STAFF INFORMATION REPORT

Tennessee and the Knowledge Economy

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Tennessee and The Knowledge Economy

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Executive Summary

What is the Knowledge Economy?

Over the last several years, the U.S. economy has evolved into what has commonly come to be referred to as the new economy. It is more accurate to describe this new economy as the knowledge economy. As former U.S. Treasury Secretary Lawrence Summers has noted, the national economy is moving from an economy based on the production of physical goods to an economy based on the production and application of knowledge. The knowledge economy does not just include new high-technology industries. It includes old economy enterprises that are adapting their processes to take advantage of new efficiencies offered by new technologies. The emerging economy places a premium on highly trained and skilled people. High growth companies identify the lack of trained professional and technical personnel as both their primary area of need and the major roadblock to maintaining their current level of expansion.

Tennessee and the Knowledge Economy

Tennessee lacks the adequately trained workforce required to be a leader in the knowledge economy. Innovations created by knowledge economy firms have lead to related manufacturing spin-off jobs in Tennessee, and these spin-off jobs have been a driving force behind Tennessee's current economic growth. However, it is important to draw a distinction between these production jobs and the more lucrative research and development jobs that other states have been more successful in attracting. Unless Tennessee is able to develop the human capital necessary to fulfill the occupational demands of today's businesses, the state will not experience the full prosperity and other rewards of the knowledge economy.

Findings of Facts

Employment Trends

- The Tennessee Department of Labor and Workforce Development projects that by 2006 about one in five jobs (19 percent) will require a college degree. Another 25 percent of all employment will call for postsecondary training of less than four years. The remaining 56 percent of employment will require limited on-the-job training of less than 12 months.

- The one overriding factor of some of the more desirable high growth knowledge economy jobs, such as computer programming, is that the prospects for employment are better for college graduates with strong technical experience.

- While the labor market continues at full employment, there is a widening gap in the growth of earnings between those employed in knowledge economy jobs and those who work in Old Economy jobs.

- In 1998, Tennessee had the third lowest number of high-tech workers per 1,000 among the southeastern states, and between 1993 and 1998, a lower rate of increase in high-tech employment than any other southeastern state.

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Findings of Facts (continued)

Education

- While Tennessee has shown some improvement in 2000, the state still has a low base of high school and college graduates. The state ranks 46th in the number of high school graduates and 41st in the number of college graduates as a percent of the population 25 years of age and older.

Research and Development

- The most recent data on R&D spending per capita shows that Tennessee's performance is better than most southeastern states, but the state is behind the southeastern states that have a strong high-tech economic base: Florida, Georgia, North Carolina, and Virginia.

Policy Implications

In order to take advantage of the opportunities of the knowledge economy, Tennessee must focus its efforts on

- improving quality of education in the state,
- maintaining its emphasis on developing worker skills,
- supporting research and development, and
- targeting economic development efforts to attract high quality knowledge economy jobs.

Quality of Education

- Tennessee will benefit by maintaining the effort to improve elementary and secondary education that it began with the Basic Education Program in 1992.

- Investing in a pre-kindergarten education program would likely improve elementary and secondary education performance.

- Expanding the state's scholarship program for students pursuing education degrees to include scholarships for students pursuing training in science and technology could help Tennessee attract and retain top candidates for high-tech employment.

- Tennessee might benefit from establishing an interagency educational accountability work group to set statewide standards and improve the performance of the various agencies supporting education and worker training. This policy initiative could be used to develop an over-arching education strategy for the Tennessee Higher Education Commission and the Tennessee Department of Education. This workgroup could also incorporate the workforce development goals of various Tennessee agencies.

Continued next page

Policy Implications (continued)

- By continuing its investment in children's health through the TennCare program, Tennessee would help ensure that its children are well enough to attend school.

Worker Skills

- Tennesse's knowledge economy preparedness could improve with the state maintaining the emphasis it has placed upon using the federal Workforce Investment Act to improve worker skills, and by continuously seeking additional opportunities to partner with other governments, and the private sector, to further job training in Tennessee.

Research and Development

- Tennessee should benefit from its TennesSeed Fund1 initiative to fund technology firm growth. The state might further benefit from seeking ways to augment that initiative with additional private research incentives.

- Tennessee would likely benefit from developing its universities into respected centers of research. State support of this research and development is particularly important in light of decreasing levels of federal support for research.

Targeted Economic Development

- Tennessee can focus its economic development activities on attracting high quality jobs that will help improve the overall quality of life in the state.

- Tennessee can assist its existing old economy employers in taking advantage of knowledge economy opportunities.

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Introduction

Will Tennessee Become A "Rustbelt" State of the Knowledge Economy?

Tennessee has made considerable progress over the last several years in improving the quality of life of its citizens. Key to this progress has been the state's ability to help employers create new jobs. As well as the state has done in the past, it is in danger of not being in position to take full advantage of the opportunities of the knowledge economy. Tennessee is doing some things well, such as providing seed funds for new industries, and emphasizing worker training through the federal Workforce Investment Act, but the state is hampered by the education level of its workforce.

Tennessee is in danger of being left in the old economy and is at risk of falling further behind states that have implemented policies resulting in knowledge economy growth. Investment in higher education and job training that produces workers with knowledge economy skills and improvements in elementary and secondary education are the most notable policies that leading knowledge economy states have adopted. The major obstacle that Tennessee faces is its low base of technology employees and high school and college-educated workers. Tennessee also must assist existing employers that are unprepared to take advantage of the technological advances that will allow them to compete in the knowledge economy. Continued economic and income growth will require a strong presence of highly skilled workers in the labor force. Tennessee's employers need better-educated and trained employees in order to compete effectively in the knowledge economy. The Tennessee Department of Labor and Workforce Development projects that by 2006, about one in five jobs (19 percent) will require a college degree. Another 25 percent of all employment will call for postsecondary training of less than four years. The remaining 56 percent of employment will require limited, on-the-job training of less than 12 months.[1] If Tennessee is to thrive in the knowledge economy, it must have a workforce that is educated and trained in the skills needed to fulfill businesses' occupational demands, current and future.

[1] Tennessee Department of Labor and Workforce Development, *Tennessee Job Outlook, 1996-2006*, June 1999, pp. 1-5.

Background: What is the Knowledge Economy?

The Knowledge Economy Is Being Driven By Information Technology and Highly Skilled Workers.

Over the past decade, the national economy has evolved from an industrial, old economy based on physical goods to one that former U.S. Treasury Secretary Lawrence Summers characterized as being based on the production and application of knowledge.[2] This knowledge economy is presumed to have several key factors:

- The emerging economy places a premium on highly trained and skilled people with backgrounds in scientific and technical disciplines. High growth companies identify the lack of trained professional and technical personnel as both their primary area of need and the major roadblock to maintaining their current level of expansion.[3]
- Small Entrepreneurial companies are playing an increasing role in the economy, accounting for a disproportionate share of job creation, new product innovations and aggressive positioning in international markets.[4]
- The knowledge economy is global and enabled by advances in transportation and communications to produce an increased share of trade-related business for the most rapid growing companies.[5]

The knowledge economy is not just about "dot-coms" or the Internet. According to the Brookings Institution of Washington, DC, the Internet is still too small of a factor in the U.S.'s $10 trillion economy to account for the increase in productivity.[6] This period of economic growth can be attributed to the globalization of business, as well as the full-scale introduction of computers in the workplace, which has boosted worker productivity. These two trends have forced businesses to restructure. How successful a business can compete and succeed under this new environment depends on how fast it can take advantage of new technologies and new markets.[7]

Much of the increase in productivity can be attributed to business investments for information-processing equipment and computer software. In nominal terms, these investments have grown from nine percent of total business investment in 1992 to 22 percent in 1999.[8] As a result of this investment, nonfarm labor productivity grew at an average annual rate of 2.5 percent between 1995 and 1999 as opposed to growing at average annual rate of 1.5 percent between 1973 and

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[2] Jonathan Rauch. "The New Old Economy: Oil, Computers, and the Reinvention of the Earth." *The Atlantic Monthly*, January 2001 (www.theatlantic.com/issues/2001/01/rauch.htm).

[3] Louis G. Tornatzky, Denis Gray, Stephanie A. Tarant, and Julie E. Howe. *Where Have All the Students Gone?: Interstate Migration of Recent Science and Engineering Graduates*, Southern Technology Council, February, 1998, p. 3.

[4] Ibid.

[5] Ibid.

[6] Jonathan Rauch. "The New Old Economy: Oil, Computers, and the Reinvention of the Earth," *The Atlantic Monthly*, January 2001 (www.theatlantic.com/issues/2001/01/rauch.htm.

[7] Stephen B. Shepard. "The New Economy: What It Really Means," *Businessweek*, November 17, 1997 (www, businessweek.com/1997/46/b3553084.htm).

[8] Barry P. Bosworth and Jack E. Triplett. "What is New About the New Economy? IT, Economic Growth, and Productivity," The Brookings Institution, revised December 2000, p. 2 (www.brook.edu/views/papers/bosworth/20001020.pdf).

1995.[9] Some of this gain in productivity can be attributed to an increase in the actual employee hours worked rather than an increase in productivity—from 1980 to 1997, the number of hours worked by US employees increased four percent.[10]

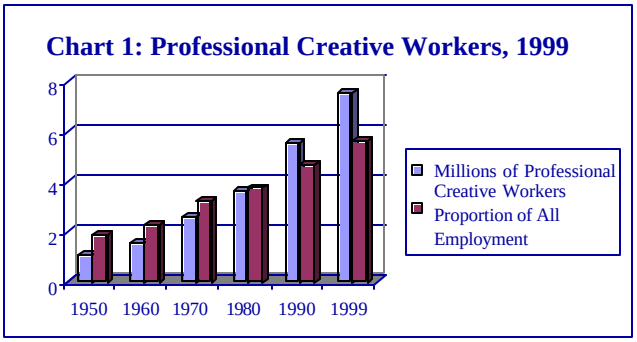
The investment by business in information-processing equipment and computer software outlays will require workers, who have little or no connection to development of new technologies, to develop the technical skills necessary to keep pace with information-technology software and hardware innovations. This requirement reflects the transformation of old economy businesses and jobs being affected by knowledge economy practices.

The recent collapse of the dot-com expansion, and the simultaneous slowdown in the value of technology stocks shows that the knowledge economy is not isolated from the business cycle, but that does not dampen the increasing demand for educated workers. The very nature of required basic employment skills is changing. Businesses, whether they are surviving high-tech startups or older, established companies adapting to meet the demands and expectations of their customers in the knowledge economy, are going to require more and more technologically sophisticated and well-educated employees.

Knowledge Economy Employment and Wage Trends

While the knowledge economy will change employment opportunities; it does not mean that overall employment opportunities will diminish. The Bureau of Labor Statistics (BLS) projects that by 2008, national employment will increase by 14 percent. While most of the employment growth is in occupations that do not require a postsecondary degree, occupations with higher educational requirements are growing faster than average, shifting employment toward occupations requiring more education and training.[11] These types of jobs are not all in what we consider high-technology industries. They are also the existing jobs in more traditional industries, jobs that are requiring more education and training as the workplace evolves.

Between 1969 and 1995, the number of jobs lost in the production and distribution of goods has been offset by increases in office jobs. Approximately 93 million American workers, who represent 80 percent of all jobs, do not spend their days making things.[12] For example, there are 7.6 million professional creative workers now employed. Of those workers, there are 2.3 million engineers and architects, 2.9 million scientists, and 2.4 million writers, designers, artists, and entertainers. These workers represented 5.7 percent of workers in 1999 (*see Chart 1*).

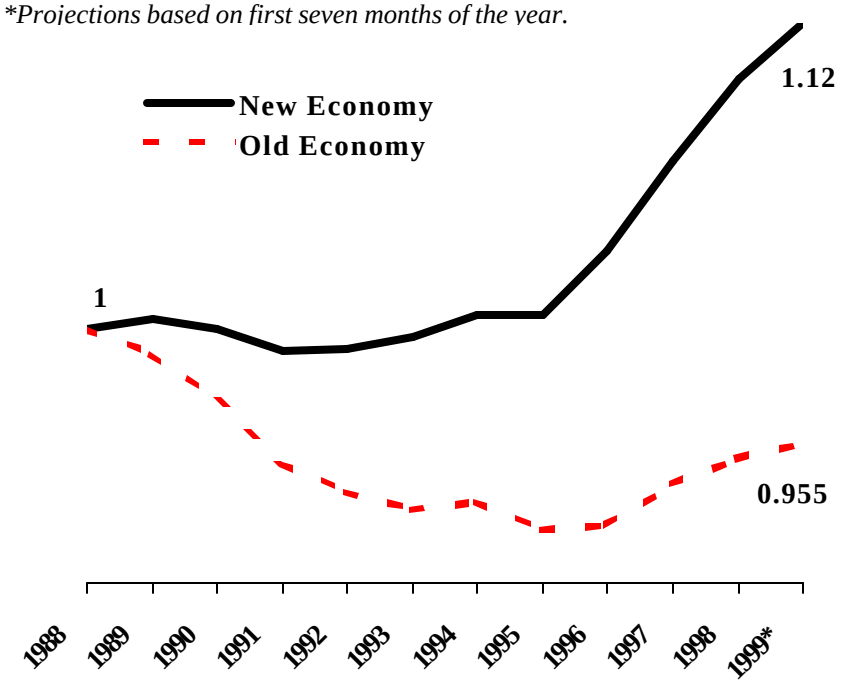


Source: Leonard Nakamura, "Economics and the New Economy." Philadelphia Federal Reserve Bank

[9] Ibid., Figure 4: Nonfarm Labor Productivity.
[10] Stephanie Nebehay. "Yankee Rat Race. The American Way: Longer Hours! More Productivity!" ABC News, September 6, 2000 (www.abcnews.go.com/sections/us/DailyNews/ilo_americans.html).
[11] Bureau of Labor Statistics, *Report on the American Workforce, 1999*, p. 63.
[12] PPI. Robert D. Atkinson, Ralph H. Court, and Joseph Ward. "The State New Economy Index: enchmarking Economic Transformation in the States." Progressive Policy Institute Technology and New Economy Project, July 1999 (www.neweconomyindex.org).

Chart 2: Index of Weekly Wages, Adjusted for Inflation

**Projections based on first seven months of the year.*



NEW ECONOMY
High-Tech
Equipment/Software
Computer Services
Financial
Services/Consulting
Communications/Media
Non-Store Retailing
Total Workforce: 19 million

OLD ECONOMY
Construction/Transportation
Utilities/All Other
Manufactures
Wholesale and Retailers
Personal Services/Health Care
Education
Total Workforce: 91 million

Source: *Business Week*, September 27, 1999

There is a widening gap in the growth of earnings between those employed in knowledge economy jobs and those who work in old economy jobs. This is shown in Chart 2, which compares wage growth in industries categorized by *Business Week* as belonging to the "new economy" versus more traditional "old economy" businesses. One reason for this disparity is that the new economy firms experienced faster job growth, higher productivity gains, and larger profit increases.[13] These firms have a high percentage of knowledge economy jobs. As a result, knowledge economy jobs have experienced faster wage gains than old economy jobs.

If this trend continues and if Tennessee lags in the number of knowledge economy jobs being created, the overall wage gains made by private sector employees will be less than in states that are either successful in attracting knowledge economy firms or already have a large knowledge economy job base. We not only need to catch up, we also need to be ready to adapt in an ever-evolving economy. We need to prepare our workforce to be ready for the next new thing—so we are always ahead.

Research, Venture Capital Link, and Industry Clusters

Over the last half-century, U.S. corporations have greatly increased their investments in research and development (R&D). Since 1953, research and development expenditures have more than doubled as a proportion of non-financial corporate GDP (from 1.3 to 2.9 percent). Tangible investment in plant and equipment as a proportion of non-financial corporate GDP was

[13] Michael J. Mandel. "The Prosperity Gap: The Economy is Booming, Profits Are Soaring – So Why isn't Everyone Riding High?" *Business Week*, September 27, 1999 (www.businessweek.com).

Table 1: R&D, Tangible Investment, and Advertising of Non-Financial Corporations (as a proportion of non-financial corporate gross domestic product)

Period	Research and Development (%)	Fixed Tangible Investment (%)	R&D and Tangible Investment (%)	Advertising Expenditures
1953-1959	1.3	12.6	13.9	4.2
1960-1969	1.7	12.7	14.4	3.9
1970-1979	1.8	13.9	15.7	3.4
1980-1989	2.3	14.1	16.4	3.9
1990-1997	2.9	12.6	15.5	4.1

Source: Leonard Nakamura, *"Intangibles: What Put the New in New Economy,"* Federal Reserve Bank of Philadelphia, July/August 1999.

no higher in the 1990s (12.6 percent) than in the 1950s and 1960s (12.7 percent) (*see Table 1*).[14]

The states that have been successful in attracting research and development investments have also been successful in attracting venture capital. Venture capital is an important indictor for state economic growth because it is largely responsible for the growth of high-tech businesses.[15] Venture capital allows businesses to augment the efforts of government research and development, taking research seeds and growing full-scale research hubs. These research hubs, focal points of collaborative or complementary public and private sector research and development, serve as the engines of successful new economies and are important in developing knowledge economy industry clusters.

Industry clusters are groupings of interdependent or linked businesses that develop where the businesses can benefit from shared pools of producers and suppliers, a workforce with similar skills, the adoption of similar technologies, or the exchange of knowledge and innovations.[16] By encouraging research and development and attracting venture capital a state can assist the development of industry clusters of high-tech businesses, and thus create attractive high-tech jobs for its citizens. Of course, the state must at the same time develop or attract a workforce to fill those jobs.

[14] Leonard Nakamura. "Intangibles: What Put the New in the new economy?" Federal Reserve Bank of Philadelphia, July/August 1999, p. 6.
[15] Edwin S. Mills. *Towards the Next Massachusetts Miracle: The Limits of Economic Development Programs*, Pioneer Institute for Public Policy Research, Boston, MA, 1997, pp. 87-88.
[16] Edward D. Feser and Henry Renski. *High-tech Clusters in North Carolina*, North Carolina Board of Science and Technology, 2000, p. 4.

Tennessee's Performance in the Knowledge Economy: Summary of Recent Studies on States and the Knowledge Economy

Several recent studies attempt to measure the overall performance of states under the knowledge economy. They provide comprehensive measures of the extent to which states have already developed to join the knowledge economy, using such measures as globalization and business vitality. Tennessee's performance lagged behind most of the nation in each of these measures.

Progressive Policy Institute: The State New Economy Index

The Progressive Policy Institute (PPI) is the policy research arm of the Democratic Leadership Council. Authors of the PPI's *State New Economy Index* report argue that the new economy is "a knowledge and idea-based economy where the keys to wealth and job creation are the extent to which ideas, innovation, and technology are embedded in all sectors of the economy."[17] This definition clearly fits the definition of a knowledge economy. The *State New Economy Index* compares the states on topics related to the knowledge economy's influence on education, economic conditions, and tax structure. The *State New Economy Index* shows that Tennessee lags behind other states in providing an environment conducive to knowledge economy growth. The PPI *Index* ranked Tennessee 31st overall and 45th in workforce education, (s*ee Table 2*). The PPI study established five primary categories and examined economic criteria for each. These categories are:[18]

1. **Knowledge jobs:** Separate indicators measure jobs in offices; jobs held by managers, professionals, and technicians; and the educational attainment of the workforce (Tennessee ranked 36th).
2. **Globalization:** Indicators measure the export orientation of manufacturing and foreign direct investment (Tennessee ranked 14th).
3. **Economic dynamism and competition:** Indicators measure the number of jobs in fast-growing "gazelle" companies (companies with sales growth of 20 percent or more for four straight years); the rate of economic "churn" (a product of new business start-ups and existing business failures); and the value of initial public stock offerings by companies

Table 2: Knowledge Economy Overall and Workforce Education Rank, Tennessee and other Southeastern States, 1999

	Overall Rank	Workforce Education
Tennessee	**31**	**45**
Alabama	44	44
Arkansas	49	48
Florida	20	30
Georgia	25	35
Kentucky	39	49
Louisiana	47	46
Mississippi	50	47
North Carolina	30	39
South Carolina	38	41
Virginia	12	13

Source: *The State New Economy Index*, Progressive Policy Institute.

[17] Robert D. Atkinson, Ralph H. Court, and Joseph Ward. "The State New Economy Index: Benchmarking Economic Transformation in the States." Progressive Policy Institute Technology and New Economy Project, July 1999 (www.neweconomyindex.org).

[18] Ibid.

(Tennessee ranked 23rd).

4. **The transformation to a digital economy:** Indicators measure the percentage of adults online; the number of ".com" domain name registrations; technology in schools; and the degree to which state and local governments use information technologies to deliver services (Tennessee ranked 24th).
5. **Technological innovation capacity:** Indicators measure the number of high-tech jobs; the number of scientists and engineers in the workforce; the number of patents issued; industry investment in research and development; and venture capital activity (Tennessee ranked 31st).

Corporation for Enterprise Development: Development Report Card

In the Development Report Card report, the Corporation for Enterprise Development (CFED) graded the states' business climates, examined economic indicators, and measured economic development strengths and successes. The CFED authors indicate that the framework for their report card is based upon the idea that the goal for state development policy is an improved well-being and standard of living for citizens.

The Development Report Card provides overall grades for each of the 50 states in the categories of:

- **performance**, which measures how well a state's economy is performing in providing a more widely shared and sustainable quality of life;
- **business vitality**, which measures the degree of dynamism of the small and large business communities in a state; and
- **development capacity**, which measures a state's capacity for future development.

The authors seek to measure how well the states' economies provide quality jobs with adequate earnings in each performance category. In order to determine business vitality grades, the authors examine the competitiveness of existing businesses as well as the innovations exhibited by entrepreneurs in the market. Finally, the authors consider development capacity through the examination of items related to human capital resources. Tennessee received a "C" in Performance, a "C" in Business Vitality, and a "C" in Development Capacity (s*ee Table 3*). [19]

The average grade in Development Capacity is alarming considering that this measure reflects that Tennessee, like most of the southeast region, is lacking in preparedness for adapting to the knowledge economy in two key areas, human resources and innovation assets. The Development Capacity measure used by the CFED evaluated each state's performance in the areas of

- Human Resources (Tennessee received an F)
  - Basic Educational Skills Proficiency
  - Average Teacher Salary
  - K-12 Education Expenditures
  - High School Graduation
  - High School Education Attainment
  - College Education Attainment

[19] The Corporation for Economic Development, *The 2000 Development Report Card For the States* (drc.cfed.org).

- Financial Resources (Tennessee received a B)
  - Commercial Bank Deposits
  - Loans to Deposits
  - Loans to Equity
  - Commercial and Industrial (C&I) Loans
  - Commercial and Industrial Loans to Total Loans
  - Venture Capital Investments
  - Small Business Investment Company (SBIC) Financing
  - Private Lending to Small Businesses

- Infrastructure Resources (Tennessee received an A)
  - Highway Deficiency
  - Bridge Deficiency
  - Urban Mass Transit Availability
  - Sewage Treatment Needs
  - Digital Infrastructure

- Amenity Resources and Natural Capital (Tennessee received a B)
  - Energy Costs
  - Urban Housing Costs
  - Health Professional Shortage Areas
  - Tourism Spending
  - Conversion of Cropland to Other Uses
  - Air Quality

- Innovation Assets (Tennessee received a D)
  - Ph.D. Scientists and Engineers in the Workforce
  - Science and Engineering Graduate Students
  - Computers in Households
  - University Research and Development
  - Federal Research and Development
  - Private Research and Development
  - Small Business Innovation Research (SBIR) Grants
  - Royalties and Licenses
  - Patents Issued
  - University Spin-outs[20]

Several of the same factors used in the CFED analysis of human resources and innovation assets are explored in the next chapter of this report.

State Policy Reports: The Camelot Index

The Camelot Index, developed by Hal Hovey of *State Policy Reports*, ranks states on various performance measures: economy, health, crime, education, social stability, and state management. The results of the indices are intended to indicate areas for contemplation or focus.

[20] Ibid.

Tennessee ranked 40th overall. Notably, Tennessee ranked 47th in the "Educated Population" component, the second lowest among the southeastern states. The "Educated Population" component measures drop out rates, standardized test performance, college admission rates, job placement rates for high school graduates, and public college affordability. Tennessee ranked the second highest among the southeastern states in the "Prudent Government" component. Most southeastern states received a high prudent government ranking (eight of the 11 states were among the top 25). This component evaluates states on their tax rates, bond rating, ability to balance their budget, and ability to provide public services without tax increases.[21]

Forbes' "Best Places to Do Business"

In a survey on business environments, *Forbes Magazine* found that the best places to do business are in areas that are defined as technology hubs and where the cost of business is low. The *Forbes'* study focused on the degree of change in business climates.[22] According to the survey, the Nashville Metropolitan Statistical Area (MSA) fell from 37th in the previous year to 54th. In the case of Nashville, the lack of job growth was one strong reason why Nashville's ranking went from 37th to 54th. Other Tennessee MSAs that were included in the survey were Chattanooga (94th), Memphis (102nd), Knoxville (163rd), and Johnson City (194th).[23]

In the southeast, North Carolina was the state with the most metropolitan areas in the top 25. Atlanta, GA was the highest-ranking southeastern metropolitan area. *Forbes'* ranked Atlanta second overall.

Table 3: Corporation for Enterprise Development Summary Indices, Tennessee and other Southeastern States, 2000

	Performance	Business Vitality	Development Capacity
Tennessee	**C**	**C**	**C**
Alabama	D	C	D
Arkansas	D	F	F
Florida	C	C	C
Georgia	C	B	C
Kentucky	D	C	D
Louisiana	F	D	F
Mississippi	F	D	F
North Carolina	D	B	C
South Carolina	C	C	F
Virginia	B	A	B

Source: Corporation for Enterprise Development

[21] *State Policy Reports*, "The Camelot Index," v. 18, i. 5, March 2000.
[22] Tim W. Ferguson and William Heuslien. "Best Places," *Forbes*, May 29, 2000 (www.forbes.com).
[23] Ibid.

Tennessee and the Requirements for a Successful Knowledge Economy

The reports in the last section demonstrated that Tennessee is not performing well in adapting to or preparing for the knowledge economy. The reason for this lackluster overall knowledge economy performance is Tennessee's lack of preparedness in the three key factors contributing to knowledge economy success: worker skills, education, and research and development. Although Tennessee has done well at helping employers create new jobs over the last decade, without addressing these factors, the state will not be able to attract sufficient high quality jobs, or adapt its workforce for the increasingly technical requirements of existing jobs.

Worker Skills: Tennessee's Labor Market Is Not Geared Towards High-tech.

High tech workers are an important component for success in the knowledge economy. They are vital for attracting high tech firms, and they indicate the relative skill level of the rest of the workforce. A high percentage of high tech workers indicates the presence of a large pool of educated and trained, or trainable, workers.

Tennessee does not have a large labor pool of high-tech workers. In 1998, Tennessee had the third lowest number of high-tech workers per 1,000 among the southeastern states (*see Table 4*). This ranking, prepared by the American Electronics Association, includes electrical and electronic engineers, industrial engineers, mechanical engineers, electrical and electronic engineering technicians, computer systems analysts, and computer programmers.[24]

Table 4: High-tech Employment, Tennessee and Other Southeastern States, 1998

	Workers Per 1,000 for 1998	Rank
Tennessee	**19.93**	**46**
Alabama	33.81	28
Arkansas	21.38	44
Florida	36.93	26
Georgia	46.07	20
Kentucky	24.32	38
Louisiana	14.83	51
Mississippi	17.81	49
North Carolina	40.01	23
South Carolina	21.76	41
Virginia	63.79	5
Total US*	**46.08**	

*Includes District of Columbia and Puerto Rico.

Source: American Electronics Association, *Cyberstates 4.0*

Education

Education Plays a Pivotal Role in Fostering Knowledge Economy Development

More serious than the problems associated with the low supply of technical workers are the problems regarding Tennessee's performance in providing and attracting educated workers for the state's economy. The Tennessee Department of Labor and Workforce Development estimates that by 2006 approximately 19 percent of all jobs in Tennessee will require a college

[24] American Electronics Association, *Cyberstates 4.0*, 2000, p. 14.

Table 5: Educational Attainment of Adults 25 Years of Age and Older, Tennessee and Border States, 1995-2000

State	March 1995		March 2000	
	% High School Graduate or More	% Completed Bachelor's or More	% High School Graduate or More	% Completed Bachelor's or More
Tennessee	**77.4%**	**17.8%**	**79.90%**	**22.00%**
Alabama	74.7%	17.3%	77.50%	20.40%
Arkansas	76.2%	14.2%	81.70%	18.40%
Georgia	78.2%	22.7%	82.60%	23.10%
Kentucky	76.7%	19.3%	78.70%	20.50%
Mississippi	76.4%	17.6%	80.30%	18.70%
Missouri	82.2%	21.9%	86.60%	26.20%
North Carolina	76.3%	20.6%	79.20%	23.20%
Virginia	82.7%	26.0%	86.60%	31.90%
Border State Avg.	**77.93%**	**19.95%**	**81.65%**	**22.80%**
United States	**81.7%**	**23.0%**	**84.10%**	**25.59%**

Source: *Current Population Survey*, Census Bureau, December 2000.

degree. The Department also estimates that 25 percent of all employment will require more education or skills training.[25] This reflects the fact that the entire economy is requiring higher educated employees, not just the jobs that we think of as high-tech jobs. The challenge that Tennessee faces is providing the human capital that can fulfill the demands of employers. In 2000, the percent of adults over the age of 25 in Tennessee that had completed high school and bachelor's degrees or higher was greater than it was in 1995. However, Tennessee has a lower base of high school and college graduates than the average of its border states and the U.S. average (*see Table 5*). The state ranks 46th in the number of high school graduates and 41st in the number of college graduates as a percent of the population 25 years of age and older.

Student Performance

In July 2000, the RAND Corporation of Santa Monica, California, released a report based on data from the National Assessment of Educational Progress, *Improving Student Achievement: What State NAEP Test Scores Tell Us*. The RAND study identifies and analyzes which state policies and programs account for the differences in achievement across states. The RAND study is important in that it isolates and analyzes the impact of differences that cannot be explained by demographics.[26] The study covers all seven state-level math and reading tests given between 1990 and 1996. The Tennessee Advisory Commission on Intergovernmental Relations has prepared a staff analysis of the implications for Tennessee found in the RAND study, *Rand Reports: Money Matters in Education, Depending on How It's Spent*, which is being released in conjunction with this report on the knowledge economy.

[25] Tennessee Department of Labor and Workforce Development. *Tennessee Job Outlook 1996-2006*, June 1999.

[26] David W. Grissmer, Ann Flanagan, Jennifer Kawata and Stephanie Williamson. *Improving Student Achievement: What State NAEP Test Scores Tell Us*, Santa Monica, CA: RAND, July 2000 (http://www.rand.org/publications/MR/MR924/).

Table 6. Unadjusted Achievement Rankings (Ranked Nationally) 1990 through 1996 National Assessment of Educational Progress and Achievement and Gains Adjusted for Socioeconomic Status, Tennessee and Border States

	Achievement Rank		Adjusted Gain Rank	
State	**Unadjusted**[27]	**Adjusted**[28]	**All Tests**[29]	**Math Only**[30]
Tennessee	**35**	**35**	**25**	**18** [a]
Alabama	41	40	20 [a]	22 [a]
Arkansas	39	37	28 [a]	21
Georgia	36	13	***36*** [b]	35
Kentucky	31	36	7 [a]	7 [a]
Mississippi	***44*** [b]	42	26 [a]	25
Missouri	19	10	33 [a]	30
North Carolina	34	23	***1***	***1***
Virginia	24	14	28 [a]	26

Notes: a. Tied. b. Lowest rank for year and subject.

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

The TACIR review of the RAND study found that Tennessee students participated in six of the seven NAEP tests, the only exception being the 1990 eighth-grade math test. As shown in Table 6, the RAND report ranked Tennessee 35th of 44 states for achievement before and after adjusting for demographic differences and 25th of 36 states for gains in achievement adjusted for differences in demographics and test participation rates—18th of 36 for gains in math.[31]

RAND's analysis indicates that Tennessee is gaining in both math and reading—improving scores and improving relative to other states. RAND based its analysis on NAEP math and reading tests given in 1990 through 1996. When reading and eighth grade writing were tested again in 1998, Tennessee's performance was mixed. It was much better for writing than for reading. Tennessee's fourth graders actually lost all of the ground they had gained in reading in terms of state rankings between 1992 and 1996.[32]

RAND's analysis of the cost-effectiveness of various education resource policies indicates that Tennessee is on the right track with the improvements brought about with the Basic Education Program, but it also suggests two specific options for improvement: teachers' resources and

[27] Grissmer, Table A.2, pp. 120-122. Numbers in both bold and italic type indicate highest and lowest ranking states.
[28] Ibid., Table 6.1, pp. 68-69.
[29] Ibid., Table 5.3, pp. 60-61.
[30] Ibid., Table 5.4, pp. 62-63.
[31] Ibid., Table A.2, pp. 120-122, Table 6.1, pp. 68-69, and Table 5.3, pp. 60-61. Forty-four states participated in a sufficient number of tests to be included in the analysis of achievement; 36 participated in a sufficient number to be included in the analysis of gains.
[32] Lynnisse Roehrich-Patrick and Harry Green. *Rand Reports: Money Matters in Education, Depending on How It's Spent*, TACIR, forthcoming, p. 15.

public pre-kindergarten.[33] These options will be discussed in the policy implications section of this report.

Retention of Educated Workers

In addition to the low educational attainment rates, the state faces the problem of retaining recent high school graduates and recent college science and engineering graduates and in encouraging qualified workers to migrate to Tennessee from other states. Tennessee has done slightly better than average in retaining graduates. However, the southeastern states, on average, have gained educated migrants at a considerably higher rate (*see Table 7*). Of particular note is that the US average state rate of gain in migrants with college science and engineering degrees is over fifty percent higher than Tennessee's rate of gain. The rates of retention and migration of most recent high school and engineering and science graduates for Tennessee compound the educated worker deficit caused by the state's already low base of high school and college graduates.

Table 7: Mean Retention and Migration Rates of High School Graduates and Recent Science and Engineering Graduates, 1997

	Degree	
	High School	Science and Engineering
Tennessee		
Retention	0.54	0.60
Migration	1.01	1.02
Southeastern States		
Retention	0.53	0.59
Migration	1.16	1.12
All US		
Retention	0.49	0.54
Migration	1.01	1.60
US minus Tennessee and Southeastern States		
Retention	0.46	0.52
Migration	0.97	1.74

A value < or =1 means that a state is gaining more graduates than losing. A value > or = 1 means that a state is losing more graduates than it is gaining

Source: Southeastern Technology Council.

Table 8: R&D Per Capita, Tennessee and Other Southeastern States, 1997[1]

	R&D Per Capita	Rank
Tennessee	**$292**	**36**
Alabama	$379	30
Arkansas	$108	50
Florida	$326	33
Georgia	$303	35
Kentucky	$134	47
Louisiana	$127	48
Mississippi	$135	46
North Carolina	$629	21
South Carolina	$277	37
Virginia	$614	22
US*	**$789**	

*Includes District of Columbia and Puerto Rico.
Source: *Cyberstates 4.0.* American Electronics Association,

[33] Ibid.

Research and Development

Tennessee's R& D Activity Is Mixed.

The most recent data on R&D spending per capita shows that Tennessee's performance is better than most southeastern states, but is behind the southeastern states that have a strong high-tech economic base: Florida, Georgia, North Carolina, and Virginia (*see Table 8*).

Higher education research serves as seed for further research and development. An important measure of the extent of higher education research is the amount of federal support a state's universities receive for research and development programs. Tennessee experienced the slowest rate of average growth among the southeastern states for this federal support for the period between 1990 and 1998. Furthermore, Tennessee was the only state of the six states that received 10 percent or more in federal research and development support in 1990 to receive less than 10 percent of the total distribution of the federal funding to the southeastern states in 1995 and 1998.

Aside from the decreasing distribution of federal support for research and development programs, the state must also face the prospect that federal support for non-defense research and development has been declining, from about 1 percent of GDP in the 1960s to less than half that percentage today (0.4 percent), and from 5.7 percent of the federal budget in 1965 to 1.9 percent in 1997.

Table 9. Federal Obligations for Research and Development for All Universities in Tennessee, Southeastern States and the Rest of the 50 States (in $000s), 1990-1998

State	1990		1995		1998		Annual Average Growth Rate
	Amount	Southeastern States Distribution	Amount	Southeastern States Distribution	Amount	Southeastern States Distribution	
Tennessee	**$133,724**	**10.3%**	**$174,888**	**9.2%**	**$185,764**	**8.3%**	**4.2%**
Alabama	$129,563	10.0%	$200,910	10.6%	$228,325	10.2%	7.3%
Arkansas	$23,537	1.8%	$38,585	2.0%	$46,840	2.1%	9.0%
Florida	$180,487	13.9%	$258,624	13.7%	$333,533	15.0%	8.0%
Georgia	$176,210	13.5%	$254,093	13.4%	$276,133	12.4%	5.8%
Kentucky	$38,098	2.9%	$62,595	3.3%	$73,265	3.3%	8.5%
Louisiana	$68,774	5.3%	$104,716	5.5%	$133,247	6.0%	8.6%
Mississippi	$36,134	2.8%	$48,750	2.6%	$74,649	3.3%	9.5%
North Carolina	$305,690	23.5%	$449,208	23.7%	$518,993	23.3%	6.8%
South Carolina	$42,668	3.3%	$72,810	3.8%	$114,629	5.1%	13.1%
Virginia	$166,017	12.8%	$228,276	12.1%	$244,426	11.0%	5.0%
Southeastern States Total	**$1,167,178**		**$1,718,567**		**$2,044,040**		**7.3%**
Rest of the 50 States Total	**$7,708,438**		**$10,287,404**		**$11,617,624**		**5.3%**

Source: Southeast Regional Educational Board (http://www.sreb.org/main/EdData/DataLibrary/highered/finance/finance.asp)

Table 10: Industry-University Technology Transfer Performance for Tennessee, 1995-96
Data Published July 1997

Category	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Patent applications per $10 million research expenditure	1	1	1	2
Patents per $10 million research expenditure		3		2
Active licenses per $10 million research expenditure	2		1	2
Royalty ROI (License income as a percent of annual research expenditure)		3		2
In-state Licenses as a percent of all active licenses	1		1	
Start-up Licenses as a percent of all active licenses			2	
In-state royalties as a percent of all royalty income	1		2	
Start-up companies formed per $10 million research expenditure	1	1	3	

Participating Institutions: Meharry University, St. Jude's Children Research Center, University of Memphis, University of Tennessee system, and Vanderbilt University.

Source: Southern Technology Council (www.southern.org)

Federal investments in research shrank at an average annual rate of 2.6 percent in constant dollars between 1987 and 1995. Between 1993 and 1997, federal support for basic and applied research fell by 12 percent as a share of GDP.[34] As federal support for research and development in relation to GDP diminishes, Tennessee must have new research support in place if the state is to maintain competitiveness.

University-technology transfer is another useful indicator for R&D activity because of its strong relationship with competitive research, leading to patents and licenses, and the growth of technology-driven businesses that has developed under the knowledge economy.[35] The presence of universities or institutes that are engaged in competitive research should not be seen as a substitute for a high concentration of research-intensive firms. However, university-community joint efforts to encourage business development has the potential to lead to more business start-ups, and greater business development.[36] Table 10 demonstrates Tennessee's recent experience in technology transfers from universities to industry, with a rate of five patents being approved per every $10 million in university research expenditures in 1995-96.

The southeastern states that have been successful in attracting federal research and development support have also been successful in attracting venture capital. Venture capital is an important indictor for state economic growth because venture capital is responsible for the growth of high-tech businesses. Investments in high technology are often seen as too risky to

[34] Atkison, (http://www.neweconomyindex.org/section3_page09.html).
[35] For more on this topic, please refer to the Southern Technology Council Internet site (www.southern.org).
[36] Ibid.

be supported by state subsidies alone.[37] Venture capital firms provide the early-stage capital needed by businesses that have high growth potential. A high availability of venture capital is seen as an indicator of a rapidly developing economy.[38]

Table 11. Rank Among the 50 States
Venture Capital Investment
Tennessee and the Other Southeastern States, 1995-2000

	2000	1999	1998	1997	1996	1995
Tennessee	**23**	**27**	**23**	**24**	**15**	**22**
Alabama	32	34	26	39	28	20
Arkansas	36	42	37	41	37	37
Florida	20	20	17	20	21	15
Georgia	14	10	13	16	17	24
Kentucky	27	22	29	41	35	26
Louisiana	39	26	36	41	37	33
Mississippi	43	38	39	32	37	37
North Carolina	11	13	12	30	8	25
South Carolina	29	33	20	11	11	13
Virginia	6	4	7	6	9	16

Source: Corporation for Enterprise Development

Table 11 shows that venture capital investments will follow the research and development activities taking place at universities and colleges. While Tennessee has been able to be among the top 25 states in attracting venture capital investments, most of the states that receive more research and development federal aid are ranked higher than Tennessee in the amount venture capital invested in their economy. If Tennessee cannot maintain or improve its current level of support for research and development, the state may face the prospect of having less venture capital flowing into state's economy.

[37] Mills, pp. 87-88.
[38] The Corporation for Economic Development.

The Creation of High-Tech Jobs

Although Tennessee has done well to date at attracting venture capital and at creating jobs, the state has not done well at creating the types of jobs required for knowledge economy success—high skill, high-tech jobs. Table 12 shows that from 1993-1998, Tennessee had the lowest rate of growth in the southeast for creating these high-tech jobs. Types of jobs included in Table 12 include jobs in high-tech manufacturing (computers, office equipment, communications equipment, etc.), communications services, and software and computer related services Tennessee grew high-tech jobs at a rate of 13 percent, compared to a national growth rate of 28 percent.[39]

Table 12: Percentage Growth in High-tech Jobs, Tennessee and Other Southeastern States, 1993-1998

	Employment % Change, 1993-1998	Rank
Tennessee	**13%**	**47**
Alabama	20%	35
Arkansas	29%	20
Florida	24%	28
Georgia	48%	9
Kentucky	25%	27
Louisiana	19%	37
Mississippi	23%	30
North Carolina	33%	17
South Carolina	14%	44
Virginia	42%	12
Total US*	**28%**	

*Includes District of Columbia and Puerto Rico.
Source: Cyberstates 4.0. American Electronics Association

[39] American Electronics Association, pp. 130-131.

Policy Implications

It is evident that if Tennessee is to take full advantage of the opportunities of the knowledge economy, the state must focus its efforts on improving its human capital through better worker skills and education, supporting research and development, and attracting high-quality jobs. Strategies to enact these improvements can be drawn from the efforts of other states, and from studies of best practices.

Human Capital

The businesses that succeed in the knowledge economy are those that use technology effectively, are flexible, and adapt quickly to changes in their business environment. In order to fit this profile, businesses require an educated, skilled, and technologically savvy workforce. States that wish to attract successful knowledge economy businesses are putting renewed emphasis on better educating children and on encouraging worker training and retraining, especially in technology skills.[40] While it is important to support both "first-chance" education (kindergarten through high school) and "second-chance" education (such programs as adult education and training and welfare to work), it is more efficient to emphasize the first over the latter. If the first-chance system is not good enough, Tennessee will face a never-ending struggle trying to catch up with the second-chance system.[41]

Education Benchmarks

Public Chapter 406 of 1999 created the Joint Select Committee on Business Taxes to review Tennessee's tax structure, receive testimony from the public, and make recommendations to the General Assembly. In its October 21, 1999 final report, the Joint Select Committee discussed benchmarks that the Committee felt are required to provide Tennessee with the educated population needed to succeed in today's economy. According to the Joint Select Committee

- **All children must be ready for first grade because a strong start is the key to success.** All children should have access to quality preschool programs that provide a solid foundation for learning. If adequate resources are not made available now, an entire generation will miss the opportunity to plan and pursue a successful future. In the long term, investments in early childhood education have the effect of reducing crime, reducing remedial education, reducing welfare, reducing the dropout rate and increasing productivity.
- **The school dropout rate must be reduced.** Without the benefit of a high school diploma, an adult's income will be half as much as the income of an adult with a diploma. Options and opportunities will be far less. Individuals without a high school diploma have a higher risk of entering the welfare rolls or entering prison.
- **Student performance on national assessments must improve.** Steps must be taken to improve curricula, raise standards and expectations and implement goals which are aimed at better preparing students for work and college.

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[40] *State Budget & Tax News*, "States Retool for the New Economy," Vol. 19, No. 21, Nov. 1, 2000, pp. 1-2.

[41] Cathleen Stasz, James Chiesa, and William Schwabe. *Education and the New Economy: A Policy Planning Exercise*, RAND, 1998, p. 29.

- **Teacher preparation and productivity must be improved and demonstrated by results.** Once the leadership of the state sets the direction and vision for K-12, local educators and administrators must establish levels of student achievement and performance measures. Higher expectations of students must be accompanied by higher expectations of teachers, administrators and parents.
- **Institutions of higher learning must set clear and measurable goals regarding accountability and effectiveness.** These benchmarks must include time to degree, mission evaluation, continuous program evaluation, articulation agreements and better coordination of resources and services.
- **Access to institutions of higher learning must be improved.** Tuition and fees must be affordable and state financial aid programs expanded. Options must be considered to provide unique academic programs through nontraditional means.
- **Higher education institutions must embrace the responsibility of partnering with state and local governments in producing an informed, skilled and knowledgeable workforce.** This partnership should extend to public-private initiatives that will harness the market energy of private enterprise and develop the research potential of our institutions of higher learning.
- **Higher education faculty must emphasize current technology skills for themselves and their students.** Faculty must become conversant in the methods of technology implementation in the classroom and must utilize technology at every opportunity. Classrooms and campuses should embrace a "culture of technology."
- **Higher education institutions should strive for national academic recognition.** Graduate programs should be structured to encourage the best students from around the nation to apply for admission. Faculty and physical resources of research institutions should be of the highest quality. Faculty of such institutions should be required to produce the highest quality results.[42]

Improve Elementary and Secondary Education

Tennessee needs to improve its quality of elementary and secondary education in order to prepare future workers for the knowledge economy. The Joint Select Committee's benchmarks for elementary and secondary education (K-12) provide a framework for needed improvements. However, in this time of budgetary limitations, it is prudent to emphasize policies that most efficiently use resources to improve performance. A recent RAND Corporation study discusses just such policies. The RAND study analyzed data from the National Assessment of Educational Progress. RAND identified and analyzed which state policies and programs account for the differences in achievement across states that cannot be explained by demographics. The RAND study evaluated the cost-effectiveness of different state education policies designed to improve student performance, including pupil-teacher ratios and expenditures; teachers' salaries, education and experience; the percentage of students in public pre-kindergarten programs; and the adequacy of teaching resources.[43]

RAND found that about 75 percent of the difference across states in average student performance test scores is attributable to differences in family characteristics, primarily socioeconomic status. However, for students with similar family characteristics, different state education policies can have a significant impact. According to RAND's report, the three most cost-effective education policies that states can adopt are

[42] *Final Report of the Joint Select Committee on Business Taxes*, October 21, 1999.
[43] Roehrich-Patrick and Green, p. i.

- for all states, regardless of socioeconomic status, providing teachers with more discretionary resources;
- for states with a disproportionate percentage of lower socioeconomic status students,
    - lowering pupil-teacher ratios in the lower grades to below the national average
    - expanding pre-kindergarten, and
    - providing teachers additional resources; and
- for states with average socioeconomic status, lowering pupil-teacher ratios in the lower grades to the national averages.

Using in-classroom teacher's aides is far less cost effective than any of these.[44]

Tennessee's Education Improvement Act, passed in 1992, provided for improvements in two of the three policy areas found by RAND to be most cost-effective. The Act required the implementation of a funding formula, the Basic Education Program (BEP), the hallmark of which was reducing class sizes at all grade levels. The BEP also explicitly funds classroom equipment, materials and supplies, and requires that $200 be allocated to each teacher to purchase instructional supplies. The new formula did not, however, provide for the other policy found by RAND to be one of the three most cost-effective: public pre-kindergarten. This may be the next best policy to implement. Based on the State Board of Education's Early Childhood Policy and the fiscal year 2000-01 Basic Education Program formula, serving all four-year-olds could cost as much as $300 million, which amounts to about $320 per pupil overall. Again based on RAND's work, a difference of this size corresponds to about a 3.5 percentile point improvement in achievement for states with middle of the range socioeconomic status. For a state in the lower range for socioeconomic status, the same increase in expenditures for pre-kindergarten corresponds to more than a nine percentile point increase in achievement.[45]

Another factor important for successful education is the basic health of the students. It is evident that children cannot learn if they are not well enough to attend school on a regular basis. Tennessee has shown commendable improvements in many health statistics related to children. The *Kids Count 2000* study by the Annie E. Casey Foundation shows that children in Tennessee are served better than the national average in two key health indicators, the percent of low-income children without health insurance in 1997 (18 percent in Tennessee compared to 25 percent nationally) and the percent of two-year olds who were immunized in 1998 (83 percent in Tennessee versus 81 percent nationally). The relatively low uninsured rate for low income children, attributable largely to the TennCare program, should be seen as an investment in improved basic education, as well as an investment in the overall quality of life of Tennessee's citizens.

Improve Higher Education

As discussed in the Select Joint Committee's Final Report, Tennessee can improve the quality of its higher education programs. Workforce demand for scientists, engineers and other highly skilled workers continues to increase as employers put ever more emphasis on investments in

[44] Ibid., pp. i-ii.
[45] Ibid., p. ii.

intellectual capital.[46] Hawaii has recently initiated two policies to improve higher education that could be emulated by Tennessee:

- Establish a program to provide scholarships to students pursuing education and training in science and technology.[47] This could serve as an incentive to retain technology students in state. These students could enhance the state's pool of high-tech workers. Tennessee already has experience in administering a scholarship incentive program for students pursuing education degrees. This program could be expanded to include science and technology students.
- Establish an interagency educational accountability work group to set statewide standards and improve the agencies' performance.[48] In Tennessee, this policy initiative could be used to develop an over-arching education strategy for the Tennessee Higher Education Commission and the Tennessee Department of Education. This workgroup could also incorporate the workforce development goals of various Tennessee agencies.

Maintain Emphasis on Worker Training and Retraining

Tennessee's *Statewide Strategic Plan, 2001-2003* places emphasis on worker training and retraining. It recognizes that "Increasing economic opportunities through education, infrastructure and commonsense regulation increases the quality of life for all Tennesseans." The *Strategic Plan* lists several sub-goals supporting the overall goal of supporting economic opportunity. These sub-goals include several concerned with worker training and retraining

- increase the number of people obtaining employment by means of the federal Workforce Investment Act,
- increase the number of people obtaining a training or education credential,
- address language barriers in the workplace,
- develop public and private partnerships to support training needs,
- provide technology training for people with limited access, and
- increase reading awareness through partnerships between local businesses and schools.

The *Strategic Plan* identifies several objective measures of the success the state should realize from meeting these goals:

- number of jobs secured and retained,
- annual capital investment,
- annual job growth,
- unemployment rate,
- per capital wages, and
- Tennessee's national rank in new companies.

It is admirable that Tennessee has identified objective measures of success regarding the creation of new jobs. However, it is more efficient to place emphasis on attracting jobs that best

[46] *State Budget & Tax News*, p. 2.
[47] Ibid., p. 4.
[48] Ibid.

support success in the knowledge economy. Targeting knowledge economy jobs will be addressed later in this section.

Tennessee is not the only state focusing on employment training. For example,

- Hawaii has extended its employment and training fund to 2003 in order to retrain unemployed workers and fund training programs addressing occupations facing worker shortages;[49]

- Kentucky has established a fund to support high-tech training programs, particularly those in rural areas.[50]

Tennessee's workforce development efforts are built upon the groundwork of the federal Workforce Investment Act. The federal planning guidance for the Workforce Investment Act acknowledges that

> *The dynamic nature of the global economy requires forward thinking and quick action to take advantage of the opportunities being created. Workers and employers must be increasingly informed about available and emerging employment and training options in order to make decisions that will ensure both their short- and long-term success.*[51]

Key principles of the Workforce Investment Act are

- streamlining services through the integration of multiple employment and training programs at the "street level" through One-Stop service centers;
- empowering individuals with the information and resources they need to manage their own careers through Individual Training Accounts;
- better statistics on the performance of service providers and the skills demanded by employers;
- universal access for all job seekers to a core set of career decision-making and job search tools;
- increased accountability of the delivery system to achieve improved results in job placement, earnings, retention in unsubsidized employment, skill gains, and occupational/academic credentials earned;
- strong role for local boards and the private sector by shifting emphasis from "nitty-gritty" operational details to strategic planning and oversight of the One-Stop delivery system;
- state and local flexibility to ensure that delivery systems are responsive to the needs of local employers and individual communities; and
- improved youth programs that strengthen linkages between academic and occupational learning and other youth development activities.[52]

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[49] Ibid.
[50] Ibid., p. 6.
[51] U.S. Department of Labor, Employment and Training Administration, *Planning Guidance and Instructions for Submission of the Strategic Five-Year State Plan for Title I of the Workforce Investment Act of 1998 (Workforce Investment Systems) and the Wagner-Peyser Act,* Washington, D.C., February 1999.
[52] Ibid.

Research and Development

Tennessee's performance in research and development is better than most southeastern states, but is behind the southeastern states that have a strong high-tech economic base: Florida, Georgia, North Carolina, and Virginia. Innovation is a key component of knowledge economy success. This innovation is not just about the work of the high-growth, high-tech companies that we often think of when we think knowledge economy—innovation is also required in the Old Economy firms that are adapting their processes to meet the demands and potential of the knowledge economy. Innovation relies on a steady stream of research and development.

Competitive knowledge economy states are ensuring that they have an adequate high-tech infrastructure in place, and they are establishing incentives to help firms along in their research and development efforts. These states see research and development, coupled with an adequate high-tech infrastructure, as platforms for knowledge economy growth. They are seeking ways to transfer the benefits resulting from university research into the marketplace.[53]

Tennessee is using a public-private partnership to establish a technology seed fund to encourage the growth of early stage technology companies. The fund, named TennesSeed Fund1 (TF1) is being established as a Small Business Investment Company (SBIC) with the Small Business Administration (SBA) providing matching funds of approximately $2 for each $1 invested in the fund. The state will use the TF1 to establish an investment pool for technology companies in excess of $40 million. The typical investment will be in the range of $500,000 with follow on co-investments up to a total of $2 million. The TF1 will invest in technologies related to

- Information Technology,
- Biotechnology,
- Materials Processing,
- Communications, and
- Internet Technology.[54]

The TF1 will rely upon the development of an extended network of venture capital firms that will be actively developed to support future rounds of investment in portfolio companies. Business incubators in Chattanooga, Oak Ridge, Nashville, Memphis (planned) and Johnson City (planned) will be informally linked to TF1, providing deal flow, mentoring and growth opportunities throughout the region.[55]

Tennessee may be able to complement the efforts of the TF1 initiative using policy examples from Kentucky and Hawaii:

- Hawaii has increased the state's high-tech research tax credit to match the 20 percent federal income credit for qualified research expenses.

[53] *State Budget & Tax News*, p. 2.

[54] Tennessee Technology Development Corporation, (http://www.tennesseetechnology.org/tf1/about.html).

[55] Ibid.

- When an individual investor contributes a minimum of $1,000 in venture capital to a Hawaii business, the gain on their contributions is not taxed.

- Kentucky has a research and development voucher program to provide matching state funds to small and medium-sized companies who conduct research with a Kentucky university.

- Kentucky appropriated $350,000 to help manufacturers develop new product lines and manufacturing methods.[56]

In addition to private sector research initiatives, Tennessee should consider aggressively supporting research and development at its universities, particularly in light of decreasing federal support for this research. Public university research, in conjunction with private sector research, helps to create the high level of innovation needed to develop knowledge economy industry clusters. Tennessee cannot hope to develop top tier industry clusters until it establishes that it is willing to make the necessary investments in higher education research facilities.

Additionally, an adequate high-tech infrastructure is necessary to support research and development, as well as the operations of knowledge economy firms. The Tennessee Advisory Commission on Intergovernmental Relations is assisting local governments in Tennessee by cataloging their high-tech infrastructure needs and reporting those needs to the General Assembly and other policy makers.

Targeted Economic Development

In the fast-paced, competitive knowledge economy environment, businesses are most concerned with the availability of the components required to succeed: a skilled and educated workforce, an adequate technology infrastructure, the existence of other businesses to establish industry clusters with, and the availability of venture capital. These businesses are less motivated by the Old Economy criteria of tax incentives and closeness to raw materials. States focusing on knowledge economy success are adapting their economic development approaches to mirror this change in priorities.[57]

Tennessee did well at attracting jobs in the 1990s. Employment in Tennessee grew at over 11 percent during that period.[58] However, Tennessee did not do so well at attracting high-tech jobs. From 1993-1998, high-tech jobs in Tennessee grew by 13 percent. This would seem to be impressive compared to total job growth, but it pales in comparison to the national high-tech job growth rate of 28 percent, or the rate of high-tech job growth in some of Tennessee's border states (i.e. Georgia - 48 percent, Virginia - 42 percent, or North Carolina - 33 percent).

Tennessee offers a competitive package of tax incentives to businesses seeking to expand or locate in the state. These incentives likely helped create the job growth the state has experienced. However, the state could benefit from focusing on incentives for specific types of job creation. The state is already heading in the right direction by establishing seed funds for the creation of high-tech firms. The state could augment that initiative by focusing other

[56] Ibid., pp. 4-6.
[57] Ibid., p. 2.
[58] Tennessee Department of Labor and Workforce Development.

economic development programs on attracting high quality jobs. The driving principle could not be merely the number of jobs created by the state's economic development initiatives, but also the quality of those jobs.

Targeted incentives will only go so far, however. The state has to demonstrate to the firms driving the knowledge economy that Tennessee is truly committed to providing a quality workforce and an attractive quality of life.

Conclusion

A highly skilled and educated workforce is essential for success in the knowledge economy. Because of the low percent of adults in Tennessee with high school and college degrees, the state has a limited supply of workers able to fulfill the occupational demands of knowledge economy firms. Furthermore, workers with the necessary academic and skills backgrounds are not migrating to Tennessee as much as they are to the rest of the southeastern states. Tennessee must address this shortfall if it is to be truly successful in the knowledge economy.

Additionally, the state can improve its performance in the knowledge economy by supporting public and private sector research and development and by targeting its economic development efforts towards attracting high quality jobs.

Appendix 1: Tennessee's PPI *New Economy Index* Scores and Rankings

	Rank	Score
Overall	**31**	**45.14**
Aggregated Knowledge Jobs Scores	**36**	**4.75**
Office Jobs *Jobs in offices as a share of the total number of jobs in each state.*	19	18.80%
Managerial, Professional, and Technical Jobs *Managers, professionals, and technicians as a share of the total workforce.*	27	23.80%
Workforce Education *A weighted measure of the educational attainment of the workforce (advanced degrees, bachelor's degrees, associate's degrees, or some college course work).*	45	47.65%
Aggregated Globalization Scores	**14**	**6.61**
Export Focus of Manufacturing *The share of jobs in manufacturing companies dependent upon exports.*	32	15.70%
Foreign Direct Investment *The percentage of each state's workforce employed by foreign companies.*	8	5.10%
Aggregated Economic Dynamism Scores	**23**	**6.2**
"Gazelle" Jobs *Jobs in gazelle companies (companies with annual sales revenue that has grown 20 percent or more for four straight years) as a share of total employment.*	14	14.80%
Job Churning *The number of new start-ups and business failures, combined, as a share of all companies in each state.*	17	2.70%
Initial Public Offerings *The value of the initial public stock offerings of companies as a share of gross state product.*	39	0.07%
Aggregated Digital Economy Scores	**24**	**6.01**
Online Population *The percentage of adults with Internet access in each state.*	26	31%
Commercial Internet Domain Names *The number of commercial Internet domain names (".com") per firm.*	33	0.17%
Technology in Schools *A weighted measure of the percentage of classrooms wired for the Internet, teachers with technology training, and schools with more than 50 percent of teachers having school-based e-mail accounts.*	20	2.34%

Appendix 1 continued

Digital Government *A measure of the utilization of digital technologies in state governments.*	20	63.70%
Aggregated Innovation Capacity Scores	**31**	**4.64**
High-Tech Jobs *Jobs in high-tech electronics manufacturing, software and computer-related services, and telecommunications as a share of total employment.*	42	1.90%
Scientists and Engineers *Civilian scientists and engineers as a percentage of the workforce.*	29	0.35%
Patents *The number of patents issued to companies or individuals per 1,000 workers.*	34	0.25%
Industry Investment in R&D *Private sector investment in research and development as a share of Gross State Product.*	34	0.70%
Venture Capital *Venture capital invested as a percentage of Gross State Product.*	6	0.18%

Source: *Progressive Policy Institute* (www.neweconomyindex.org)

Appendix 2: 10 Industries With the Fastest Wage & Salary Employment Growth for the Nation (000): 1998-08

	1998	2008	Growth	Change
Computer and data processing services	1,599	3,472	1,872	117.1%
Health services, not elsewhere classified	1,209	2,018	809	66.9%
Residential care	747	1,171	424	56.8%
Management and public relations	1,034	1,500	466	45.1%
Personnel supply services	3,230	4,623	1,393	43.1%
Miscellaneous equipment rental and leasing	258	369	111	43.0%
Museums, botanical and zoological gardens	93	131	39	40.9%
Research and testing services	614	861	247	40.2%
Miscellaneous transportation services	236	329	94	39.4%
Security and commodity brokers	645	900	255	39.5%

10 Occupations With the Largest Job Growth (000): 1998-08

	1998	2008	Growth	% Change
Systems analysts	617	1,194	577	93.5%
Retail salespersons	4,056	4,620	564	13.9%
Cashiers	3,198	3,754	556	17.4%
General managers and top executives	3,362	3,913	551	16.4%
Truck drivers	2,970	3,463	493	16.6%
Office clerks	3,021	3,484	463	15.3%
Registered nurses	2,079	2,530	451	21.7%
Computer support specialists	429	869	440	102.6%
Personal care and home health aides	746	1,179	433	58.0%
Teacher assistants	1,192	1,567	375	31.5%

10 Occupations With the Fastest Rate of Job Growth (000): 1998-08

	1998	2008	Growth	Change
Computer engineers	299	622	323	108.0%
Computer support specialists	429	869	440	102.6%
Systems analysts	617	1,194	577	93.5%
Database administrators	87	155	68	78.2%
Desktop publishing specialists	26	44	18	69.2%
Paralegals and legal assistants	136	220	84	61.8%
Personal care and home health aides	746	1,179	433	58.0%
Medical assistants	252	398	146	57.9%
Social and human service assistants	268	410	142	53.0%
Physician assistants	66	98	32	48.5%

Source: *Bureau of Labor Statistics*

Glossary

This glossary is included to provide the reader with a reference source for some of the terms, phrases, and buzzwords used in discussions of the new economy and the knowledge economy. Not all of the words and phrases defined here are discussed in this report, but they are all fairly common in the popular press and finance periodicals.

Angel Investor - A financial backer providing venture capital funds for small startups or entrepreneurs.

Big Mac Index - Invented by the London-based magazine *The Economist*, the Big Mac Index uses an edible icon of globalization as a kind of new economy gold standard. Its basis is the price of the signature McDonald's hamburger, converted into US dollars. Because the fast-food giant's production methods and pricing policies are standardized worldwide, the operating assumption is that month-to-month price differences from country to country reflect local currencies getting out of whack with fundamental costs and economic efficiencies.

Brick and Mortar - A traditional "street-side" business that deals with its customers face-to-face in an office or store that the business owns or rents.

Burn Rate - The rate at which a new company uses up its venture capital to finance overhead before generating positive cash flow from operations. It is the rate of negative cash flow, usually quoted as a monthly rate.

Churn - Ever faster innovation that produces more possibilities for customers to decide they don't really like your product after all - or to realize that someone else has a cheaper, faster, or better version. And the new economy's ever more efficient markets make it less costly - in money, time, or both - for consumers to make the move.

Contract Worker - A worker employed by an organization for an agreed-upon period of time, usually to contribute to specific short-term projects. When the work period ends, a contract worker looks for other temporary work opportunities with other organizations. This arrangement can allow workers to have diversity in their careers and help them gain work experience.

Data Mining - The combination of fast computers, cheap storage, and better communication makes it easier by the day to tease useful information out of everything from supermarket buying patterns to credit histories.

Drive-By-Deal - Slang referring to a deal in which a venture capitalist invests in a startup with the goal of a quick exit strategy. The venture capital investor takes little or no role in the management and monitoring of the startup.

Dot.com - This is a company that embraces the Internet as the key component in its business.

Electronic Commerce (E-commerce) - When a person or business conducts all or some of their operations on-line (on the Internet).

Exit Strategy - The way that a venture capitalist or business owner intends to get out of an investment that he/she has made. Also referred to as a "harvest strategy".

Entrepreneur - A person who creates employment opportunities for himself/herself by launching businesses or developing new work possibilities.

Global Economy - A new economic arrangement that consists of countries around the world investing money and resources into other countries, forming one large economic system. This means the economies of all countries are linked, so they all rely heavily on the success of the other to prosper. Developments in technology have made it easier for countries to do business with each other.

Information and Technology (IT) - A broad term used to describe all aspects of collecting, processing, storing, managing, retrieving and transmitting data and information. Managing these processes usually involves electronic and digital tools such as computers, software products and telecommunications services. Large companies and organizations often refer to their computing and network or telecom departments as IT departments.

Intangible Assets - In most industries, research, expertise, and the knowledge of how to do things make up an increasing share of a company's value. These assets typically are missing from the audited figures that supposedly show how much a company is worth.

Intellectual Capital - The working knowledge that people carry in their heads - knowledge of products, customers, how to work together, and so on - are a company's intellectual capital.

Intellectual Property - patents, copyrights, and trademarks - is an intangible asset that can be bought and sold.

Internet Service Provider (ISP) - An entity that provides consumers and corporations with various services such as access to the Internet.

Just-In-Time Education - It delivers the right tools and parts when people need them. Instead of spending time in the classroom, people can use networks and clever databases to answer questions and solve problems as they crop up.

Knowledge Economy – The developing economy based upon the production and application of knowledge rather than the production of physical goods. The use of the phrase Knowledge Economy reduces the emphasis on high technology and dot.com firms implied by the common usage of the phrase New Economy. Rather, the emphasis is on the realization that the entire economy is evolving, and that even jobs in traditional industrial economy firms are becoming more technical.

Knowledge Worker – Workers who earn their livings by making decisions and manipulating information, rather than by manufacturing products.

Labor Market Information (LMI) - Information and data, such as the supply and demand for jobs, salaries and industry growth, within a particular labor market. LMI allows workers to understand the world around them and helps them find out where work opportunities exist.

New Economy - Buzzword describing the new, high growth industries which are on the cutting edge of technology and are the driving force of economic growth. This definition does not adequately address the fundamental changes occurring in the economy. See Knowledge Economy.

Non-Standard Labor Force - A term explaining changes that have taken place in the traditional workplace. In the past, most workers had full-time and part-time positions. The labor force now consists of a large number of workers employed in new working arrangements such as contract work, and entrepreneurship.

Outsourcing- Many companies are trying to focus on doing only what they absolutely need to - the core competencies that bring the highest rates of return. Thus, more companies are turning to outside suppliers for the components that make up their products

Restructuring - During the 1980s, corporate America realized that installing computers to automate the status quo meant they didn't need to do things the "old way" anymore. Out went systems designed around the limitations of paper; in came new ones designed around the freedoms of computers. Sequential processes, with workers pushing forms from department to department, became parallel ones, with workers sharing information stored in electronic databases. Companies decentralized, even broke themselves up into smaller, better-focused pieces.

Training (Education) - Acquiring the skills necessary to do a specific job - is commonly believed to be the most important form of investment in an information economy. Training, or education, allows people to manage their own ability to acquire and use knowledge - and, thus, to manage their own careers and lives.

Venture Capital - Money or funds made available for startup firms and small businesses with exceptional growth potential. Managerial and technical expertise is often also provided. Investors receive a say in the management of the company as well as equity.

Sources:

British Columbia *WorkinfoNet* (http://workinfonet.bc.ca/youth/mindgallery/glossary.cfm)
Investopedia.com (http://www.investopedia.com/categories/neweconomy.asp)
Encyclopedia of the New Economy (http://hotwired.lycos.com/special/ene/index.html)

Bibliography

American Electronic Association. *Cyberstates 4.0.*

Atkinson, Robert D., Court, Ralph H., and Ward, Joseph. "The State New Economy Index: Benchmarking Economic Transformation in the States." Progressive Policy Institute Technology and New Economy Project, July 1999 (www.neweconomyindex.org).

Bosworth, Barry P. and Triplett, Jack E. "What is New About the New Economy? IT, Economic Growth, and Productivity," The Brookings Institution, revised December 2000, (www.brook.edu/views/papers/bosworth/20001020.pdf).

Bureau of Labor Statistics. Report on the American Workforce, 1999.

The Corporation for Economic Development. *The 1999 Development Report Card: A New Index for the Changing Field of Economic Development* (www.cfed.org).

The Economist. "Waiting for the New Economy." October 25, 2000. (www.economist.com).

Federal Reserve Bank of Dallas. "What's New About the New Economy," *Southwest Economy.* July/August 1998.

Ferguson, Tim W. and Heuslien, William. "Best Places." *Forbes*, May 29, 2000. (www.forbes.com).

Feser, Edward D. and Renski, Henry. *High-tech Clusters in North Carolina*, North Carolina Board of Science and Technology, 2000.

Grissmer, David W., Flanagan, Ann, Kawata, Jennifer, and Williamson, Stephanie. *Improving Student Achievement: What State NAEP Test Scores Tell Us*, Santa Monica, CA: RAND, July 2000 (http://www.rand.org/publications/MR/MR924/).

Kelison Jonathan W. and Tate, Patricia. "The 1998-2008 Job Outlook in Brief." *Occupational Outlook Quarterly*, Spring 2000.

Mandel, Michael J. "The Prosperity Gap: The Economy is Booming, Profits Are Soaring – So Why isn't Everyone Riding High?" *Business Week*, September 27, 1999 (www.businessweek.com).

Mills, Edwin S. *Towards the Next Massachusetts Miracle: The Limits of Economic Development Programs*, Pioneer Institute for Public Policy Research, Boston, MA, 1997.

Nakamura, Leonard. "Economics and the New Economy: The Invisible Hand Meets Creative Destruction." Philadelphia Federal Reserve Bank. July/August 2000.
_____."Intangibles: What Put the New in the New Economy." Federal Reserve Bank of Philadelphia, July/August 1999.

Nebehay, Stephanie. "Yankee Rat Race. The American Way: Longer Hours! More Productivity!" ABC News, September 6, 2000 (www.abcnews.go.com/sections/us/DailyNews/ilo_americans.html).

Rauch, Jonathan. "The New Old Economy: Oil Computers and the Reinvention of the Earth," *The Atlantic Monthly*, January 2001 (www.theatlantic.com/issues/2001/01/rauch.htm).

Roehrich-Patrick, Lynnisse and Green, Harry. *Rand Reports: Money Matters in Education, Depending on How It's Spent,* TACIR, forthcoming.

Shepard, Stephen B.. "The New Economy: What It Really Means," *Businessweek*, November 17, 1997 (www, businessweek.com/1997/46/b3553084.htm).

Southern Growth Policy Board. *The Final Report of the 1998 Commission the Future of the South, Southern Connections: Connecting with Each Other, Connecting with the Future*. (www.southern.org).

State Budget & Tax News, "States Retool for the New Economy," Vol. 19, No. 21, Nov. 1, 2000.

State Policy Reports. "The Camelot Index." March 2000. v. 18, i. 5.

Stasz, Cathleen, Chiesa, James, and Schwabe, William. *Education and the New Economy: A Policy Planning Exercise*, RAND, 1998.

Tennessee Department of Labor and Workforce Development. *Tennessee Job Outlook, 1996-2006.* June 1999.

Tennessee Technology Development Corporation, (http://www.tennesseetechnology.org/tf1/about.html).

Tornatzky, Louis G., Gray, Denis, Tarant, Stephanie, and Howe, Julie. "Where Have All the Students Gone? Interstate Migration of Recent Science and Engineering Graduates." Southern Technology Council, February 1998.

U.S. Department of Labor, Employment and Training Administration, *Planning Guidance and Instructions for Submission of the Strategic Five-Year State Plan for Title I of the Workforce Investment Act of 1998 (Workforce Investment Systems) and the Wagner-Peyser Act*, Washington, D.C., February 1999.

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