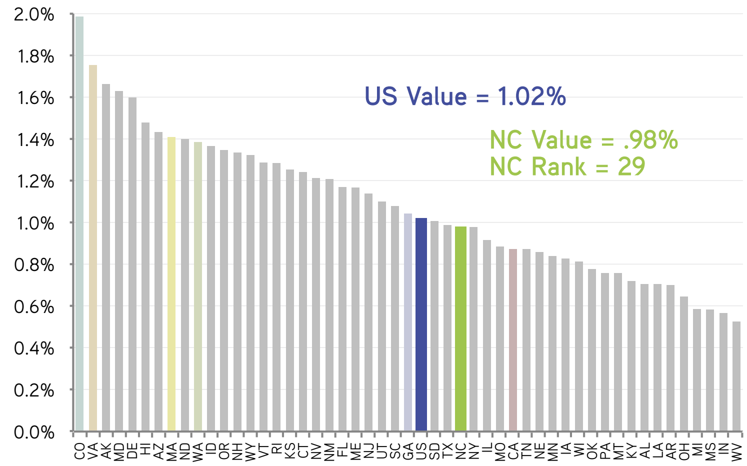
Within North Carolina, the in-migration of individuals with a bachelor's degree or higher is very concentrated in a small number of counties *[5.7e]*.[1] Two counties combined account for 32 percent of the state's in-migrants with a bachelor's degree or higher during 2010—Wake (16.5%) and Mecklenburg (15.6%). The next eight counties combined—Durham (7.3%), Guilford (4.6%), Cumberland (4.1%), Buncombe (3.7%), Orange (3.6%), Forsyth (3.4%), New Hanover (3.0%), and Union (2.0%)—account for another 31.7 percent of the state's in-migrants with a bachelor's degree or higher during 2010. In total, this means that 10 of the state's 100 counties account for slightly less than two-thirds of the state's in-migrants with a bachelor's degree or higher during 2010. The next 13 counties combined—Onslow (1.8%), Pitt (1.5%), Brunswick (1.4%), Alamance (1.3%), Moore (1.3%), Iredell (1.2%), Cabarrus (1.2%), Craven (1.1%), Gaston (1.0%), Harnett (1.0%), Henderson (1.0%), Catawba (1.0%), and Chatham (1.0%)—account for another 15.8 percent of the state's in-migrants with a bachelor's degree or higher during 2010. Each of the remaining 77 counties accounts for less than one percent of the state's in-migrants with a bachelor's degree or higher during 2010, and together they account for 20.5 percent of that in-migration.

What Does This Mean for North Carolina?

The ability of the state to attract highly educated individuals is a key factor that influences the generation of innovative ideas and strengthens a knowledge-based economy. Strong influxes of highly educated workers strengthen the innovation economy labor pool by providing diverse and highly demanded skill sets. North Carolina's performance on this factor—in the middle of the state distribution—suggests that the state can do more to attract highly educated individuals to re-locate here. Additionally, a small number of counties accounts for the majority of the state's in-migration of individuals with a bachelor's degree or higher. These findings suggest that the state should work to increase the opportunities for highly educated individuals to relocate from other states and countries. This holds especially true for counties with a low percentage of college-educated in-migrants.

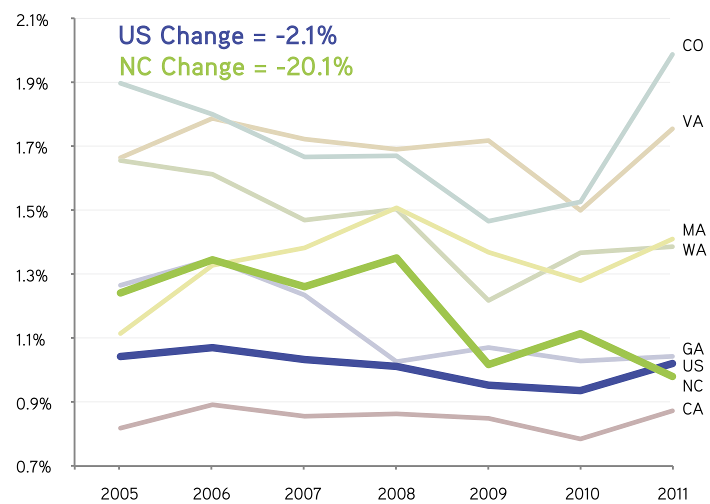
[1] The percentages presented here are based, for a given county, on the number of in-migrants that have a bachelor's degree or higher and that relocated from another county within the state, a different state, or from a different country in 2010. The trends illustrated in map 5.7e are highly correlated with trends illustrated in map 1.6b and chart 1.6c.

5.7c–In-Migration of College-Educated Adults as Percentage of Total State Population, All U.S. States, 2011



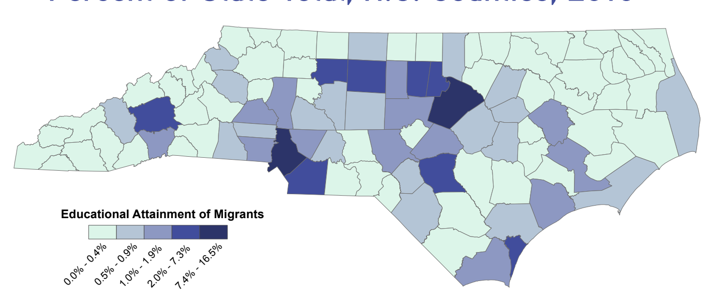
Source: U.S. Census Bureau

5.7d–In-Migration of College Educated Adults as Percentage of Total State Population, Comparison States, 2005–2011



Source: U.S. Census Bureau

5.7e–In-Migration of College Educated Adults, Percent of State Total, N.C. Counties, 2010



Source: U.S. Census Bureau

Indicator 6.1: *Public Investment in Education*

Key Findings

- **North Carolina's elementary and secondary public school current expenditures as a percentage of state gross domestic product (GDP) ranks well below the U.S. average, has since at least the early 2000s, and is increasing at a rate roughly equal to the U.S. average.**
- **North Carolina's appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP ranks well above the U.S. average, has since at least the early 2000s, and is increasing at a rate faster than the U.S. average.**
- **Within North Carolina, per-pupil expenditures vary considerably by local education agency (LEA), typically with less-prosperous, less-populous LEAs having higher per-pupil expenditures; authorized appropriations for the University of North Carolina (UNC) institutions are highly correlated with the size of the institutions.**

Indicator Overview

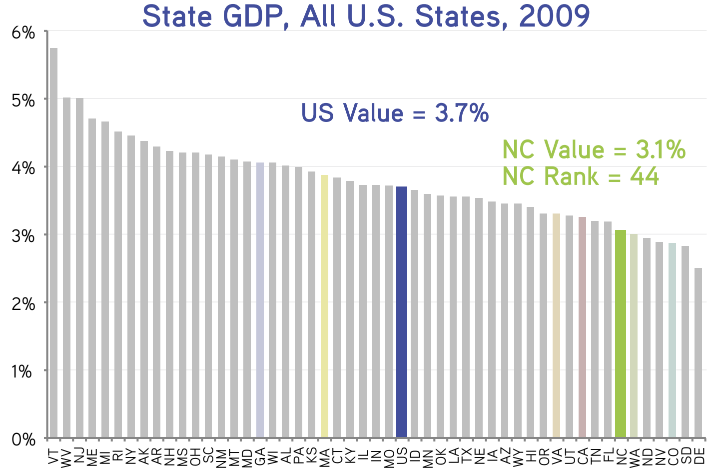
This indicator measures public investment in education two ways: elementary and secondary public school current expenditures, and appropriations of state tax funds for operating expenses of higher education, each as a percentage of state GDP. The first measure represents the relative amount of resources that state governments expend to support public education in pre-kindergarten through grade 12. Current expenditures include instruction and instruction-related costs, student support services, administration, and operations; they exclude funds for school construction and other capital outlays, debt service, and programs outside of public elementary and secondary education.[1] State and local support are the largest sources of funding for elementary and secondary education. The second measure represents the relative amount of resources that state governments expend to support higher education operating expenses.[2]

For each measure, a higher value indicates that a state has made financial support of the respective education level more of a priority.[3] Investments in public pre-kindergarten through grade 12 are important for preparing a broadly educated and innovation-capable workforce. Investments in public post-secondary education are critical to increase the ability of public academic institutions to prepare students for skilled and well-paying employment. Well-regarded public higher education programs enhance a state's ability to attract students from around the globe, many whom choose to remain and work in the state after graduation.

How Does North Carolina Perform?

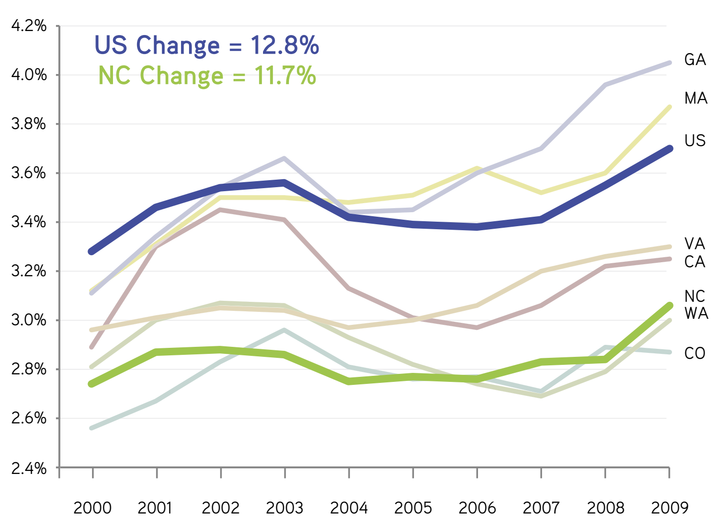
In terms of the elementary and secondary public school current expenditures as a percentage of state GDP, North Carolina ranks 44th in the nation, with a level that is 84 percent of the

6.1a–Elementary and Secondary Public School Current Expenditures as Percentage of State GDP, All U.S. States, 2009



Source: National Science Board

6.1b–Elementary and Secondary Public School Current Expenditures as a Percentage of State GDP, Comparison States, 2000–2009



Source: National Science Board

[1] Current expenditures are expressed in actual dollars and their data year is the end date of the academic year. GDP data refer to the 2009 calendar year in current dollars.

[2] Because of decreases in state tax collections in FY 2009 and FY 2010, state monies allocated to higher education decreased in many states. This decrease was offset to a degree by federal stimulus funds that were used to restore the level of state support for public higher education. The state monies used to calculate this indicator do not include federal stimulus funds for education stabilization or government funds for the modernization, renovation, or repair of higher education facilities.

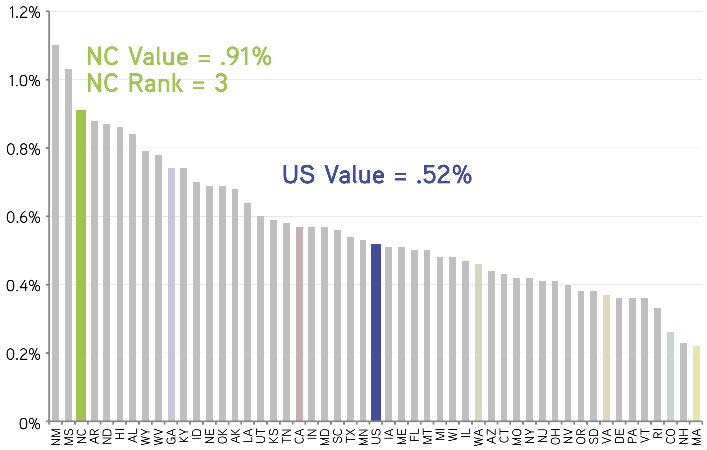
[3] This does not assume that more spending necessarily leads to improved educational outcomes.

U.S. average value and 53 percent of the value of the state with the highest value, Vermont *[6.1a]*. Among the comparison states, only Washington and Colorado spend a lower percentage of their state GDP on elementary and secondary public school current expenses. Among the four other comparison states, two—Virginia and California—spend a slightly higher percentage of their state GDP on elementary and secondary public school current expenses. Massachusetts and Georgia spend a considerably higher percentage of their state GDP on elementary and secondary public education, at levels that are higher than the U.S. average. From 2000 to 2009, North Carolina's elementary and secondary public school current expenditures as a percentage of state GDP increased significantly, by 11.7 percent, though this rate of increase does not differ significantly from the 12.8 percent increase for the U.S. overall *[6.1b]*. Over this same period, each of the comparison states increased the percentage of its state GDP on elementary and secondary public school current expenses, though none of these increases differed significantly from North Carolina's increase.

In terms of appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP, North Carolina ranks 3rd in the nation, with a level that is 175 percent of the U.S. average value and 83 percent of the value of the state with the highest value, New Mexico *[6.1c]*. North Carolina ranks well ahead of all of the comparison states, of which only two—Georgia and California—have percentages above the U.S. average. Each of the four other comparison states—Washington, Virginia, Colorado, and Massachusetts—has a percentage considerably below the U.S. average. From 2000 to 2010, North Carolina's appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP increased significantly, by 12.3 percent, which differs significantly from the 8.8 percent decrease for the U.S. overall *[6.1d]*. Over this same period, each of the comparison states except Georgia decreased the percentage of its GDP appropriated for operating expenses of higher education (an average of 26 percent); Georgia increased the percentage by 40 percent. None of these decreases differed significantly from North Carolina's increase.

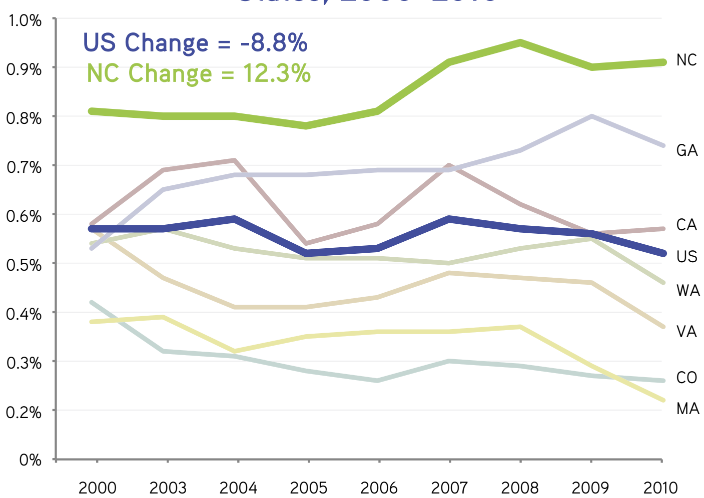
Within North Carolina, the per-pupil expenditures vary considerably by local education agency (LEA) *[6.1e]*.[4] In general, less-prosperous counties, particularly those in rural regions with lower populations (see indicators 1.2, 1.3, 1.5, and 1.6), have higher per-pupil expenditures. This pattern is not absolute, however. A small number of highly populated counties (e.g., Durham, Forsyth) or targeted LEAs (e.g., Chapel Hill-Carrboro City Schools, Asheville City Schools) have notably high per-pupil expenditures, while a small number of less-populated counties (e.g. Alexander, Pender) have lower per-pupil expenditures.

6.1c–Appropriations of State Tax Funds for Operating Expenses of Higher Education as a Percentage of State GDP, All U.S. States, 2010



Source: National Science Board

6.1d–Appropriations of State Tax Funds for Operating Expenses of Higher Education as a Percentage of State GDP, Comparison States, 2000–2010



Source: National Science Board

[4] A Local Education Agency, or LEA, is synonymous with a local school system or a local school district, indicating that a public board of education or other public authority maintains administrative control of the public schools in a city or county. North Carolina has 116 LEAs; most counties have one LEA, but some counties have more than one.

Indicator 6.1: *Public Investment in Education, continued*

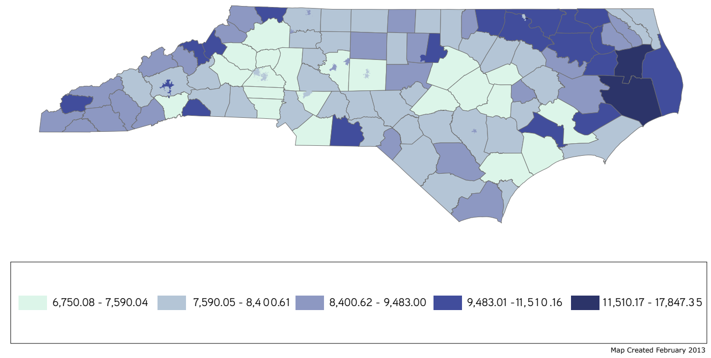
In terms of authorized appropriations for the University of North Carolina (UNC) institutions, the pattern is highly correlated with the size of the institutions.[5] For example, the three largest institutions together account for 43.8 percent of total appropriations to UNC institutions—NC State University (19.3 percent), UNC-Chapel Hill (13.7 percent), and East Carolina (10.9 percent). In contrast, the three smallest institutions together account for five percent of total appropriations to UNC institutions—NC School of the Arts (1.3 percent), Elizabeth City State University (1.8 percent), and UNC-Asheville (1.9 percent).

What Does This Mean for North Carolina?

In general, North Carolina's public investment in education correlates highly with its performance in the other education-related indicators tracked in this report. Specifically, given the state's near-last ranking on elementary and secondary public school current expenditures as a percentage of state GDP, it isn't surprising that it ranks similarly low in terms of the educational attainment of its residents age 25 and older (see indicator 5.6), its unemployment rate (see indicator 1.4), and its employment in high-tech establishments as a percentage of total employment (see indicator 4.2).[6] Conversely, given the state's near-top ranking on appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP, it isn't surprising that the state ranks similarly high in terms of academic science & engineering (S&E) research and development as a percentage of State GDP (see indicator 2.3), employed S&E doctorate holders as a percentage of the workforce (see indicator 5.2), and natural S&E degrees as percentage of total higher education degrees conferred (see indicator 5.5).

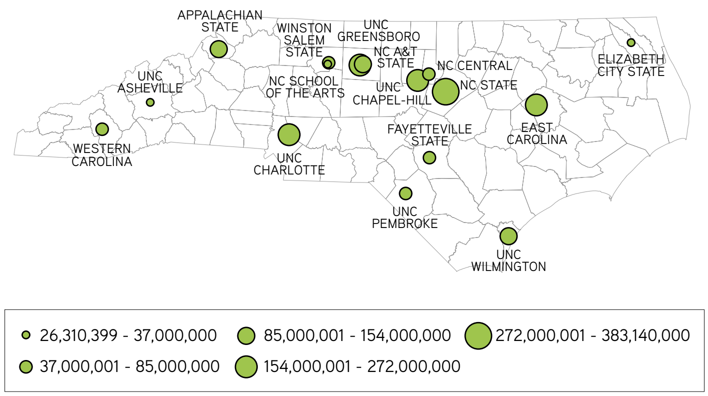
North Carolina's ability to compete in a knowledge- and innovation-driven economy depends critically on the education and training of its workforce at all levels. Given the link between investment in education and related measures of success in education, it is clear that North Carolina should continue its strong levels of investment in higher education and significantly increase its levels of investment in elementary and secondary education. Without such investments, North Carolina will not prosper, economically or socially.

6.1e–Per Pupil Expenditures, N.C, Local Education Agencies, School Year, N.C. Counties, 2011–2012



Source: N.C. Department of Public Instruction

6.1f–Authorized Appropriations, University of North Carolina (UNC) Institutions, FY 2010-2013 Average



Source: N.C. Office of State Budget and Management

These data include only General Fund appropriations, not other funding sources that comprise the UNC system budget. Additionally, the data include only FY 2010-2013 average appropriations for each institution's Academic Affairs functions, not for other functions, such as Health Affairs ($195,446,856) and Area Health Education Centers ($44,101,047) at UNC-Chapel Hill; Agricultural Research Service ($55,796,221) and Cooperative Extension ($40,587,831) at NC State; and Health Services ($63,322,662) at East Carolina.

[5] Here size is measured by the headcount enrollment in 2011. This pattern of appropriations is more correlated with institution size than are other measures of university activity, such as academic science & engineering research & development (see indicator 2.3), academic patents (see indicator 3.2), and academic license income (see indicator 3.5).

[6] North Carolina has similar low rankings on other measure of educational achievement not tracked in this report, such as eight-grade science performance and high school graduates among individuals 25-44 years old. For more information, see: National Science Board. 2012. *Science and Engineering Indicators 2012* (Chapter 8, Elementary and Secondary Education).

Indicator 6.2: *Broadband*

Key Findings

- **North Carolina's broadband deployment rate ranks roughly equal to the U.S. average, but the availability of broadband decreases considerably at higher speeds.**
- **North Carolina's rate of residential broadband adoption ranks below that of virtually all U.S. states.**
- **North Carolina has significant and unique middle-mile assets that can be leveraged to increase speeds and capacity in last-mile deployments and help leverage solutions for serving some of the unserved pockets in the state.**

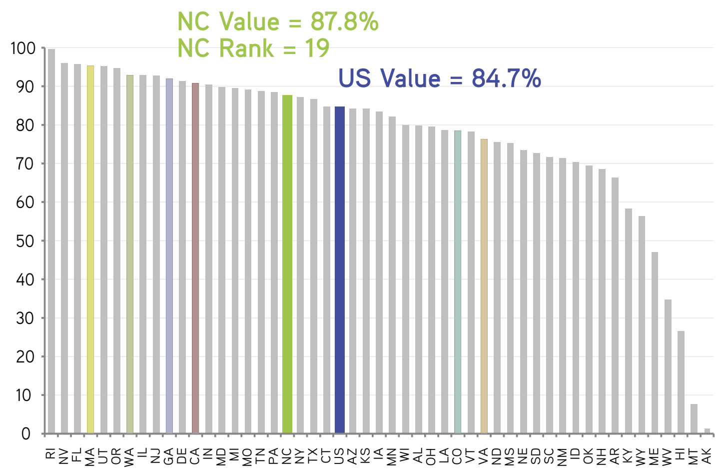
Indicator Overview

The term "broadband" refers to a range of technologies (e.g., fiber, coax cable, copper, and wireless technologies) that allow for higher capacity and faster data transmission with the Internet. Broadband as a communications medium serves as a platform for innovation. Utilization of broadband technologies can foster and enable innovation in all sectors by increasing business productivity, improving health care and education, and enabling the creation and use of new technologies.

Broadband is examined here in three ways: deployment rate, percent fiber deployment, and adoption rate. The deployment rate is the ratio of the population with access to fixed broadband at particular threshold speeds.[1] As such, it measures the basic "supply" level of broadband, or the capacity of the general population to utilize broadband communications. Fiber deployment, or the percent of the population with access to last-mile fiber (fiber-to-the-home), is a more refined measure of the deployment rate, as fiber technology generally offers the fastest Internet connections possible. Adoption is the "demand" side of the broadband equation, measuring the extent to which the population is actually subscribing to broadband

[1] For the charts in this report, a speed of 6 Mbps (download)/1.5 Mbps (upload) or faster is used, which is a speed that reflects service levels available to users today and is closest to, but slightly higher than, the Federal Communication Commission's (FCC's) "availability" target of 4 Mbps (download)/1 Mbps (upload) for all households. As a point of reference, a speed combination of 3 Mbps/768 kbps allows a user to access a basic set of applications that include sending and receiving email, downloading Web pages, photos, and video, and simple video conferencing. Applications such as distance learning, telemedicine, and high-quality video conferencing require much faster speeds. In addition, if more than one person shares a connection (e.g., two parents and two children in a household), the group will need greater bandwidth to maintain the same experience level that a single user has over the same connection. Data trends suggest that the need and demand for faster broadband speeds is growing, and will continue to grow, rapidly. For example, in August 2000, 41.6 percent of households had adopted dial-up connections (at either 28.8 kbps or 56 kbps), but only 4.4 percent of households had a home connection to broadband (then considered 200 kbps). By 2010, dial-up subscribers declined to 2.8 percent of households, whereas 68.2 percent of households were subscribed to broadband service (National Telecommunications & Information Administration. *2013. U.S. Broadband Availability: June 2010-June 2012: A Broadband Brief)*.

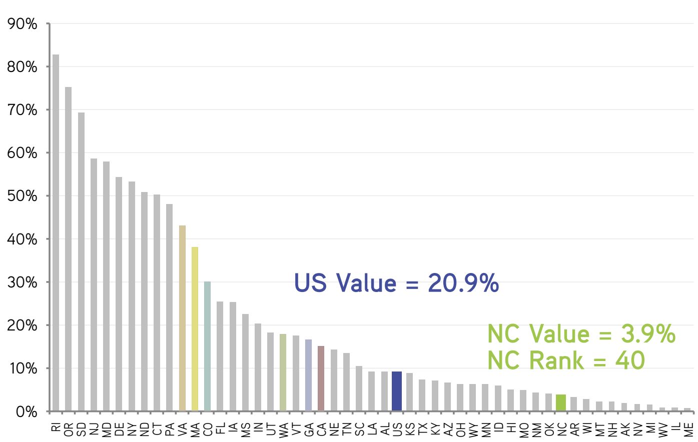
6.2a–Broadband Deployment Rate at 6 Mbps/1.5 Mbps or Faster, All U.S. States, 2011



Source: Federal Communications Commission

Deployment for "fixed" broadband (wired only).

6.2b–Percent Fiber Deployment, All U.S. States, 2012



Source: National Telecommunications & Information Administration

Indicator 6.2: *Broadband, continued*

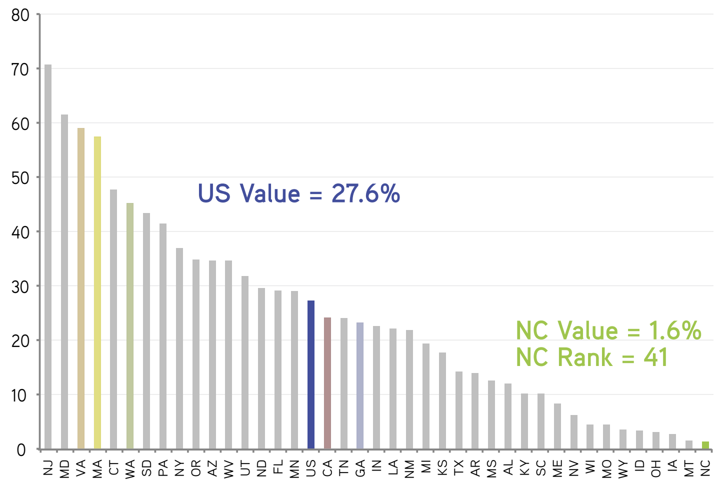
where it is available.[2] Adoption rates can reflect the ability of a state's population to utilize online learning tools and telework options, and may provide some indication of workforce preparedness in terms of digital literacy and digital activity.

How Does North Carolina Perform?[3]

At the speed examined, North Carolina ranks 19th in the nation in terms of broadband deployment rate. *[6.2a]*. Specifically, at 87.8 percent, North Carolina's broadband deployment rate[4] is slightly above the U.S. average, is 85 percent of the value of the highest-ranking state (Rhode Island), and is below that of all the comparison states except Colorado and Virginia.[5] North Carolina ranks considerably lower, however, on fiber deployment *[6.2b]*. Specifically, only 3.9 percent of North Carolinians have access to fiber-to-the-home Internet services. As such, North Carolina ranks 40th in the nation in fiber-to-the-home deployment, which is well below the U.S. value of 20.9 percent and the value of the highest-ranking state, Rhode Island, at 82.7 percent. In terms of adoption rate, North Carolina ranks even lower, at 41st in the nation *[6.2c]*.[6] With an adoption rate of 1.6 percent, at the speed examined, North Carolina's adoption rate is six percent of the U.S. value and two percent of the value of the top-ranked state, New Jersey.[7]

Within North Carolina, 45 out of 100 counties have a household broadband deployment rate, at the speed examined, equal to or above 95.4 percent *[6.2d]*. Twenty two counties have a deployment rate between 87.1 percent and 95.3 percent. In total, 75 counties have a deployment rate greater than the U.S average. Of the 25 North Carolina counties below the U.S. average, 16 have

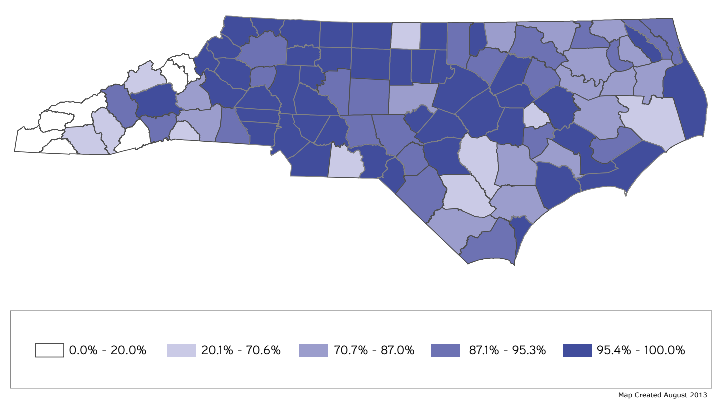
6.2c–Broadband Adoption Rate at 6 Mbps/1.5 kbps or Faster, All U.S. States, 2011



Source: Federal Communications Commission

Adoption for "fixed" broadband (wired only). Only 41 states reported adoption rates at this speed.

6.2d–Estimates of Households With Broadband Access, 6 Mbps/1.5 Mbps, N.C. Counties, 2013



Source: NC Broadband

[2] The FCC tracks broadband subscriptions (the number of active connections to households out of the total number of households). Broadband adoption is then calculated by the FCC as a fraction of the number of households who have access to broadband in a given census tract. For example, in an area with 20 homes, in which 10 of the homes have access to broadband and all 10 subscribe to broadband, the adoption rate would be 100 percent (10 subscriptions in 10 homes that have access). The subscription rate would be 50 percent (10 subscriptions in 20 homes).

[3] Over-time data are not presented here because broadband delivery technology is changing so rapidly that consistent, accurate over-time data are not available.

[4] Household percentage broadband availability data are often overstated because the data submitted by service providers indicate an entire census block has access to broadband even if only one household in the census block has access.

[5] At the next lowest speed, 3 Mbps/768 kbps, North Carolina's deployment rate of 93.6 percent ranks 26th in the nation and is roughly the same as the U.S. average (94 percent).

[6] Data are available for only 41 states. Thus, North Carolina ranks last among the states for which data are available.

[7] At the lower speed, 3 Mbps/768 kbps, North Carolina's adoption rate of 13.8 percent ranks 47th in the nation and is considerably below the U.S. average (27.6 percent).

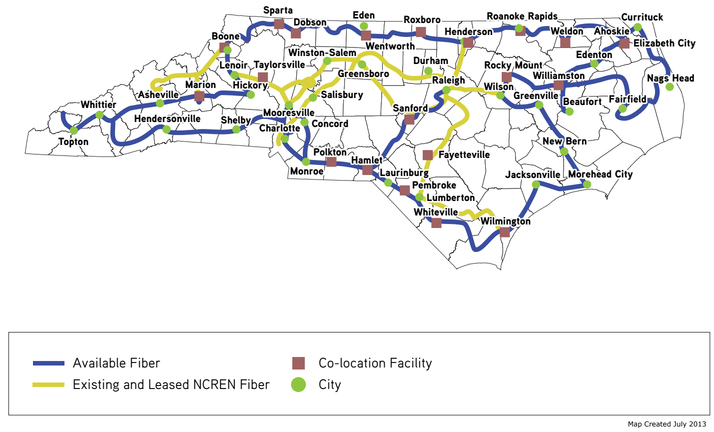
a deployment rate between 70.7 and 87 percent, 10 have a deployment rate between 20.1 and 70.6 percent, and the remaining seven have a deployment rate of less than 20 percent.

When examining speeds and capacity available through these "last-mile" deployments (connections to the end-user), as well as potential solutions to serve the unserved pockets in the state, it is critical to note that North Carolina has significant "middle-mile" assets, which are the backbone of the networks and determine the ability for higher capacity and speeds around the state *[6.2e]*. While standard metrics for middle-mile are difficult to obtain, North Carolina's major broadband providers do have significant middle-mile assets. In addition, North Carolina possesses the highest recorded inventory of open access middle-mile dark fiber assets of any state in the country. The dark fiber shares the conduit with a lit fiber optic backbone that serves the broadband needs of all K–20 public education institutions, most of K–20 private education and select research institutes, nonprofit healthcare providers, public safety, and other anchor institutions. The dark fiber strands are in a 2,600-mile contiguous build that touches 82 of the state's 100 counties. Forty-eight to 96 strands of fiber are available to broadband service providers to serve consumers and businesses in all areas of the state and for enterprises across all vertical markets (financial services, technology, healthcare, biotech, transportation, logistics, etc.) to build their own enterprise networks. The significance of these assets must be considered and acted upon when looking at North Carolina's opportunities for innovation.

What Does This Mean for North Carolina?

Deployment rates show that much of North Carolina has access to basic broadband. However, pockets of unserved areas do exist. These sparsely populated areas generally lack a traditional business case for private sector providers to serve them, and as the last pockets in the state, are likely the hardest and most expensive areas to serve. Without a concerted effort to find solutions to serve these pockets, they may remain unserved. Moreover, as speeds increase, availability of broadband drops, which can hinder innovation, depending on the applications utilized through the broadband platform. The very limited amount of fiber-to-the-home technology in North Carolina reflects the fact that none of the large providers in the state offer this technology.[8]

6.2e–MCNC Middle-Mile Infrastructure through the N.C. Research and Education Network (NCREN), 2013



Source: MCNC

[8] Cable modem service is the fastest service that is widely available. Upgraded cable modem systems can offer speeds comparable to fiber.

Indicator 6.2: *Broadband, continued*

North Carolina has significant and unique middle-mile assets that can be leveraged to increase speeds and capacity in last-mile deployments and help leverage solutions for serving some of the unserved pockets in the state. The North Carolina Research and Education Network (NCREN) can serve Community Anchor Institutions (CAIs) with a service that can scale to speeds up to 100 Gbps at fixed Intranet costs. This infrastructure also makes middle-mile fiber available to private sector broadband service providers of all types (telephone, cable, wireless, etc.), who can then deploy innovative, higher speed wire-line and wireless services to areas of the state that have no scalable fiber infrastructure available for them to use. Through North Carolina's strong private sector broadband providers, as well as this unique middle-mile asset, North Carolina is well positioned to remain innovative in the broadband arena.

North Carolina's low rates of residential broadband adoption are cause for concern, especially in terms of ensuring a digitally active and digitally literate workforce. While the state has average adoption rates for broadband at the lowest speed tier, as speeds increase, adoption rates drop considerably and put North Carolina below virtually all other states. Broadband adoption is a complex challenge, with many factors impacting uptake of wired broadband at home such as, cost and income levels, literacy and digital literacy, access to devices, availability of other public Internet access (such as libraries), use of mobile service instead of wired broadband, and relevancy. While there are certainly differences among states in these decision factors, adoption in North Carolina at meaningful speed levels is particularly low.[8] To move forward with broadband efforts in North Carolina, it is important for broadband partners in the state to examine why adoption rates are low, which segments of the population are not adopting, and to develop and implement responses to address these challenges.

[9] Adoption of mobile broadband is not measured here, but should be considered in terms of assessing future opportunities and impacts for North Carolina. Mobile broadband is not necessarily a replacement for wired home or business service, but is, nevertheless, the fastest growing sector in terms of adoption growth, especially among lower income populations.

Indicator 6.3: *Cost of Living Index*

Key Findings

- **North Carolina's Cost of Living Index ranks below the U.S. average, has since at least the early 2000s, and is decreasing at a rate faster than the U.S. average.**
- **Within North Carolina, the cost of living varies considerably. Most North Carolina counties have a Cost of Living Index value slightly or moderately lower than the U.S average, while a small number of counties have values slightly or moderately above the U.S. average.**

Indicator Overview

This indicator is a price index that compares cost of living differences among urban areas based on the price of consumer goods and services. Specifically, it uses the Cost of Living Index produced quarterly by the Council for Community and Economic Research (C2ER)[1]. The Cost of Living Index assumes that prices collected at a specified time, in strict conformance with standard specifications, provide a sound basis for constructing a reasonably accurate gauge of relative differences in the cost of consumer goods and services. The average for all participating areas, both metropolitan and nonmetropolitan, equals 100, and each participant's index is read as a percentage of the average for all areas combined, i.e., the U.S average[2]. Assessments of quality of life, of which cost of living is a major component, influence states' and regions' ability to attract and retain talented people. A reasonable and affordable cost of living can attract people to an area, thus facilitating businesses' ability to fill open positions and fuel expansion in the area[3].

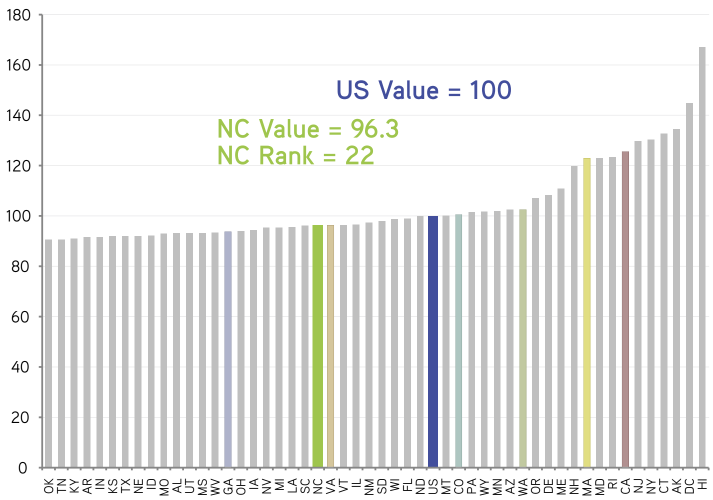
How Does North Carolina Perform?

In terms of the Cost of Living Index, North Carolina ranks 22nd in the nation, with a level that is 96.3 percent of the U.S. average value and 106 percent of the value of the state with the lowest Cost of Living Index value, Oklahoma *[6.3a]*. Among the comparison states, only Georgia has a Cost of Living Index value lower than North Carolina's; Virginia's index value is identical to North Carolina's. Together, these are the only three comparison states whose cost of living is lower than the U.S. average. The Cost of Living Index values for Colorado and Washington are slightly above the U.S. average, while the values for Massachusetts and California are considerably above the U.S. average and among the top-10 most expensive states.

[1] For more detail on the Cost of Living Index and C2ER, see http://www.coli.org/. In general, the Cost of Living Index is intended to measure differences among urban areas; however, C2ER has developed a county-level Cost of Living Index based on an econometric model that identifies key determinants of an area's cost of living. Data using that model appear in map 6.3c.

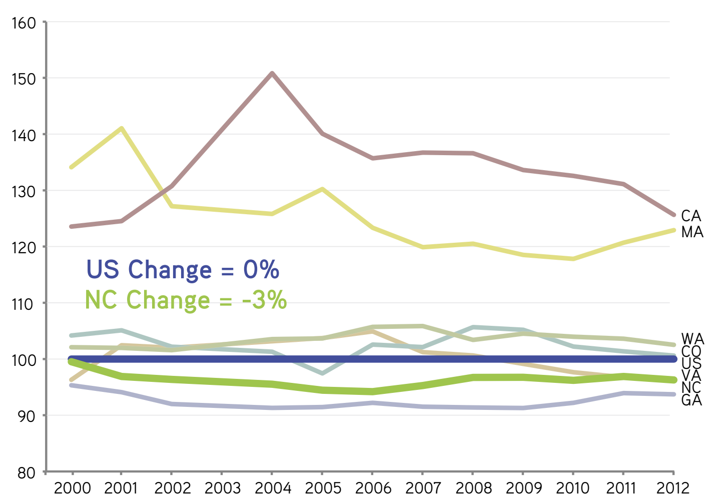
[2] For example, if City A has an index of 98.3, the cost of living in that city is approximately 1.7percent less than the U.S. average cost of living. If City B has a composite index of 128.5, the cost of living in that city is approximately 28.5 percent higher than the U.S. average. Thus, if a worker lives in City A and is contemplating a job offer in City B, that worker would need a 30.72 percent increase in after-tax income to remain at his/her City A lifestyle once moving to City B (30.72% = 100*[(128.5 - 98.3)/98.3]). Conversely, if the same worker were considering a move from City B to City A, that worker could sustain a 23.5 percent decrease in after-tax income without reducing his/her lifestyle (23.5% = 100*[(98.3 – 128.5)/128.5]).

6.3a–Cost of Living Index, All U.S. States, 2012



Source: Council for Community and Economic Research (C2ER) and Missouri Economic Research and Information Center (MERIC)

6.3b–Cost of Living Index, Comparison States, 2000–2012



Source: Council for Community and Economic Research (C2ER) and Missouri Economic Research and Information Center (MERIC)

[3] For the purposes of this report, a Cost of Living Index slightly above or slightly below the U.S. average is advantageous, as it indicates that an area's cost of living is reasonably affordable, but no so extreme as to suggest that the area is excessively expensive (in the case of a high index value) or has low-quality infrastructure, amenities, goods, and services (in the case of a low index value).

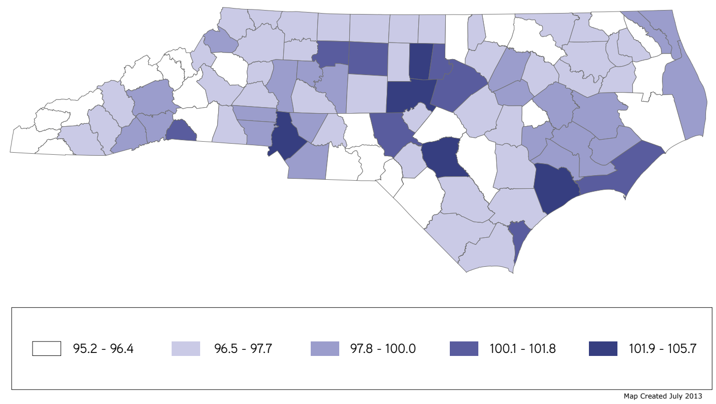
Indicator 6.3: *Cost of Living Index; continued*

From 2000 to 2012, North Carolina's Cost of Living Index decreased significantly, by three percent *[6.3b]*. Over this same period, the index for California increased slightly, the indexes for Washington and Virginia remained the same, and the indexes for Georgia, Colorado, and Massachusetts decreased slightly.

Within North Carolina, the cost of living varies considerably by county *[6.3c]*. Five counties have a Cost of Living Index greater than 102—Orange, Mecklenburg, Chatham, Onslow, and Cumberland. An additional nine counties—Durham, Wake, New Hanover, Polk, Guilford, Carteret, Moore, Forsyth, and Dare—have index values greater than 100, but less than 102. In total, this means that 14 of North Carolina's 100 counties have a cost of living roughly equal to or moderately higher than the U.S. average[4]. In general, these counties contain the largest urban areas or are home to a large number of retirees or recreational and tourist attractions.

North Carolina's 86 remaining counties have a cost of living equal to or lower than the U.S. average. Twenty-one of those counties—Craven, Henderson, Davie, Pamlico, Currituck, Buncombe, Cabarrus, Camden, Transylvania, Gaston, Lincoln, Lenoir, Nash, Union, Pitt, Wilson, Davidson, Iredell, Jones, Beaufort, and Watauga—have an index value between 97.8 and 100, or slightly lower than the U.S. average. The largest number of counties, 40, has an index value between 96.5 and 97.7, while another 25 counties have an index value between 95.2 and 96.4. The index values for these latter two groups of counties may be sufficiently below the U.S. average that those counties are less attractive as locales for innovation.

6.3c–Cost of Living Index, N.C. Counties, 2012



Source: Council for Community and Economic Research (C2ER)

What Does This Mean for North Carolina?

In general, independent of other factors, an affordable, close-to-average cost of living is an advantage for a state or region. A cost of living that is significantly higher than the U.S. average could be unattractive to both employers and employees, as costs for employers could be excessive, and workers may prefer to live in lower-cost areas. Alternatively, a cost of living that is significantly lower than the U.S. average could also be unattractive to both employers and employees, potentially indicating the area has fewer amenities and infrastructure.

On average, North Carolina's cost of living is neither excessively high nor overly low. In general, counties with a cost of living slightly above or slightly below the U.S. average are more likely to be the targets for innovative activity, as they are relatively affordable and more likely to possess a good mix of infrastructure, amenities, goods, and services. Those counties with a cost of living that is significantly lower than the U.S. average, while more affordable, may have a less suitable mix of infrastructure, amenities, goods, and services. To the extent that is the case, efforts may be needed to increase those factors in order to increase the innovative activity and economic growth of those areas.

[4] The standard deviation of the index across all U.S counties is 10.54, meaning at least 68 percent of all U.S. counties would normally be expected to have values within 10.54 points of 100. At least 95 percent of all U.S. counties would be expected to have values within 21.08 points (two standard deviations) of 100. The standard deviation of the index across all North Carolina counties is 2.01, meaning at least 68 percent of all North Carolina counties would normally be expected to have values within 2.01 points of 100. At least 95 percent of all North Carolina counties would normally be expected to have values within 4.02 points (two standard deviations) of 100.

Indicator 6.4: *Industry Mix*

Key Findings

- **North Carolina's overall industry structure does not position the state, overall, to be a leader in innovation.**
- **A large portion of the state's industries and employment is not high technology in nature and therefore less likely to produce the types of innovations that drive growth, employment, and higher wages in the economy.**
- **Among the small number of sectors that are high technology, virtually all have wages well above the U.S. average, and approximately half are increasing in employment.**
- **North Carolina's manufacturing GDP as a percentage of state GDP ranks above the U.S. average, has since at least the early 2000s, and is decreasing at a rate roughly equal to the U.S. average.**

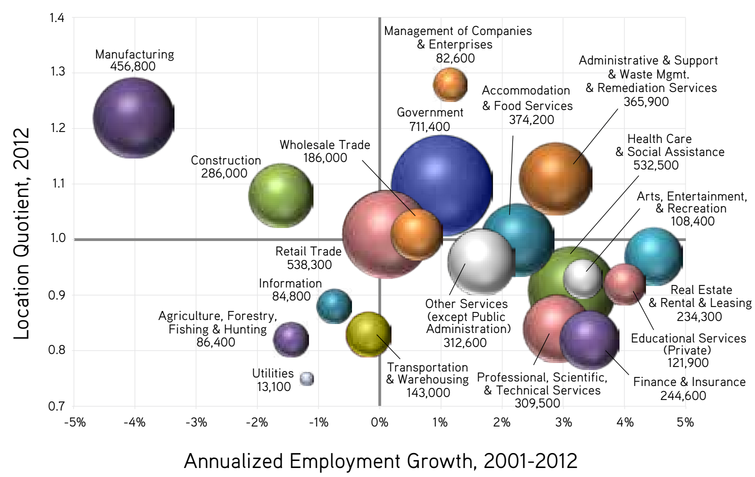
Indicator Overview

This indicator measures North Carolina's industry mix (i.e., the basic industry composition and trends of North Carolina's economy) in several ways. Industry mix is measured first by detailing—for each major economic sector—four factors[1]: the level of employment, employment change (2001-2012), relative concentration (see Methodological Note, page 70), and average wage. The second measure details—for high-technology industries only[2]—the same four factors. The third measures manufacturing GDP as a percentage of state GDP. Together, these measures provide useful context for interpreting and explaining many of the other indicators in this report, particularly the ones focused on industry activity (e.g., Innovative Organizations in Section 4) and Employment (e.g., Workforce in Section 5)[3].

How Does North Carolina Perform?

In terms of major economic sectors, more than half of North Carolina's employment is in five major

6.4a - Industry Employment (bubble size & number), Annualized Employment Growth (horizontal axis), and Concentration (vertical axis), All Sectors, North Carolina



Source: Economic Modeling Specialists, Inc.
Employment numbers rounded to the nearest hundreds; excludes NAICS codes 99 (Unclassified Industry) and 21 (Mining, Quarrying, & Oil & Gas Extraction).

6.4b - Sector Employment, Annualized Employment Growth, Concentration (Location Quotient), and Average Wage, All Sectors, North Carolina (sorted in descending order by employment)

2-Digit NAICS Code	Industry	Employment: Total 2012	Share of Total 2012	Cumulative Share of Total 2012	Annual Change 2001-2012	Location Quotient 2012	Average Wage 2012
90	Government	711,400	13.7%	13.7%	1.0%	1.10	$42,300
44	Retail Trade	538,300	10.3%	24.0%	0.1%	1.01	$23,500
62	Health Care & Social Assistance	532,500	10.2%	34.3%	3.1%	0.91	$39,900
31	Manufacturing	456,800	8.8%	43.1%	-4.0%	1.22	$52,300
72	Accommodation & Food Services	374,200	7.2%	50.2%	2.2%	1.00	$15,400
56	Admin. & Support & Waste Mgmt. & Remed. Services	365,900	7.0%	57.3%	2.9%	1.11	$24,600
81	Other Services (except Public Administration)	312,600	6.0%	63.3%	1.7%	0.96	$19,600
54	Professional, Scientific, & Technical Services	309,500	6.0%	69.2%	2.9%	0.84	$53,600
23	Construction	286,000	5.5%	74.7%	-1.6%	1.08	$34,600
52	Finance & Insurance	244,600	4.7%	79.4%	3.4%	0.82	$62,200
53	Real Estate & Rental & Leasing	234,300	4.5%	84.0%	4.5%	0.97	$22,500
42	Wholesale Trade	186,000	3.6%	87.5%	0.6%	1.01	$60,100
48	Transportation & Warehousing	143,000	2.7%	90.3%	-0.2%	0.83	$38,100
61	Educational Services (Private)	121,900	2.3%	92.6%	4.0%	0.92	$30,800
71	Arts, Entertainment, & Recreation	108,400	2.1%	94.7%	3.3%	0.93	$21,100
11	Agriculture, Forestry, Fishing & Hunting	86,400	1.7%	96.4%	-1.5%	0.82	$25,500
51	Information	84,800	1.6%	98.0%	-0.8%	0.88	$57,300
55	Management of Companies & Enterprises	82,600	1.6%	99.6%	1.1%	1.28	$87,100
22	Utilities	13,100	0.3%	99.8%	-1.2%	0.75	$76,900
21	Mining, Quarrying, & Oil & Gas Extraction	8,400	0.2%	100.0%	2.3%	0.19	$30,700
Total		5,200,700					

Source: Economic Modeling Specialists, Inc.

Note: Excludes NAICS code 99 (Unclassified Industry); GDP, Average Wage, and Employment numbers rounded to the nearest hundreds.

[1] Economic sectors are defined by 2-digit North American Industry Classification System (NAICS) codes. NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS is a 2- through 6-digit hierarchical classification system, offering five levels of detail. Each digit in the code is part of a series of progressively narrower categories, and more digits in the code signify greater classification detail. The first two digits designate the economic sector, the third digit designates the subsector, the fourth digit designates the industry group, the fifth digit designates the NAICS industry, and the sixth digit designates the national industry. For more information about NAICS codes, see http://www.census.gov/eos/www/naics.

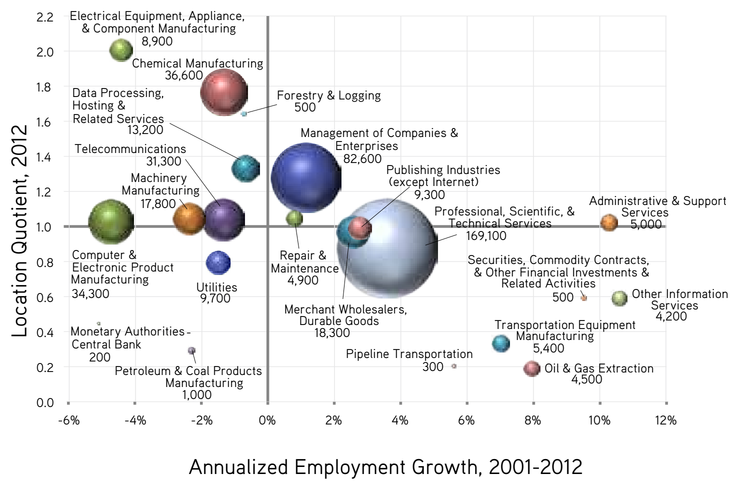
[2] The data pertaining to establishments are based on their classification according to the 2002 edition of the North American Industry Classification System (NAICS). See the Appendix for a list of the 46 industries (by 4-digit NAICS code) that are defined as high technology.

[3] This indicator does not present a "cluster" analysis. A cluster is a group of businesses and industries that are related through presence in a common product chain, dependence on similar labor skills, or utilization of similar or complementary technologies. Whereas an industry is a group of businesses that produce a similar product, a cluster includes final market producers, suppliers, related producer services, and other linked enterprises. Often-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 North Carolina Department of Commerce has produced cluster analyses in reports not presented here.

economic sectors—Government (13.7%),[4] Retail Trade (10.3%), Health Care and Social Assistance (10.2 %), Manufacturing (8.8 %)[5], and Accommodation and Food Services (7.2%) [6.4a and 6.4b][6]. Of these, only Manufacturing has above-average wages (see indicator 1.3)[7] and a substantial share of high-technology industries and employment (see chart 6.4c and table 6.4d)[8]. The next four sectors—Administrative and Support and Waste Management and Remediation (7.0 %), Other Services (6.0 %), Professional, Scientific, and Technical Services (6.0 %), and Construction (5.5%)—together account for another 24.5 percent of all of North Carolina's employment. Of these, only Professional, Scientific, and Technical Services has above-average wages and a substantial share of high-technology industries and employment. The remaining 25 percent of North Carolina's employment is spread across 11 additional sectors, of which only a small minority consists of high-technology industries and employment. In general, the average wages of the nine sectors comprising approximately three-fourths of North Carolina's employment are lower than the average wages of the 11 sectors comprising approximately one-fourth of North Carolina's employment.

In terms of the sectors' relative concentration, as measured by location quotients, there are five sectors in which North Carolina has a larger share of activity in the industry than we would expect based on national trends—Management of Companies and Enterprises; Manufacturing; Administrative and Support and Waste Management and Remediation Services; Government; and Construction. Of these, only the first two—Management of Companies and Enterprises, and Manufacturing—have above-average wages and a substantial share of high-technology industries and employment. The first of these sectors is growing in employment over time, whereas the other is shrinking in employment over time. Of the sectors in which North Carolina has a smaller share of activity in the industry than we would expect based on national trends, there are five that have above-average wages and a substantial share of high-technology industries and employment—Wholesale Trade; Information; Professional, Scientific, and Technical Services; Finance and Insurance; and Utilities. Some of these are growing in employment over time (Wholesale Trade; Professional, Scientific, and Technical Services; and Finance and Insurance), while others are shrinking in employment over time (Information, and Utilities).

6.4c - Industry Employment (bubble size & number), Annualized Employment Growth (horizontal axis), and Concentration (vertical axis), High-Technology Subsectors North Carolina



Source: Economic Modeling Specialists, Inc.

Employment numbers rounded to the nearest hundreds.

In terms of high-technology industries, more than half (55%) of North Carolina's high-technology employment is in industries within two subsectors—Professional, Scientific and Technical Services (37%) and Management of Companies and Enterprises (18.1%) *[6.4c and 6.4d]*[9]. In the first subsector—Professional, Scientific and Technical Services—North Carolina has a smaller share of activity than we would expect based on national trends; within that subsector, Scientific Research & Development Services is the only industry in which North Carolina's share of activity is equal to or greater than the national average. In the second subsector—Management of Companies and Enterprises—North Carolina has a larger share of activity than we would expect based on national trends. Each subsector is growing in employment and has average wages well

[4] Government excludes federal military.

[5] Manufacturing industries are defined as those industries whose 2-digit NAICS code ranges from 31–33.

[6] The data in table 6.4b are the source for the graphics in chart 6.4a, which simply provides a summary-level pictorial representation of the data, from which it is easier to discern patterns.

[7] "Wage" includes wages, salaries, commissions, tips, overtime pay, hazard pay, bonuses, stock options, and severance pay. It does not include supplements, such as employer contributions to 401(k) plans, pensions, insurance funds, and government social insurance (FIA/FUTA).

[8] Each sector consists of a large number of subsectors and an even larger number of industries, of which only a minority (46) is classified as "high technology." See the Appendix for a list of the 46 industries.

6.4d - Industry Employment, Annualized Employment Growth, Concentration (Location Quotient), and Average Wage, High-Technology Industries, North Carolina (sorted in descending order by employment)

NAICS Code	High-Technology Industry	High-Tech Employment Total 2012	Share of Total 2012	Cumulative Share of Total 2012	Annual Change 2001-2012	Location Quotient 2012	Average Wage 2012
541	**Professional, Scientific, and Technical Services**	169,100	37.0%	37.0%	3.6%	0.88	$65,700
5416	Management, Scientific, & Technical Consulting Services	60,900	13.3%		6.4%	0.97	$54,300
5415	Professional, Scientific, & Technical Services	49,400	10.8%		3.1%	0.81	$71,600
5413	Architectural, Engineering, & Related Services	38,200	8.4%		0.4%	0.79	$60,600
5417	Scientific Research & Development Services	20,600	4.5%		5.1%	1.01	$94,400
551	**Management of Companies and Enterprises**	82,600	18.1%	55.0%	1.1%	1.28	$87,100
5511	Management of Companies & Enterprises	82,600	18.1%		1.1%	1.28	$87,100
325	**Chemical Manufacturing**	36,600	8.0%	63.0%	-1.3%	1.76	$80,300
3254	Pharmaceutical & Medicine Manufacturing	20,700	4.5%		0.9%	2.56	$91,400
3252	Resin, Synthetic Rubber, & Artificial Synthetic Fibers & Filaments Manufacturing	4,700	1.0%		-6.4%	1.71	$55,700
3259	Other Chemical Product & Preparation Manufacturing	3,600	0.8%		-1.0%	1.38	$56,600
3251	Basic Chemical Manufacturing	3,100	0.7%		-2.6%	0.71	$77,900
3253	Pesticide, Fertilizer, & Other Agricultural Chemical Manufacturing	2,500	0.5%		-2.7%	2.19	$89,100
3255	Paint, Coating, & Adhesive Manufacturing	2,000	0.4%		-1.0%	1.10	$60,300
334	**Computer and Electronic Product Manufacturing**	34,300	7.5%	70.5%	-4.7%	1.03	$105,500
3341	Computer & Peripheral Equipment Manufacturing	10,700	2.3%		-5.0%	2.25	$131,000
3345	Navigational, Measuring, Electromedical, & Control Instruments Manufacturing	10,100	2.2%		0.3%	0.82	$105,500
3344	Semiconductor & Other Electronic Component Manufacturing	7,400	1.6%		-8.7%	0.63	$70,100
3342	Communications Equipment Manufacturing	3,600	0.8%		-2.1%	1.06	$97,600
3346	Manufacturing & Reproducing Magnetic & Optical Media	2,000	0.4%		-6.4%	3.02	$123,700
3343	Audio & Video Equipment Manufacturing	500	0.1%		-5.4%	0.78	$61,300
517	**Telecommunications**	31,300	6.9%	77.4%	-1.3%	1.04	$55,600
5171	Wired Telecommunications Carriers	20,800	4.5%		-0.2%	1.01	$53,900
5172	Wireless Telecommunications Carriers (except Satellite)	5,300	1.2%		-1.7%	1.03	$50,000
5179	Other Telecommunications	5,200	1.1%		-4.6%	1.29	$68,300
5174	Satellite Telecommunications	100	0.0%		-0.8%	0.26	$43,800
423	**Merchant Wholesalers, Durable Goods**	18,300	4.0%	81.4%	2.6%	0.97	$83,400
4234	Professional & Commercial Equipment & Supplies Merchant Wholesalers	18,300	4.0%		2.6%	0.97	$83,400
333	**Machinery Manufacturing**	17,800	3.9%	85.3%	-2.4%	1.04	$62,000
3339	Other General Purpose Machinery Manufacturing	7,300	1.6%		-3.8%	0.94	$63,800
3336	Engine, Turbine, & Power Transmission Equipment Manufacturing	4,500	1.0%		1.3%	1.46	$69,900
3332	Industrial Machinery Manufacturing	3,800	0.8%		-4.6%	1.14	$50,000
3333	Commercial & Service Industry Machinery Manufacturing	2,200	0.5%		1.9%	0.77	$60,600
518	**Data Processing, Hosting and Related Services**	13,200	2.9%	88.1%	-0.7%	1.33	$76,600
5182	Data Processing, Hosting, & Related Services	13,200	2.9%		-0.7%	1.33	$76,600
221	**Utilities**	9,700	2.1%	90.3%	-1.5%	0.79	$86,200
2211	Electric Power Generation, Transmission & Distribution	9,700	2.1%		-1.5%	0.79	$86,200
511	**Publishing Industries (except Internet)**	9,300	2.0%	92.3%	2.7%	0.99	$90,700
5112	Software Publishers	9,300	2.0%		2.7%	0.99	$90,700
335	**Electrical Equipment, Appliance, and Component Manufacturing**	8,900	1.9%	94.2%	-4.4%	2.01	$64,700
3353	Electrical Equipment Manufacturing	8,900	1.9%		-4.4%	2.01	$64,700
336	**Transportation Equipment Manufacturing**	5,400	1.2%	95.4%	7.0%	0.34	$87,500
3364	Aerospace Product & Parts Manufacturing	4,600	1.0%		6.5%	0.31	$91,600
3369	Other Transportation Equipment Manufacturing	700	0.2%		10.8%	0.66	$62,100
561	**Administrative and Support Services**	5,000	1.1%	96.5%	10.3%	1.02	$35,000
5612	Facilities Support Services	5,000	1.1%		10.3%	1.02	$35,000
811	**Repair and Maintenance**	4,900	1.1%	97.6%	0.8%	1.05	$40,200
8112	Electronic & Precision Equipment Repair & Maintenance	4,900	1.1%		0.8%	1.05	$40,200
211	**Oil and Gas Extraction**	4,500	1.0%	98.5%	7.9%	0.19	$21,800
2111	Oil & Gas Extraction	4,500	1.0%		7.9%	0.19	$21,800
519	**Other Information Services**	4,200	0.9%	99.5%	10.6%	0.59	$45,500
5191	Other Information Services	4,200	0.9%		10.6%	0.59	$45,500
324	**Petroleum and Coal Products Manufacturing**	1,000	0.2%	99.7%	-2.3%	0.30	$63,100
3241	Petroleum & Coal Products Manufacturing	1,000	0.2%		-2.3%	0.30	$63,100
113	**Forestry and Logging**	500	0.1%	99.8%	-0.7%	1.65	$27,700
1132	Forest Nurseries & Gathering of Forest Products	300	0.1%		3.4%	2.75	$20,200
1131	Timber Tract Operations	200	0.0%		-5.8%	0.89	$43,600
523	**Securities, Commodity Contracts, and Other Financial Investments and Related Activities**	500	0.1%	99.9%	9.5%	0.59	$447,700
5232	Securities & Commodity Exchanges	500	0.1%		9.5%	0.60	$447,700
486	**Pipeline Transportation**	300	0.1%	99.9%	5.6%	0.21	$81,700
4869	Other Pipeline Transportation	200	0.0%		3.6%	0.78	$78,700
4862	Pipeline Transportation of Natural Gas	100	0.0%		9.8%	0.13	$86,100
4861	Pipeline Transportation of Crude Oil	-	0.0%		0.0%	0.00	$0
521	**Monetary Authorities-Central Bank**	200	0.1%	100.0%	-5.1%	0.45	$82,200
5211	Monetary Authorities-Central Bank	200	0.1%		-5.1%	0.45	$82,200
Total		457,500					

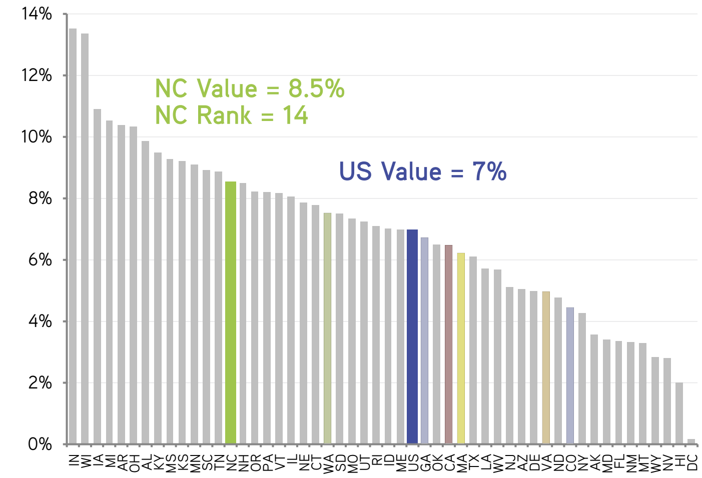
Source: Economic Modeling Specialists, Inc.

Employment and Average Wage numbers rounded to the nearest hundreds.

above the U.S. average wage for all industries. The next two subsectors, both focused on manufacturing, together account for 15.5 percent of North Carolina's high-technology employment—Chemical Manufacturing (8.0%) and Computer and Electronic Product Manufacturing (7.5%). In each subsector, North Carolina has a larger share of activity than we would expect based on national trends, average wages well above the U.S. average wage for all industries, but employment levels that are decreasing. Within the first subsector—Chemical Manufacturing—North Carolina has a relatively high degree of concentration in all high-technology industries except Basic Chemical Manufacturing; in the latter subsector—Computer and Electronic Product Manufacturing—North Carolina has a relatively high degree of concentration in half of the high-technology industries and a relatively low degree of concentration in the other half. Together, these first four subsectors account for more than two-thirds (70.5%) of North Carolina's high-technology industry employment[10].

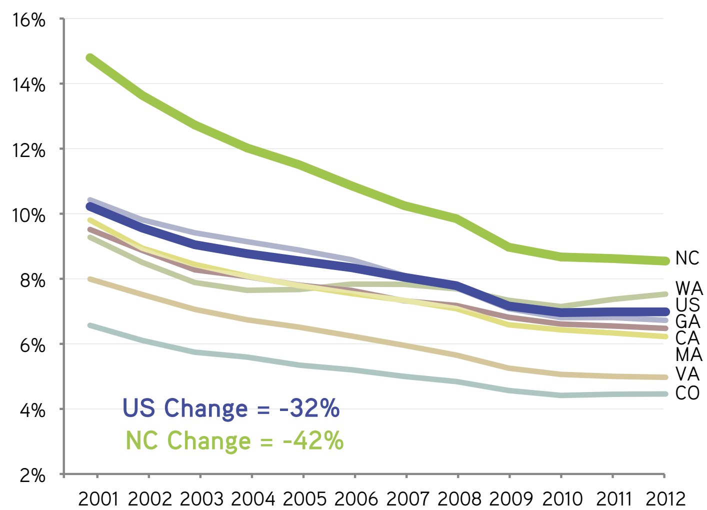
Adding the next three subsectors brings the total to 85.3 percent of North Carolina's high-technology industry employment—Telecommunications (6.9%), Merchant Wholesalers, Durable Goods (4.0%), and Machinery Manufacturing (3.9%). In each subsector, North Carolina's share of activity is consistent with what we would expect, based on national trends, and average wages are well above the U.S. average wage for all industries. Two of the subsectors—Telecommunications and Machinery Manufacturing—have decreasing employment levels, whereas the percent, which is greater than, but not significantly different from, the decrease for the U.S. overall, 32 percent, or any of the comparison states, which also decreased by an average of 32 percent *[6.4f]*. Merchant Wholesalers, Durable Goods subsector has increasing employment levels. Within the first subsector—Telecommunications—North Carolina has a relatively high degree of concentration in all the high-technology industries except Satellite Telecommunications. Within the second subsector—Merchant Wholesalers, Durable Goods—North Carolina's activity level is equal to or slightly below the U.S. level. Within the third subsector—Machinery Manufacturing—North Carolina has a relatively high degree of concentration in half of the high-technology industries and a relatively low degree of concentration in the other half. The 14 remaining subsectors together account for 14.7 percent of North Carolina's high-technology industry employment.

6.4e–Manufacturing GDP as Percentage of State GDP, All U.S. States, 2012



Source: Economic Modeling Specialists, Inc.

6.4f–Manufacturing GDP as Percentage of State GDP, Comparison States, 2001–2012



Source: Economic Modeling Specialists, Inc.

North Carolina ranks well ahead of all the comparison states, most of which have values lower than the U.S. average. From 2001 to 2012, the percentage of North Carolina's GDP accounted for by manufacturing decreased significantly, by 42

[9] Employment numbers, location quotients, and average wages are reported only for those industry (4-digit NAICS codes) that are identified as a "high technology" industry. Accordingly, the subsector data reported here at the 3-digit NAICS code level do not match similar data for the entire subsector defined at the 3-digit NAICS level. Moreover, the data in chart 6.4c are presented at the 3-digit level because the four-digit level is too detailed for graphic presentation purposes.

[10] Although North Carolina is well known for having a strong financial services and banking sector, major portions of those sectors do not appear here because this analysis includes only the portions considered high technology. Additionally, a considerable portion of those jobs are classified in other sectors, such as Management of Companies and Enterprises.

In terms of manufacturing GDP as a percentage of state GDP, North Carolina ranks 14th in the nation, with a level that is 121 percent of the U.S. average value and 63 percent of the value of the state with the highest value, Indiana *[6.4e]*.

What Does This Mean for North Carolina?

North Carolina's overall industry structure does not position the state, overall, to be a leader in innovation. Specifically, as summarized in indicators 4.1 (High-Technology Establishments) and 4.2 (Employment in High-Technology Establishments) and illustrated in more detail here, a large portion of the state's industries and employment is not high technology in nature and, therefore, less likely to produce the types of innovations that drive growth, employment, and higher wages in the economy. Among the small number of sectors that are high technology, however, virtually all have wages well above the U.S. average for all sectors, and approximately half are increasing in employment [11].

While North Carolina has lost a substantial number of jobs in manufacturing since 2001, it is notable that most of those job losses have been in low-technology, low-skill industries, while productivity and job gains have been the case in high-technology, high-skill industries. Overall in North Carolina, manufacturing wages are higher than the U.S. average, and for high-technology manufacturing industries, the average wages are even higher. In general, manufacturing (particularly technology-based advanced manufacturing) remains the key source of U.S. traded-sector strength[12]. This is important because traded-sector establishments provide the economic foundation upon which the rest of the economy grows. Manufacturing jobs also have large employment multiplier effects (nationally, each manufacturing job supports as many as 2.9 other jobs in the rest of the economy)[13].

Within North Carolina, only 23 percent of the manufacturing jobs are currently in high-technology industries.[14] Given the importance and impact of high-technology manufacturing, and given that manufacturing establishments perform 70 percent of industry R&D (see indicator 2.2, Industry R&D), North Carolina should work to ensure that new high-technology manufacturing industries are forming in or relocating to the state. It should also work to ensure that existing manufacturing industries are innovating and incorporating new technologies to increase their productivity. Similar efforts should also be devoted to high-technology industries not in the manufacturing sector, such as Professional, Scientific, and Technical Services. These efforts and others will improve the state of innovation in North Carolina, thereby improving the economic well-being and quality of life of all its citizens.

Methodological Note

Relative concentration is measured using a simple descriptive measure called a location quotient. For a given industry, the location quotient is the ratio of the industry's share of employment in North Carolina to its share of employment in the U.S. as a whole. A location quotient equal to 1.0 indicates that the industry's share in North Carolina matches the comparable share for the U.S. as a whole. A location quotient significantly above 1.0 (i.e., more than 10 percent higher) signifies state specialization, i.e., the state has a larger share of activity (more concentration) in the industry than we would expect based on national trends. Conversely, a location quotient significantly below 1.0 (i.e., more than 10 percent lower) signifies state lack of specialization, i.e., the state has a smaller share of activity (less concentration) in the industry than we would expect based on national trends. The formula for computing a location quotient is as follows:

$$\frac{(\text{Employment,industry i, NC})}{(\text{Total employment, NC})} \div \frac{(\text{Employment,industry i, US})}{(\text{Total employment, US})}$$

11 A more detailed analysis, not presented here, shows three relevant findings. First, Massachusetts and California have significantly higher location quotients in Professional, Scientific and Technical Services and in Information; together, these two sectors account for much of the industrial activity that is popularly thought of as high technology. Second, Massachusetts and California have significantly higher location quotients for the Computer and Electronic Product Manufacturing subsector. Third, each of these two states has more subsectors with very high location quotients, compared to North Carolina, where high-technology employment appears to be more evenly distributed.

12 The traded sector comprises those industries and establishments that produce goods and services (e.g. electronics, management consulting, advertising) that have a high potential to be consumed outside the region of production. The non-traded sector comprises local-serving industries (e.g., construction, personal services, real estate).

13 For more information, see Ezell, Stephen and Robert D. Atkinson. 2011. The Case for a National Manufacturing Strategy. Information Technology and Innovation Foundation (http://www.itif.org/publications/case-national-manufacturing-strategy).

14 This percentage results from dividing the number of high-technology manufacturing jobs (i.e., those with 3-digit NAICS codes within the 2-digit range 31–33) in table 6.4d (104,000) by the total number of manufacturing jobs (456,800) in table 6.4b.

High-Technology Industries

To define high-technology industries, this report adopts the approach used in the National Science Board's *Science and Engineering Indicators 2012*, which is a modification of the approach employed by the Bureau of Labor Statistics (BLS) (Hecker 2005). BLS's approach is based on the intensity of high-technology employment within an industry.

High-technology occupations include scientific, engineering, and technician occupations. These occupations employ workers who possess an in-depth knowledge of the theories and principles of science, engineering, and mathematics, which is generally acquired through postsecondary education in some field of technology. An industry is considered high-technology if employment in technology-oriented occupations accounts for a proportion of that industry's total employment that is at least twice the 4.9% average for all industries (i.e., 9.8% or higher).

In this report, the category "high-technology industries" refers only to private sector businesses. The list of high-technology industries used in this report includes the 46 four-digit codes from the 2002 NAICS listing below.

NAICS code	Industry
1131, 1132	Forestry
2111	Oil and gas extraction
2211	Electric power generation, transmission, and distribution
3241	Petroleum and coal products manufacturing
3251	Basic chemical manufacturing
3252	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing
3254	Pharmaceutical and medicine manufacturing
3255	Paint, coating, and adhesive manufacturing
3259	Other chemical product and preparation manufacturing
3332	Industrial machinery manufacturing
3333	Commercial and service industry machinery manufacturing
3336	Engine, turbine, and power transmission equipment manufacturing
3339	Other general purpose machinery manufacturing
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3343	Audio and video equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational, measuring, electromedical, and control instruments manufacturing
3346	Manufacturing and reproducing magnetic and optical media
3353	Electrical equipment manufacturing
3364	Aerospace product and parts manufacturing
3369	Other transportation equipment manufacturing
4234	Professional and commercial equipment and supplies, merchant wholesalers
4861	Pipeline transportation of crude oil
4862	Pipeline transportation of natural gas
4869	Other pipeline transportation
5112	Software publishers
5161	Internet publishing and broadcasting
5171	Wired telecommunications carriers
5172	Wireless telecommunications carriers (except satellite)
5173	Telecommunications resellers
5174	Satellite telecommunications
5179	Other telecommunications
5181	Internet service providers and Web search portals
5182	Data processing, hosting, and related services
5211	Monetary authorities, central bank
5232	Securities and commodity exchanges
5413	Architectural, engineering, and related services
5415	Computer systems design and related services
5416	Management, scientific, and technical consulting services
5417	Scientific research and development services
5511	Management of companies and enterprises
5612	Facilities support services
8112	Electronic and precision equipment repair and maintenance

NAICS = North American Industry Classification System

Introduction

"2013 Global Manufacturing Competitiveness Index." Deloitte. Accessed February 20, 2013. http://www.deloitte.com/view/en_US/us/Industries/Process-Industrial-Products/manufacturing-competitiveness/mfg-competitiveness-index/index.htm.

Atkinson, Robert D., and Luke D. Stewart. 2012. *The 2012 State New Economy Index: Benchmarking Economic Transformation in the States*. Washington, D.C.: Information Technology & Innovation Foundation.

Atkinson, Robert D., and Stephen J. Ezell. 2012. *Innovation Economics: The Race for Global Advantage*. New Haven, Conn.: Yale University Press.

Hecker Daniel E. 2005. "High-Technology Employment: A NAICS-Based Update." *Monthly Labor Review* July: 57–72.

Jones, C. and Williams, J. 2000. "Too Much of a Good Thing?: The Economics of Investment in R&D." *Journal of Economic Growth* 5: 65–85.

Jones, C. I., and J. C. Williams. 1998. "Measuring the Social Return to R&D." *The Quarterly Journal of Economics* 113, no. 4: 1119-135.

Tassey, Gregory. 2007. *The Technology Imperative*. Cheltenham, UK: Edward Elgar.

United States. Department of Commerce. 2012. *The Competitiveness and Innovative Capacity of the United States*. Washington, D.C.: U.S. Dept. of Commerce.

Indicators

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

1.1: Gross Domestic Product (GDP)
State-level GDP data are from the Per Capita Real GDP by State dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed February 28, 2013, http://www.bea.gov/regional/. National-level GDP data are from the World Bank, GDP Per Capita dataset, accessed February 28, 2013, http://databank.worldbank.org/data/home.aspx. MSA-level GDP data are from the Per Capita Real GDP by Metro Area dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed February 28, 2013, http://www.bea.gov/regional/. Over-time data are adjusted for inflation using the BEA's GDP deflator.

1.2: Income
State-level per-capita income data are from the U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, Per Capita Personal Income dataset, accessed March 28, 2013, http://www.bea.gov/regional/. State-level median household income data are from the U.S. Census Bureau, American Community Survey, Median Income in the Last 12 Months dataset, 1-Year Estimates, accessed March 28, 2013, http://www.census.gov/acs/www/. County-level median household income data are from the U.S. Census Bureau, American Community Survey, Median Income in the Last 12 Months dataset, 5-Year Estimates, accessed March 28, 2013, http://www.census.gov/acs/www/. Over-time data are adjusted for inflation using the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Consumer Price Index (CPI).

1.3: Average Annual Wage
State and county-level average annual wage data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages dataset, accessed April 4, 2013, http://data.bls.gov/cgi-bin/dsrv. Occupation wage data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Occupational Employment Statistics dataset, accessed April 4, 2013, http://www.bls.gov/oes/tables.htm. Over-time data are adjusted for inflation using the BLS Consumer Price Index (CPI).

1.4: Unemployment
State and county-level unemployment data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Local Area Unemployment Statistics, Unemployment Rates for States dataset and Labor Force by County dataset, accessed March 31, 2013, http://www.bls.gov/lau/#tables. National-level unemployment data are from the International Labour Organization, Key Indicators of the Labour Market dataset, accessed March 31, 2013, http://www.ilo.org/empelm/what/WCMS_114240/lang--en/index.htm.

1.5: Poverty
State-level poverty data are from the U.S. Census Bureau, American Community Survey, Poverty Status in the Last 12 Months dataset, 1-Year Estimates, accessed April 17, 2013, http://www.census.gov/acs/www. County-level poverty data are from the U.S. Census Bureau, American Community Survey, Poverty Status the Last 12 Months dataset, 5-Year Estimates, accessed April 17, 2013, http://www.census.gov/acs/www.

1.6: Population Growth
State-level population data are from the U.S. Census Bureau, American Community Survey, Total Population dataset, 1-Year Estimates, accessed May 14, 2013, http://www.census.gov/acs/www. County-level population data are from the U.S. Census Bureau, American Community Survey, Total Population dataset, 2010 Census Summary File, accessed May 14 2013, http://www.census.gov/acs/www.

[1] Website addresses provided here link to the sites of the relevant organizations or the relevant sections within those sites. Links are not provided to specific reports or data tables, whose links are often very long, the product of a search query, or subject to change over time (i.e., they may change or expire after publication of this report). In general, the applicable reports and/or data tables are easy to find on a site by browsing the available information or by using the site's search tool. Readers who are unable to find specific data may contact the authors of this report.

2.1: Total Research & Development (R&D)
State-level total R&D data are from the National Science Board, *Science and Engineering Indicators 2012*, R&D as a Percentage of Gross Domestic Product dataset, accessed March 3, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o39.htm. National-level total R&D data are from the World Bank, Research & Development Expenditure (% of GDP) dataset, accessed March 3, 2013, http://databank.worldbank.org/data/home.aspx. Business-level R&D data are an approximation based on mapping the location of all manufacturing establishments in North Carolina, as provided by the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages dataset, as provided by the Demand Driven Data Delivery (D4) System, North American Industry Classification (NAICS) codes 31-33 (Manufacturing), Annual by County, accessed March 3, 2013, http://esesc23.esc.state.nc.us/d4/QCEWSelection.aspx. University-level R&D data are from the National Science Foundation, National Center for Science and Engineering Statistics, Higher Education R&D Expenditures by Source of Funds dataset, accessed March 11, 2013, http://www.nsf.gov/statistics/nsf12330/content.cfm?pub_id=4211&id=2.

2.2: Industry R&D
State-level business-performed R&D data are from the National Science Board, *Science and Engineering Indicators 2012*, Business-Performed R&D as a Percentage of Private-Industry Output dataset, accessed March 3, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o45.htm. Business-level R&D data are an approximation based on mapping the location of all manufacturing establishments in North Carolina, as provided by the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages dataset, as provided by the Demand Driven Data Delivery (D4) System, North American Industry Classification (NAICS) codes 31-33 (Manufacturing), Annual by County, accessed March 3, 2013, http://esesc23.esc.state.nc.us/d4/QCEWSelection.aspx.

2.3: Academic Science & Engineering R&D
State-level academic science & engineering R&D data are from the National Science Board, *Science and Engineering Indicators 2012*, Academic Science and Engineering R&D per $1,000 of Gross Domestic Product dataset, accessed March 3, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4.htm. University-level R&D data are from the National Science Foundation, National Center for Science and Engineering Statistics, Higher Education R&D Expenditures by Source of Funds dataset, accessed March 11, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o46.htm.

2.4: Federal R&D
State-level federal R&D obligations data are from the National Science Board, *Science and Engineering Indicators 2012*, Federal R&D Obligations per Employed Worker dataset, accessed April 23, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o40.htm.

2.5: Academic Articles
State-level academic articles data are from the National Science Board, *Science and Engineering Indicators 2012*, Academic Science and Engineering Article Output per 1,000 S&E Doctorate Holders in Academia dataset, accessed May 17, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s5.htm. Organization-level academic articles data are from the Science Citation Index and Social Sciences Citation Index, accessed July 1, 2013 via the Web of Science via UNC-Chapel Hill library's online proxy server, available at http://thomsonreuters.com/social-sciences-citation-index/ and http://thomsonreuters.com/social-sciences-citation-index/.

3.1: SBIR & STTR Funding
State-level SBIR data are from the National Science Board, *Science and Engineering Indicators 2012*, Average Annual Federal Small Business Innovation Research Funding per $1 Million of Gross Domestic Product dataset, accessed March 19, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o55.htm. State-level STTR data are from SBIR.gov, Awards Search, accessed March 19, 2013, http://www.sbir.gov/sbirsearch/technology. City, county, and ZIP Code-level SBIR and STTR data are from SBIR.gov, Awards Search, accessed March 19, 2013, http://www.sbir.gov/sbirsearch/technology.

3.2: Academic Patents
State-level academic patents data are from the National Science Board, *Science and Engineering Indicators 2012,* Academic Patents Awarded per 1,000 Science and Engineering Doctorate Holders in Academia dataset, accessed March 24, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s5o50.htm. University-level academic patents data are from the Association of University Technology Managers (AUTM), 2012 Licensing Survey, accessed March 19, 2013, http://www.autm.net/AM/Template.cfm?Section=Licensing_Surveys_AUTM&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=6&ContentID=2409.

3.3: Patents
State-level patents data are from the National Science Board, *Science and Engineering Indicators 2012*, Patents Awarded per 1,000 individuals in science and engineering occupations dataset, accessed March 24, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s5o51.htm. National-level patents data are from the World Intellectual Property Organization (WIPO) IP Statistics Data Center, accessed May 16, 2013, http://ipstatsdb.wipo.org/ipstatv2/ipstats/patentsSearch. National-level GDP data are from the World Bank, GDP Per Capita dataset, accessed February 28, 2013, http://databank.worldbank.org/data/home.aspx. State-level GDP data are from the Per Capita Real GDP by State dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed February 28, 2013, http://www.bea.gov/regional/. County-level patents data are from the U.S. Patent and Trademark Office (USPTO), General Patent Statistics Reports Available For Viewing, Listing of All U.S. Counties and Other Regional Components, Total Utility Patent Counts, 2000-2011, accessed June 17, 2013, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm.

3.4: Venture Capital
State-level venture capital data are from the National Science Board, *Science and Engineering Indicators 2012*, Venture Capital Disbursed per $1,000 of Gross Domestic Product dataset, accessed March 28, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o56.htm and Venture Capital Deals as a Percentage of High-Technology Business Establishments dataset, accessed March 28, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o57.htm. ZIP Code-level venture capital data are from Dow Jones Venture Source, accessed April 7, 2013, https://www.venturesource.com.

3.5: Technology License Income
State and university-level license income data are from the Association of University Technology Managers (AUTM), 2012 Licensing Survey, accessed March 19, 2013, http://www.autm.net/AM/Template.cfm?Section=Licensing_Surveys_AUTM&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=6&ContentID=2409. Academic science & engineering R&D expenditures data are from the National Science Board, Science and Engineering Indicators 2012, Academic Science and Engineering R&D dataset, accessed March 3, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o46.htm.

4.1: High-Technology Establishments and Formations
State-level high-technology establishments data are from the National Science Board, *Science and Engineering Indicators 2012*, High-Technology Establishments as a Percentage of All Business Establishments dataset, accessed March 24, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o52 htm. State-level high-technology formations data are from the National Science Board, *Science and Engineering Indicators 2012*, Net High-Technology Business Formations as a Percentage of All Business Establishments dataset, accessed March 24, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o53.htm. High-technology business establishments by county data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages dataset, as provided by the Demand Driven Data Delivery (D4) System, Annual by County, accessed March 24, 2013, http://esesc23.esc.state.nc.us/d4/QCEWSelection.aspx. The data pertaining to establishments are based on their classification according to the 2002 edition of the North American Industry Classification System (NAICS). See the Appendix for a list of the 46 industries (by 4-digit NAICS code) that are defined as high technology.

4.2: High-Technology Employment
State-level high-technology employment data are from the National Science Board, Science and *Engineering Indicators 2012*, Employment in High-Technology Establishments as Percentage of Total Employment dataset, accessed March 29, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s6o54.htm. High-technology employment by county data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages dataset, as provided by the Demand Driven Data Delivery (D4) System, Annual by County, accessed March 29, 2013, http://esesc23.esc.state.nc.us/d4/QCEWSelection.aspx. The data pertaining to establishments are based on their classification according to the 2002 edition of the North American Industry Classification System (NAICS). See the Appendix for a list of the 46 industries (by 4-digit NAICS code) that are defined as high technology.

4.3: Entrepreneurial Activity
State-level entrepreneurial activity data are from the Kauffman Foundation, Kauffman Index of Entrepreneurial Activity, State Data, accessed May 17, 2013 http://www.kauffman.org/what-we-do/research/kauffman-index-of-entrepreneurial-activity.

4.4: Exports
State-level export data are from the World Institute for Strategic Economic Research (WISER), WISERTrade, State Exports by NAICS database, accessed April 26, 2013, http://www.wisertrade.org/. State-level GDP data are from the Per Capita Real GDP by State dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed February 28, 2013, http://www.bea.gov/regional/. National-level export data are from the World Bank, Exports of Goods and Services (% of GDP) dataset, accessed February 28, 2013, http://databank.worldbank.org/data/home.aspx. National-level GDP data are from the World Bank, GDP Per Capita dataset, accessed February 28, 2013, http://databank.worldbank.org/data/home.aspx.

5.1: Science & Engineering Workforce
State-level science & engineering workforce data are from the National Science Board, *Science and Engineering Indicators 2012*, Individuals in Science and Engineering Occupations as a Percentage of the Workforce dataset, accessed April 5, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s4o46.htm.

5.2: Employed S&E Doctorate Holders
State-level employed S&E doctorate holders data are from the National Science Board, Science and Engineering Indicators 2012, Employed Science and Engineering Doctorate Holders as a Percentage of the Workforce dataset, accessed April 5, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s3o34.htm.

5.3: Engineers as a Percentage of the Workforce
State-level engineers as a percentage of the workforce data are from the National Science Board, Science and Engineering Indicators 2012, Engineers as a Percentage of the Workforce dataset, accessed August 3, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s3o35.htm.

5.4: B.A. Degrees in Natural S&E
State-level natural sciences & engineering (NS&E) bachelor's degree data are from the National Science Board, Science and Engineering Indicators 2012, Bachelor's Degrees in Natural Sciences and Engineering Conferred per 1,000 Individuals 18–24 Years Old dataset, accessed May 27, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s2o18.htm.

5.5: Natural S&E Degrees
State-level natural sciences & engineering (NS&E) degree data are from the National Science Board, Science and Engineering Indicators 2012, Natural Sciences and Engineering Degrees as a Percentage of Higher Education Degrees Conferred dataset, accessed August 19, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s2o20.htm.

5.6: Educational Attainment
State-level educational attainment data are from the U.S. Census Bureau, American Community Survey, Educational Attainment, American Community Survey 1-Year Estimates datasets, accessed June 9, 2013, http://www.census.gov/acs/www/. County-level educational attainment data are from the U.S. Census Bureau, American Community Survey, Educational Attainment, 2011, American Community Survey 5-Year Estimates dataset, accessed June 9, 2013, http://www.census.gov/acs/www/.

5.7: Educational Attainment of In-Migrants

State-level educational attainment of in-migrants data are from the U.S. Census Bureau, American Community Survey, Geographical Mobility in the Past year by Educational Attainment for Current Residence in the United States, Universe: Population 25 years and over in the United States, American Community Survey 1-Year Estimates datasets, accessed May 13, 2013, http://www.census.gov/acs/www/. County-level educational attainment data are from the U.S. Census Bureau, American Community Survey, Geographical Mobility in the Past year by Educational Attainment for Current Residence in the United States, Universe: Population 25 years and over in the United States, 2007-2011 American Community Survey 5-Year Estimates dataset, accessed May 13, 2013, http://www.census.gov/acs/www/.

6.1: Public Investment in Education

State-level elementary and secondary public school current expenditures data are from the National Science Board, Science and Engineering Indicators 2012, Elementary and Secondary Public School Current Expenditures as Share of Gross Domestic Product dataset, accessed June 2, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s1o10.htm. State-level appropriations of state tax funds for operating expenses of higher education data are from the National Science Board, Science and Engineering Indicators 2012, Appropriations of State Tax Funds for Operating Expenses of Higher Education as a Percentage of Gross Domestic Product dataset, accessed June 2, 2013, http://www.nsf.gov/statistics/seind12/c8/c8s2o27.htm. Per-pupil expenditures data are from the North Carolina Department of Public Instruction, Per Pupil Expenditure Ranking dataset, accessed June 2, 2013, http://apps.schools.nc.gov/pls/apex/f?p=1:35:0::NO:::. Authorized appropriations for the University of North Carolina (UNC) institutions data are from the North Carolina Office of State Budget and Management, provided by special data request, June 17, 2013.

6.2: Broadband

State-level data for broadband deployment are from the Federal Communications Commission, Eighth Broadband Progress Report, Appendix G, accessed May 28, 2013, http://www.fcc.gov/reports/eighth-broadband-progress-report. State-level data for broadband percent fiber deployment are from the National Telecommunications & Information Administration, National Broadband Map, accessed May 21, 2013, http://www.broadbandmap.gov/analyze. State-level data for broadband adoption are from the Federal Communications Commission, Eighth Broadband Progress Report, Appendix H, accessed May 28, 2013, http://www.fcc.gov/reports/eighth-broadband-progress-report. County-level broadband access data are from NC Broadband, Estimation of Percent of Households by County, With Broadband Access, developed April 29, 2013.

6.3: Cost of Living Index

State-level Cost of Living Index data are from the Council for Community and Economic Research (C2ER) and the Missouri Economic Research and Information Center (MERIC). C2ER charges for historical cost of living data; MERIC has purchased these data and shared them with the Tracking Innovation report staff on June 19, 2013. C2ER's Cost of Living Index website is http://www.coli.org/; MERIC's cost of living data website is http://www.missourieconomy.org/INDICATORS/cost_of_living/index.stm. County-level Cost of Living Index data are from C2ER, County Cost of Living Index, accessed July 15, 2013, http://www.coli.org/.

6.4: Industry Mix

Industry mix data are from the Economic Modeling Specialists, Inc. (EMSI), accessed June 21, 2013, http://www.economicmodeling.com/. EMSI derives its industry employment data by combining covered employment data from the Quarterly Census of Employment and Wages (QCEW) produced by the Bureau of Labor Statistics (BLS) with total employment data in Regional Economic Information System (REIS) published by the Bureau of Economic Analysis (BEA), and augmenting it with County/ZIP Business Patterns (CBP) and Non-employer Statistics (NES) published by the U.S. Census Bureau. In addition, the Current Employment Statistics database from BLS is used to fill the lag in QCEW and create more informed estimates for current-year data. EMSI has a detailed methodology for estimates, including changes to standard QCEW data, such as moving public school employees from the Educational Services sector into Government. Information from EMSI is provided as part of a subscription service paid for by the North Carolina Department of Commerce.

Manufacturing industries are defined as those industries whose 2-digit NAICS code ranges from 31-33. The National Science Foundation defines "high technology" industries at the 4-digit NAICS level according to the 2002 NAICS coding scheme. EMSI employment data are reported according to the 2007 NAICS coding scheme. Industries considered "high technology" in this analysis follow the NSF's classification method, except where adjusted to account for differences between the 2002 and 2007 NAICS coding scheme as follows: 2007 NAICS 5191 has been classified as a "high technology" industry (see explanation below). State-industry combinations whose employment data are reported as "<10" were adjusted to 0. Job counts, average wages, and location quotients are reported only for those subcategories of each industry that are identified as a "high technology" industry. Accordingly, those data reported at the 3-digit NAICS level do not match similar data for the entire industry defined at the 3-digit NAICS level.

Explanation of 2002-2007 "High Technology" NAICS Reconciliation

The National Science Foundation defines "high technology" industries at the 4-digit NAICS level according to the 2002 NAICS coding scheme. EMSI's employment data are reported according to the 2007 NAICS coding scheme.

In the shift from the 2002 to the 2007 NAICS coding scheme, many codes remained the same. In other instances, two or more 2002 codes were combined under one new or preexisting 2007 code, a 2002 code may have been divided among many new or preexisting 2007 codes, a 2002 code was eliminated, or a code changed in scope.

Such shifts from 2002 to 2007 NAICS codes affected several of the codes that the NSF identified as being "high technology" industries. Where code shifts did not change whether a code was composed entirely of "high technology" or entirely not of "high technology," no adjustment was required. In cases where a code resulted in a mix of "high technology" and not "high technology" industries based on 2002 classifications, *Tracking Innovation* report staff determined whether the 2007 code qualified as "high technology" for the purposes of the 2013 report. These special determinations are summarized here:

- 2007 NAICS codes 3332 and 3339 are equivalent to 2002 codes designated by the NSF as "high technology." They encompass a division of 2002 NAICS code 3391, which was not designated by the NSF as "high technology." Since the components of 3391 that were allocated to 3332 and 3339 are specific to the type of product produced in the latter two industries, those two industries kept their "high technology" designation. These codes pertain to manufacturing laboratory machinery and equipment.

- 2002 NAICS codes 5161 and 5181 were designated by the NSF as "high technology" but were grouped (in part—5181 was distributed among many codes) under 2007 NAICS code 5191, which is equivalent to a 2002 code that was not designated "high technology." NAICS code 5191 includes Internet publishing (a component of 2002 code 5161) and Web search portals (a component of 2002 code 5181), but also news syndicates, libraries, and other establishments not previously designated "high technology." Since internet-related information services compose a majority of 2012 employment in NAICS code 5191, it has been classified as a "high technology" industry.

- 2002 NAICS code 5175 was not designated by the NSF as "high technology," but is a component of 2007 NAICS code 5171, which is equivalent to a 2002 code that was designated "high technology." Tracking Innovation report staff determined that 2007 NAICS code 5171 would maintain its designation as "high technology."

- 2002 NAICS code 5416 was designated by the NSF as "high technology" and was divided among many 2007 NAICS codes. One of these codes, 5613, was not designated as "high technology." Given that the component of 5416 that was shifted to 5613—human resources and executive search—is similar to other employment services that fall under 5613 in both 2002 and 2007 NAICS code schemes, 2007 NAICS 5613 is not designated as "high technology".

While all of the above discrepancies were reviewed, the only change to the NSF scheme is the addition of 2007 NAICS 5191 as a "high technology" industry.

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North Carolina Board of Science & Technology

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