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California's Position in Technology and Science 2010

Kevin Klowden and Candice Flor Hynek
with Benjamin Yeo

Milken Institute

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For more information

The full report, complete citations, and an interactive website with data for each state can be found at **www.milkeninstitute.org.**

Acknowledgement

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financial capital: innovations that allocate financial resources efficiently, especially to those who ordinarily would not have access to them, but who can best use them to build companies, create jobs, accelerate life-saving medical research, and solve long-standing social and economic problems; and
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Contents

Executive Summary

This report provides an in-depth examination on California's opportunities and challenges in the increasingly competitive area of science, technology and knowledge-based industries. A complement to the national version of the State Technology and Science Index, this study provides key stakeholders in California with direct evidence of how the state is faring in the sectors of the economy that are most likely to impact the state's future economic position. It addresses not only the state's strengths but also looming concerns about its future competitiveness.

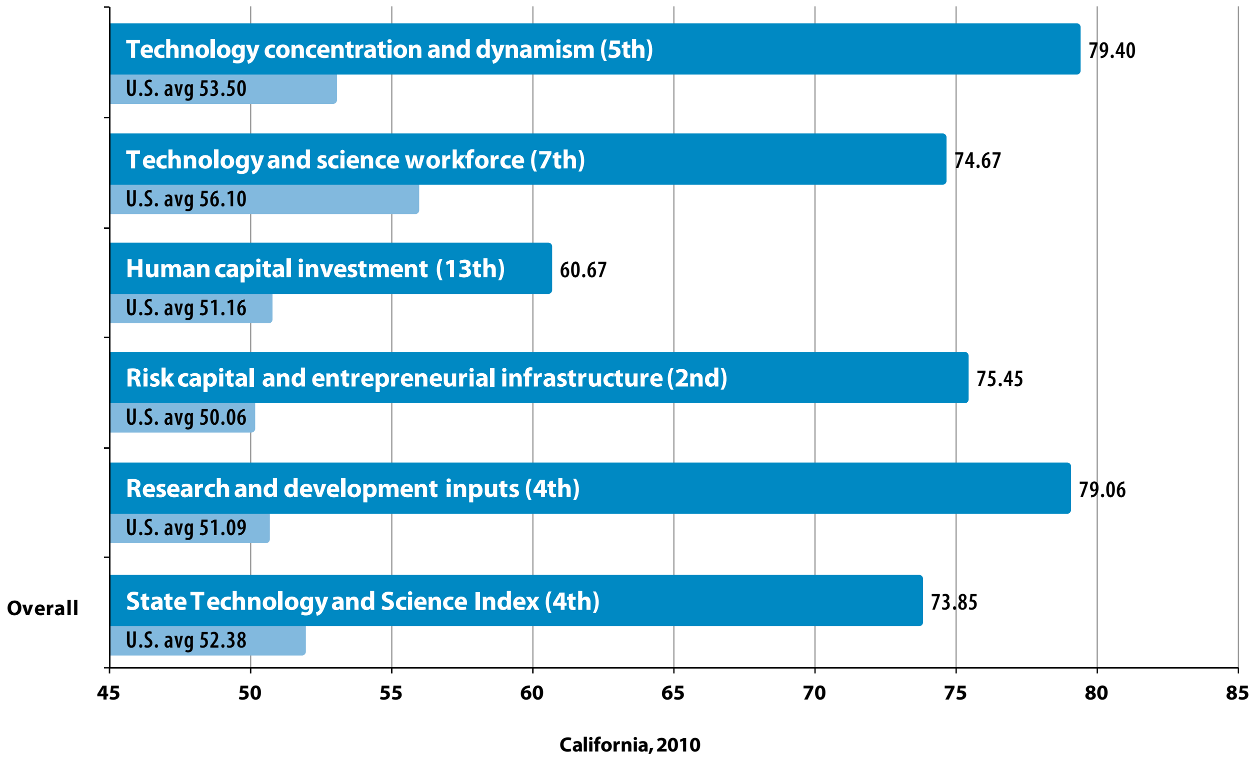
The broad State Technology and Science Index is based on five composite indexes, which are created using 79 different indicators. Below is a summary of California's performance in the broader index and the composite indexes, with more detail in the pages that follow.

- In the overall **State Technology and Science Index**, California held its ground at fourth with a score of 73.85. But the gap between California and top-ranked Massachusetts continued to grow to a difference of almost nine points.
- California slid to fourth in the **Research and Development Inputs Composite Index**. The state's composite score has declined from a peak of 80.3 in 2004 to 80.12 in 2008 and 79.06 in 2010. Its ranking has also slipped from second in 2004 and third in 2008.
- California ceded the top ranking in the **Risk Capital and Entrepreneurial Infrastructure Composite Index** to Massachusetts, settling back into second place. California's score dropped six points from 81.27 to 75.45.
- California maintained a modest 13th position in the **Human Capital Investments Composite Index**, though its score declined from 64.10 to 60.67.
- California slipped one spot to seventh in the **Technology and Science Workforce Composite Index**, although its score declined only slightly from 75.00 to 74.67.
- **Technology Concentration and Dynamism** provided a bright spot as California gained ground in both score and ranking. The state climbed to fifth from seventh in 2008, and its score improved to 79.40 from 72.60.

Analyzing the Five Composite Components

The analysis that follows is based on juxtaposing California's performance to that of other leading states. The full report includes a brief description of each individual indicator, why it is important, and how California performed compared to its peers.

California's performance in the State Technology and Science Index



Research and Development Inputs Composite Index

The Research and Development Inputs Composite Index measures each state's R&D and innovation capacities—the building blocks of technology-based economic development. The composite gauges a state's ability to attract various types of federal, industry, and academic funding.

Since peaking at second in this composite in the 2004 index, California has continued its descent, slipping to fourth in 2010, behind New Hampshire, Maryland, and first-place Massachusetts. California's score fell more than a point to 79.06, far behind Massachusetts' tally of 93.15. (A perfect score of 100 requires a state to score first in each of the individual components that make up the five composite indexes.)

California's rankings remained relatively steady across the various components, placing in the top half in all but one indicator and in the top 10 in nine components. It maintained a top five ranking in industry R&D funding, and improved its positions in federal R&D funding (sixth vs. eighth in 2008) and academic R&D funding (18th vs. 19th in 2008). But academic R&D remains a concern, especially when California is compared to first-place Maryland and second-place Massachusetts, which clearly utilize their universities for research at a much higher level than California does.

Looking at the bigger picture, California's ranking declined in nine of the 18 different indicators that make up the R&D Composite Index, the most significant of which was a fall to 23rd in R&D expenditures in engineering from 19th in the 2008 index. Although NSF research funding had a larger decline (from 12th to 20th), the consistent deterioration in R&D expenditures in engineering may be more significant because it is so important to the high-tech sector and has long-term implications. In fact, the state's ranking in engineering R&D has declined every year since debuting at 12th in 2002. Much of California's high-technology and knowledge-based industries—from

Silicon Valley's computing firms to Los Angeles' satellite and rocket technology companies—continue to be connected to engineering research. Many of these firms have shifted not only manufacturing but also research to lower-cost states such as Oregon, Arizona, and Colorado.

Research and Development Inputs Composite Index

State	Rank 2010	Rank 2008
Massachusetts	1	1
Maryland	2	2
New Hampshire	3	5
California	**4**	**3**
Colorado	5	4

State	Rank 2010	Rank 2008
Washington	6	8
Connecticut	7	7
Virginia	8	9
Pennsylvania	9	11
New Mexico	10	10

Risk Capital and Entrepreneurial Infrastructure Composite Index

The Risk Capital and Entrepreneurial Infrastructure Composite Index has long been a strength for California, which has finished in the top two since the first index in 2002. Slipping one spot to second this year, California's score also dipped, to 75.45 from 81.27 in 2008, and it now stands more than four points behind top-ranked Massachusetts. While this suggests a loss of momentum, the Golden State's tally far surpasses that of its closest rival, Connecticut, which scored 66.39.

Although first-place rankings eluded California in this index's components, the state placed second in four indicators and third in two more. It continued to perform well in general venture capital investment and investment in green technology. A significant strength is second in the net number of business starts per 10,000 people, indicating that despite concerns about the state's business climate, California remains an incredibly popular location to open a business.

The main concern for California in this composite index involves growth in the number of companies receiving VC investment and growth in the total amount of VC investment. While most states suffered in these categories due to the recession, California's numbers declined more rapidly than those of chief competitor Massachusetts. California's tech sector clearly needs a rebound in venture capital and entrepreneurial investment, making these indicators the ones to watch over the next few years. The state's weak ranking of 45th in the number of business incubators further emphasizes the need for a strong venture capital sector.

Risk Capital and Entrepreneurial Infrastructure Composite Index

State	Rank 2010	Rank 2008
Massachusetts	1	2
California	**2**	**1**
Connecticut	3	11
New Jersey	4	21
Utah	5	16

State	Rank 2010	Rank 2008
Colorado	6	3
New Hampshire	7	18
North Carolina	8	8
Arizona	9	10
Washington	10	4

Human Capital Investment Composite Index

One of the most significant determinants of long-term success in the knowledge-based economy is a state's ability to produce and retain educated workers. The Human Capital Investment Composite Index measures the availability of skilled human capital, a state's level of investment in higher education, and the concentration of recent graduates in key science and engineering fields.

California held its ground at 13th place, despite its score dropping from 64.10 to 60.67 to tie with Illinois. With severe budgetary pressure on higher education, and the initial budget proposal from Governor Jerry Brown suggesting even steeper cuts to funding for state universities, California not only faces concerns about its future workforce but is also likely to see its competitiveness in tech-based development slide further. It also threatens to undo one of the few positive indicators for California, percent change in appropriations for higher education. California ranked seventh in this category, having increased appropriations by 3.44 percent in the 2009–2010 period.

The areas of highest concern are California's consistently low rankings in producing and retaining graduates in science and engineering fields. In terms of the percentage of graduate students age 25-34 in science, engineering, and health, California ranked 37th, down from 36th in 2008. By contrast, Massachusetts ranked first in this category and Maryland fourth. In addition, although California has strong showings in the percent of the population with a Ph.D. (seventh) and the number of doctoral engineers per 100,000 people (eighth), it does not fare nearly as well in terms of the talent pipeline. The state ranked 45th in recent bachelor degrees in science and engineering in the workforce (down from 34th), 30th in recent science and engineering master's degrees (down from 21st), and 43rd in recent degrees in science and engineering per 1,000 civilians in the workforce (down from 32nd). This suggests that although much high-end research is still occurring in the state, the mid-level talent is moving out of California in search of jobs.

Human Capital Investment Composite Index

State	Rank 2010	Rank 2008
Maryland	1	1
Massachusetts	2	2
Colorado	3	3
Minnesota	4	5
Connecticut	5	4
Vermont	6	9
North Dakota	7	22
Utah	8	7
New York	9	6
Pennsylvania	10	14
California	**13**	**13**

Technology and Science Workforce Composite Index

Just as examining the state's human capital pipeline indicates a state's prospects in the near future, examining the workforce in knowledge- and technology-based industries provides an understanding of how well a state is positioned to thrive in the current economy. The Technology and Science Workforce Composite Index examines six indicators in three fields: computer and information science, life and physical science, and engineering.

In this composite, California slipped one spot to seventh, continuing a downward trend for a state that ranked second in the 2002 index and third in 2004. The state's score declined only slightly, from 75.00 to 74.67, so the drop in ranking can be attributed more to Delaware's rise from seventh to third than from a change in California's fortunes. That said, the combination of California's cost of living and the reluctance of such California tech leaders as Intel to significantly expand hiring due to high business costs and an unfriendly regulatory environment[1]

1 Dale Kasler, "Businesses Scared Off by California Go Global," *Sacramento Bee*, April 4, 2010. http://www.sacbee.com/2010/04/04/2654053/businesses-scared-off-by-california.html (accessed March 7, 2011).

strongly suggests that California is unlikely to see significant improvement in this indicator any time soon. Massachusetts and Maryland hold the top two spots in this composite, respectively, while Colorado dropped from second to fifth place.

California's strengths were second in concentration of computer hardware engineers, second in concentration of medical scientists, fourth in concentration of biomedical engineers, and fourth in concentration of electronics engineers. The greatest decline occurred in concentration of other engineers, where the state fell from 26th to 36th place.

Technology and Science Workforce Composite Index

State	Rank 2010	Rank 2008	State	Rank 2010	Rank 2008
Massachusetts	1	1	Virginia	6	5
Maryland	2	3	**California**	**7**	**6**
Delaware	3	7	Utah	8	11
Washington	4	4	New Jersey	9	10
Colorado	5	2	Texas	10	8

Technology Concentration and Dynamism Composite Index

The Technology Concentration and Dynamism Composite Index measures growth and positive change in technology-based economic sectors and demonstrates how effective states are at utilizing their resources to encourage tech-based companies and jobs. California gained two spots to rank fifth in this composite, while Utah remains the leader for a second consecutive index. In contrast to its tech and science workforce ranking, Colorado gained ground from fifth to second. Washington leapfrogged California, moving from eighth to third. The biggest decliner was Rhode Island, which fell 21 places from 13th to 34th due to slowing growth in its tech sectors. In addition, New Mexico fell out of the top 10, dropping from fourth to 17th place.

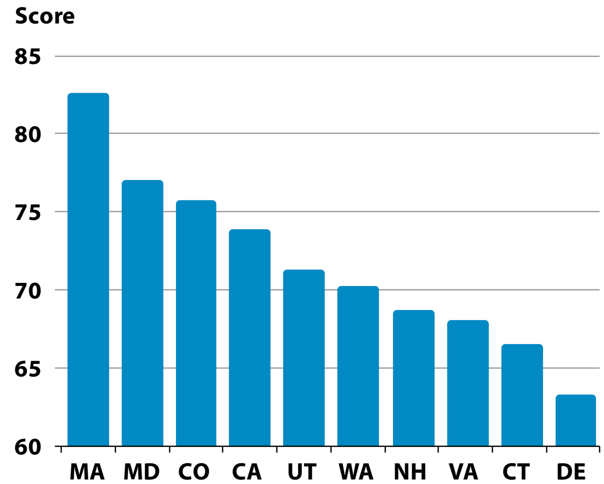
As the impact of the dot-com collapse of the early 2000s has faded, California's overall tech sector is losing ground, but the losses have been smaller with time, suggesting it is stabilizing. From 2002 to 2006, the state lost 3.2 percent in the category of average annual growth in high-tech industries, for a ranking of 41st in the 2008 index. But it lost just 0.19 percent from 2004 to 2008 to rank 36th this year. The greatest positive sign comes from the state's 11th-place ranking in net formation of high-tech establishments, after ranking 42nd in the 2008 index and 10th in the 2004 edition. The 2010 indicator marks a significant improvement since the 2008 ranking, which was based on 2002 data reflecting the dot-com crash.

California remains the leader in the number of high-tech industries with a location quotient greater than 1.0 (i.e. the concentration of industry employment relative to the national average). It also has top five finishes in percent of employment in high-tech industries, percent of payroll in high-tech industries, and number of tech Fast 500 companies per 10,000 businesses.

Technology Concentration and Dynamism Composite Index

State	Rank 2010	Rank 2008	State	Rank 2010	Rank 2008
Utah	1	1	Maryland	5	2
Colorado	2	5	Massachusetts	7	11
Washington	3	8	New Hampshire	8	10
Virginia	4	3	Texas	9	15
California	**5**	**7**	Arizona	10	6

State Technology and Science Index Top 10 States



Conclusions

California has held its ground among the nation's leaders in technology at fourth in the overall State Technology and Science Index. It ranks in the top five in the composite indexes for R&D, risk capital investment, and the concentration of tech industries in the state, and it ranks in the top ten in tech and science workforce. But continued success in all those categories hinges on investment in human capital, where California ranks far below the leaders at 13th.

In the aftermath of the Great Recession, California's position in technology has not insulated it from high unemployment that as recently as December 2010 stood at 12.5 percent, and significant downturns in economic growth, which in turn have played havoc with state revenue. Recent budget cuts have strained the already overwhelmed K-12 system and caused rapid rises in tuition at public universities. And the proposed budget for the next fiscal year includes additional cuts of up to $1 billion at state universities.[2]

This is concerning on many levels:

- Deterioration in the university system could easily result in less industry and government funding for basic research over time. That has a trickle-down effect on the potential to commercialize university research, the creation of high-tech companies that feed off that research, and the investment of risk capital to fund these start-ups.
- Continued funding shortfalls for schools and universities put in doubt the state's ability to fully educate children of immigrants and working-class residents to participate in the knowledge-based economy. This causes further deterioration in the quality of the state's tech and science workforce. As the protests in May 2010 and March 2011 demonstrated, there is little appetite for further tuition hikes.[3,4]

2 Shane Goldmacher, "Jerry Brown Rolls the Dice with Pain-filled Budget Plan for California," *Los Angeles Times*, January 11, 2011. http://articles.latimes.com/2011/jan/11/local/la-me-state-budget-20110111 (accessed February 4, 2011).

3 Carla Rivera, Nicole Santa Cruz and Larry Gordon, "Thousands Protest California Education Cuts," *Los Angeles Times*, March 5, 2010. http://articles.latimes.com/2010/mar/05/local/la-me-protests5-2010mar05 (accessed February 4, 2011).

4 Damian Ortellado and True Shields, "Hundreds of College Students Protest Across Country, Rallying Against Funding Cuts to Public Education on Day of Protest," *Daily Californian*, March 3, 2011. http://www.dailycal.org/article/112198/hundreds_of_college_students_protest_across_countr (accessed March 6, 2011).

- Although private universities such as the University of Southern California continue to attract large numbers of foreign students, public universities have not recovered sufficiently from the declines of 2001–2005 after the dot-com crash and post-9/11 travel restrictions. Much of California's high-tech industry was built by the best and brightest from other states and nations coming to California for an education and remaining here to conduct research and start companies, so maintaining that influx of talent is important to the state's future success.

It is no accident that the top three states in the State Technology and Science Index—Massachusetts, Maryland, and Colorado—also rank highest in the Human Capital Investment Composite Index. California must find a long-term solution for funding higher education or watch its technology and science sector erode.

As a policy aside, maintaining the industries the state has now will also be key to its success. California has a diverse base of talent, and its high-tech industries are not concentrated on any particular few, offering opportunities to grow its bases in any high-tech industry as the global marketplace changes. While California has a reputation as a high-cost state for business, this is not true for the entire state. For example, the cost of doing business in San Jose is 20 percent higher than the U.S. average, but Fresno is 5 percent cheaper than the national average. Rather than allowing high-tech companies to move out of California, creating lower-cost high-tech clusters may be a viable way to retain and expand high-tech industries. California's technology sector has led the way in the past, and it is essential that it be able to do so in the future.

Introduction

Since the initial publication of the Milken Institute's State Technology and Science Index in 2002, technology-based economic development has expanded its place in government policy and become an increasingly accurate barometer of how well a state is positioned to compete in the global economy. In the 2010 edition, we examine the continued effects of the states' changing spending and policy priorities on education, investment, job creation, and technology-based entrepreneurship.

This California-specific report uses the broad State Technology and Science Index as a starting point to delve into the state's specific strengths and weaknesses in such areas as scientific research, the human capital pipeline, and other elements necessary to maintaining the knowledge-based industries within its borders. We examine 79 specific indicators that make up the most recent index to provide a comprehensive picture of how well California is faring in the vitally important intangible economy.

The greatest threat for all states is the increasing global competition for intellectual capital. This competition, paired with U.S. immigration policy, has resulted in graduates of U.S. universities returning to their home countries. This erodes the U.S. supply of skilled workers while building those of other countries that formerly competed only on the lower end of the technology curve. Countries such as China, India, South Korea, Thailand, and Singapore in Asia, as well as eastern Germany, Hungary, and Poland in Europe, all provide highly skilled workforces that can design and manufacture high-tech products, often at a much lower cost than in the United States as a whole, particularly California.

The state's two greatest challenges are bolstering the development of human capital and arresting the decline of its finances. California's Legislature and governor must address not only short-term revenue concerns but also long-term structural imbalances. As long as the state's finances are unstable, funding for its universities will be inconsistent, placing the state at a competitive disadvantage.

Although significant strides were made in investing in schools thanks to the bond issues launched in 2006, recent fiscal realities are placing increasing pressures on state and local education budgets. With top 10 performances in four of the five composite indexes, California's lowest ranking remains 13th in human capital investment. Unless a means can be found to improve this weakness, there is no guarantee the state's future workforce will match the quality of the current one.

Outline of the Index

In the pages that follow, we will examine California's performance relative to that of other states in five composite indexes: Research and Development Inputs, Risk Capital and Entrepreneurial Infrastructure, Human Capital Investment, Technology and Science Workforce, and Technology Concentration and Dynamism. These composites are made up of 79 indicator components (typically benchmarked on a per capita, gross state product, or other type of equalizing basis), which are listed in the appendix. Scores are derived from state rankings, and the five composite indexes detailed below are averaged to compute each state's overall performance.

- **Research and development inputs:** This composite index gauges a region's R&D capabilities and includes such measures as industrial, academic, and federal R&D funding, Small Business Innovation Research awards, and the Small Business Technology Transfer program.

- **Risk capital and entrepreneurial infrastructure:** This component includes different measures of venture capital as well as patenting activity, new businesses formed, and initial public offerings, which together determine a state's success at turning research into services and products.
- **Human capital capacity:** This composite index weighs various areas of a region's educational attainment, including the number of bachelor's, master's, and Ph.D.s relative to a state's population, and measures of specific science, engineering, and technology degrees.
- **Technology and science workforce:** This indicates the depth of a state's high-end technical talent. It measures the intensity of employment in 18 different occupations that make up the categories of computer and information science, life and physical science, and engineers.
- **Technology concentration and dynamism:** This measure of technology outcomes assesses the effectiveness of policymakers and other stakeholders in transforming regional assets into regional prosperity. Measures include the percent of establishments, employment, and payrolls that are in high-tech categories, as well as growth in a number of technology categories.

Research and Development Inputs

Background and Relevance

The Research and Development Inputs Composite Index measures each state's R&D performance, including its ability to attract various types of federal, industry, and academic funding.

Funding for R&D is a key measure of a region's competitiveness in science and technology. R&D funding supports the research labs, universities and innovative companies that educate the workforce, and invent and develop new technologies. It also helps commercialize the research results, taking inventive new products from minds to markets. These regional research centers attract more entrepreneurs[5] looking to take advantage of the innovative atmosphere, the R&D, the educated workforce, and the businesses that are suppliers, and soon a "cluster" is born. Not only do these clusters produce new products, but they also create high-paying jobs. All this activity results in economic ripple effects for restaurants, retailers, Realtors and other businesses in the regional economy.

Regions that can create a virtuous cycle of continuous innovation have the capacity to be at the forefront of economic competitiveness in the knowledge-based economy.[6] The presence of R&D activities enables regions to develop unique competitive advantages[7] and generate innovation.[8]

The U.S. is known for its advocacy of cutting-edge R&D. World-renowned high-tech leaders such as Microsoft, Apple, Google, Genentech, and Amgen were launched from the springboard of the country's R&D landscape. Thanks to such global success stories, the country has a high rate of commercializing innovations. In the U.S., approximately 6 percent of adults are involved in start-ups, and university licenses have generated more than 3,800 companies in the U.S. since 1980.[9] The government has helped facilitate this cooperation between universities and industries through its tech transfer offices. In addition, the Bayh-Dole Act in 1980, granting universities the right to own, license, and market the fruits of their faculty research, also has contributed to a strong national foundation for technology transfer and commercialization.[10]

The use of information technologies to procure goods, services, and information reduces the importance of geography, but industry clusters remain important.[11] Though companies in clusters such as California's Silicon Valley and Boston's Route 128 could collaborate remotely, intrinsic economic value can be more effectively derived in a closely knit cluster. For example, a strong cluster can influence government initiatives that are geared toward economic development, the economic impact of universities, and the configuration of companies.[12]

5 Dirk Engel and Andreas Fier, "Does R&D-Infrastructure Attract High-Tech Start-Ups?," ZEW Discussion Paper 00-30 (2000).

6 Benjamin Yeo, *Developing a Sustainable Knowledge Economy. An Investigation of Contextual Factors* (Germany: VDM Publishing, 2009).

7 Malcolm Gladwell, *The Tipping Point: How Little Things Can Make a Big Difference* (Boston: Back Bay Books, 2000).

8 Daniel Bell, ed., *The Coming of the Post-Industrial Society: A Venture in Social Forecasting* (New York: Basic Books, 1973).

9 Magnus Karlsson, "Commercialization of Research Results in the United States: An Overview of Federal and Academic Technology Transfer," (Swedish Institute for Growth Policy Studies (2004).

10 Ross DeVol et al., "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization," (2006).

11 Michael E. Porter, "Clusters and the New Economics of Competition," in *World View: Global Strategies for the New Economy*, ed. Jeffrey E. Garten (Boston, MA: Harvard Business School Publishing, 2000).

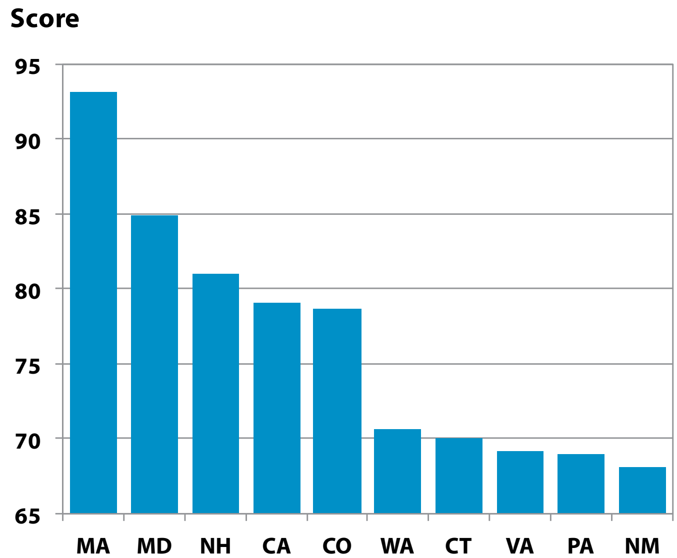
12 Ibid.

California and Other State Rankings

With a score of 79.06, California slipped one position, to fourth in the 2010 R&D Inputs Composite Index, behind Massachusetts (first for the second consecutive index with a score of 93.15 points), Maryland (second at 84.91 points), and New Hampshire (third at 81.01 points). The Golden State edged out Colorado, which fell from fourth to fifth place with a score of 78.69. The remaining states in the composite index top 10, in descending order, are Washington, Connecticut, Virginia, Pennsylvania, and New Mexico. Figure 2 shows California's performance in the composite index's 18 individual indicators and the corresponding U.S. average.

Figure 1. Research and Development Inputs Composite Index

Top 10 states, 2010



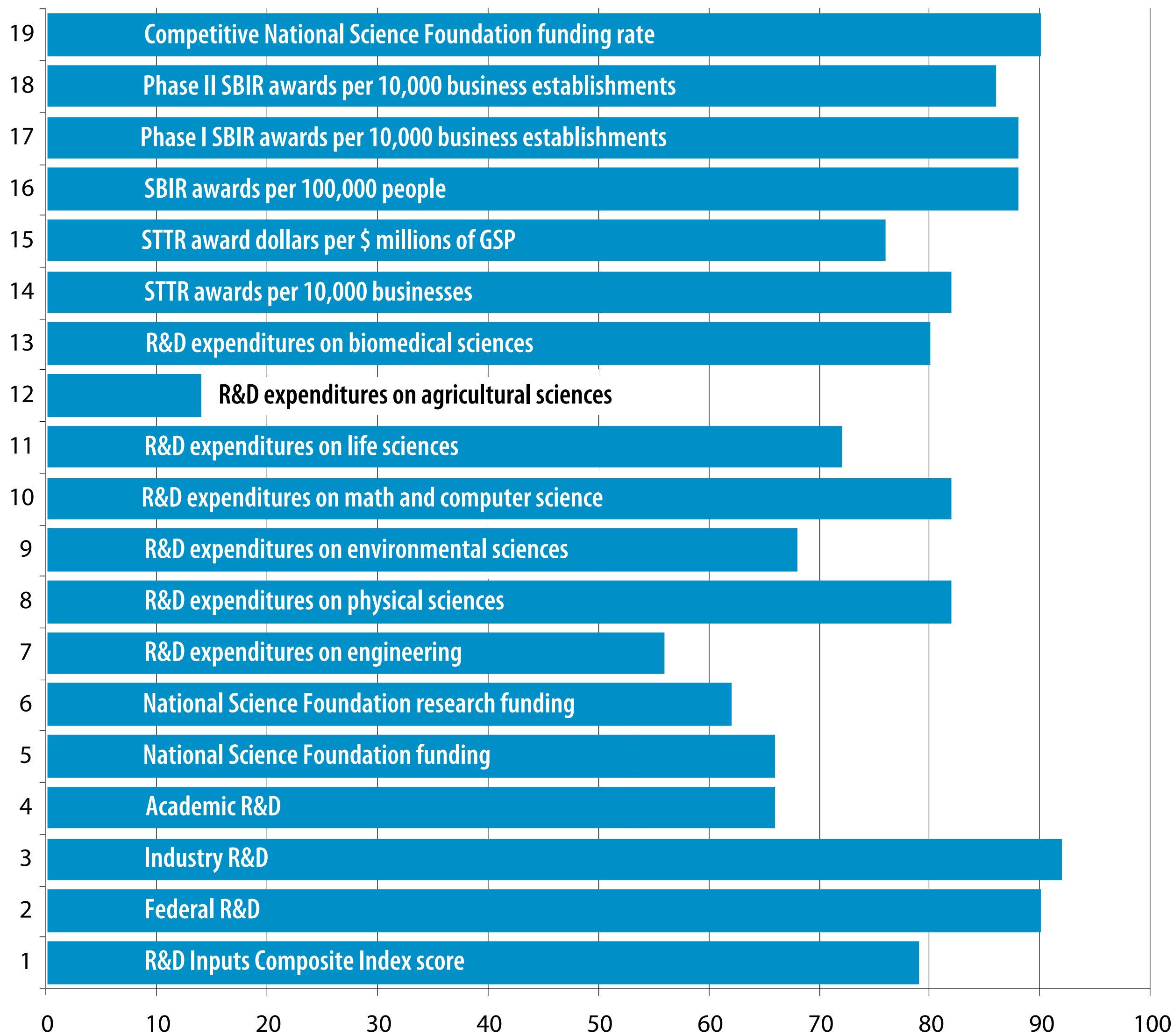
Source: Milken Institute.

In general, R&D funds come from three sources: the federal government, private industry, and academia. Awards won from all three of these sources are reflected in each state's composite score.

The index's measure of federal R&D expenditures captures the sum of all basic and applied research in federally supported projects, including work pertaining to national defense, health, space research and technology, energy, and general science. The industry R&D measure totals all the money corporations spent on basic and applied research, including at federally funded R&D centers. Industry R&D receives great weight in the composite index because of its large share of overall R&D. All research, basic and applied, performed by colleges and universities is funded by a combination of federal, industry, and academic sources, but more than 60 percent of R&D funding at universities originates from the federal government.

The National Science Foundation (NSF) is an independent federal agency that funds R&D in science and engineering through grants, contracts, and cooperative agreements. Its R&D expenditures on engineering are a key source of funding at doctorate-granting institutions for various basic and applied engineering programs. It also supports physical sciences, environmental sciences, math, computer sciences, and life sciences.

Figure 2. California's scores in R&D components



California's statistics, 2010

	1	2	3	4	5	6	7	8	9	10
California	79.06	$585.71	$1764.47	$185.08	$59.70	$50.29	$22.73	$18.36	$10.72	$7.97
U.S. avg.	50.09	$319.74	$693.91	$163.85	$66.19	$50.52	$25.77	$11.99	$13.31	$5.88

	11	12	13	14	15	16	17	18	19
	$113.66	$6.03	$107.15	1.31	$25.77	2.74	8.34	4.24	38%
	$92.94	$15.61	$72.24	0.87	$20.12	1.61	4.43	2.34	31%

State Technology Transfer Research (STTR) awards are federally funded research grants to small businesses and nonprofit research institutes to support the technology commercialization efforts of innovative small businesses. The Small Business Innovative Research program (SBIR) funds the often costly start-up and development stages, and encourages commercialization of the research findings. To be eligible, firms must be for-profit, American-owned, and independently operated, and must employ a principal researcher and fewer than 500 workers. The funding rates of competitive NSF project proposals for basic research are crucial for generating momentum in the formative stages of R&D at universities.

California's Performance by Indicator

As a high-tech powerhouse, California recognizes the importance of investments in science and technology R&D to sustainable economic growth. It performs well in nearly all the indicators in this component but fell below the national average in five: NSF funding, NSF research funding, and R&D expenditures on engineering, environmental science, and agricultural science.

California continues to occupy the top 10 in federal and industry R&D per capita, ranking sixth and fifth, respectively. The Golden State's technology clusters—San Jose's Silicon Valley, San Diego's life sciences cluster, and Southern California's Tech Coast—are key drivers of its strong high-tech performance. However, the state placed 18th in academic R&D per capita, a slight improvement from 19th in the 2008 index but still not a top 10 finish. Despite California's strong public and private research institutions, the indicators suggest science and technology programs have continued to receive insufficient attention compared to those in higher-scoring states.

California fell short of expectations in NSF funding, ranking 18th compared with 15th in 2008, and sliding to 20th from 12th in NSF research funding. With the state's performances in these two measures below the national average, it is important to examine ways to improve its ability to attract NSF funding.

In R&D expenditures in engineering per capita, California came in at 23rd and about $3 per capita below the national average despite a wealth of science and engineering assets in its world-renowned institutions. In R&D expenditures per capita in environmental sciences, California placed 17th with $10.72 expended per capita, less than the national average of $13.31. And in R&D expenditure in agricultural sciences, California placed 44th, with $6.03 per capita in R&D expenditures vs. the national average of $15.61. These findings suggest that California's R&D efforts are geared toward other areas.

California held its ground at seventh in the average annual number of SBIR awards per 100,000 people. At 2.74 SBIR awards, it far exceeds the national average of 1.61 awards. Looking deeper, California ranked seventh in Phase I SBIR awards received per 10,000 business establishments, with 8.34 awards vs. the national average of 4.43. The state placed eighth in Phase II SBIR awards received per 10,000 business establishments, with 4.24 awards compared with the U.S. average of 2.34. These SBIR-related measures suggest the level of innovation that is apparent in the state's high-tech industry.

Beyond the dot-com era, California has shown its ability to create a sustainable high-tech economy. Despite weaker R&D expenditures in fields like environmental and agricultural science, the state is a proven high-tech powerhouse in other R&D indicators. Further leveraging its knowledge assets and focusing on the areas where California does not perform as well will give the state a diverse platform that will attract high-tech investments, anchor companies, and entrepreneurs alike.

Risk Capital and Entrepreneurial Infrastructure

Background and Relevance

Entrepreneurs contribute to economic growth through direct and indirect channels.[13] Creating new businesses directly impacts economic growth, but entrepreneurs stimulate regions in other ways: They increase productivity through technological change.[14] They manipulate existing technologies and services, which speeds up the learning curve. And their new products increase competition, persuading established players to innovate as well or risk losing market share. This competition drives down prices and brings about better products.[15]

The role of entrepreneurs has been key to the growth and development of high-tech industries in the U.S. Apple CEO Steve Jobs witnessed Xerox's early prototype of the graphic user interface (GUI), a standard interface in today's computer applications. When Xerox did not thoroughly understand how the technology could be applied, Jobs founded Apple Computer and used the GUI for its Macintosh personal computer. Similarly, Sun Microsystems as a start-up firm created the computer workstation market even though tech giant IBM held the patents to the technology. Eventually, paired with the R&D prowess of the Bay Area's universities, these scientific and technological innovations gave birth to Silicon Valley's vibrant high-tech cluster.

Inventions advance knowledge but do not affect the local economy until they are implemented. The process of taking ideas from mind to market has been facilitated greatly by the explosion in the availability of capital to individual entrepreneurs over the past few decades. Intel, Microsoft, Apple, Cisco, Genentech, and Amazon were all venture-backed firms. Venture capital funding represents a small share of the overall capital markets, but its true value cannot be measured in dollars. Venture capitalists help develop business plans, become board members, lend management skills, suggest strategic partnerships and alliances, assist in expansion plans, and bring in key talent where needed. Studying venture capital activity is an excellent way to assess whether financiers have confidence in the new ideas and entrepreneurial infrastructure of a region.

California and Other State Rankings

California slid one spot to second in the Risk Capital and Entrepreneurial Infrastructure Composite Index with a score of 75.45, compared with the U.S. average of 50.06. Massachusetts clinched the top spot, besting California's score by more than four points. Of note, California established a nine-point gap between its score and that of third-place Connecticut and fourth-place New Jersey. The remaining top 10 states are, in descending order, Utah, Colorado, New Hampshire, North Carolina, Arizona, and Washington. Figure 3 shows California's rank in the composite index's individual indicators and the corresponding U.S. average.

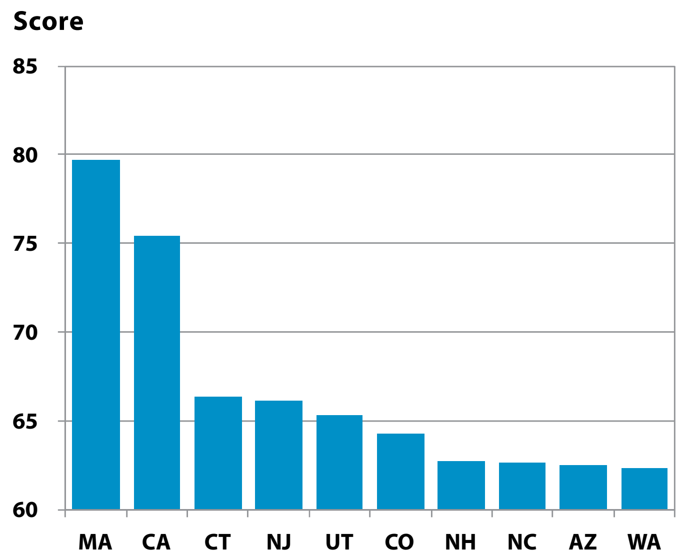
13 Adriaan Johannes van Stel, "Entrepreneurship and Economic Growth Some Empirical Studies" (EIM Business and Policy Research in Zoetermeer, 2005).

14 Zoltan Acs, "How Is Entrepreneurship Good for Economic Growth?," *Innovations: Technology, Governance, Globalization* 1, no. 1 (2006).

15 Jean Tirole, *The Theory of Industrial Organization* (The MIT Press, 1988).

Figure 3. Risk Capital and Entrepreneurial Infrastructure Composite Index

Top 10 states, 2010



Source: Milken Institute

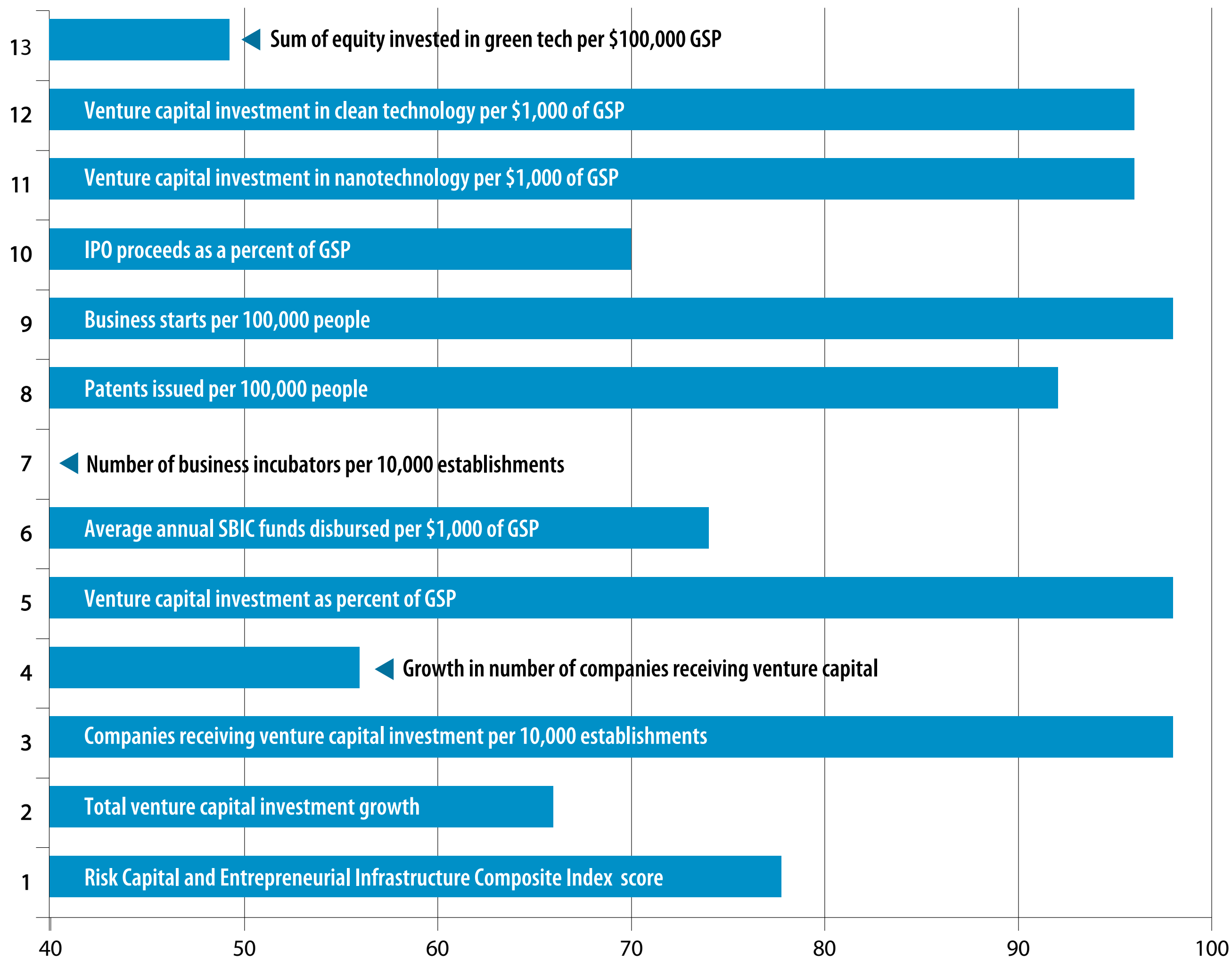
The RCEI Composite Index is calculated by totaling the scores (which are based on state rankings in each indicator) and dividing by the total number of indicators. Several venture capital indicators are included to capture its relative importance and reflect which states are witnessing rapid gains. A high growth rate in VC placements indicates that a state is experiencing early success in building technology-based firms for future economic development and job creation, and is closing the gap with more advanced states. Growth in total venture capital funding and in the number of companies receiving VC investment captures this element.

We include the number of companies receiving venture capital investment per 10,000 firms and VC investment as a percentage of Gross State Product (GSP) to measure the flow and strength of each state's venture capital activity relative to its total economy. Venture capital's share of a state's economy is important because there is a strong relationship between higher venture capital investment activity and entrepreneurial success, job creation, wealth creation, and higher standards of living. The level numbers represent where the states rank in terms of size for each indicator. The growth indicators demonstrate the continued vitality of the indicators within each state. So both combined give a more complete picture of how states are performing.

California's Performance by Indicator

California showed strength in a number of indicators, particularly a second-place finish in number of businesses that received venture capital investments per 10,000 establishments. Nearly 20 California companies per 10,000 establishments received VC investments compared with the national average of 3.47. Massachusetts is clearly the leader in this indicator, occupying the top spot with more than 26 companies. Third-place Washington clocked in at almost nine companies, while fourth-place Colorado and fifth-place Maryland had roughly eight companies per 10,000 establishments.

Figure 4. California's scores in risk capital and entrepreneurial infrastructure components



California's statistics, 2010

	1	2	3	4	5	6	7	8	9	10	11	12	13
California	75.45	-58.08%	19.8	-30.07%	0.59%	$0.19	0.66	52.18	462.74	0.18%	$0.37	$0.31	$123.67
U.S. avg.	50.06	-38.95%	3.47	-23.04%	0.08%	$0.15	1.27	22.02	38.08	0.35%	$0.05	$0.07	$25.18

In venture capital investments as a percentage of GSP, California dominated all but Massachusetts. The Golden State indicator was at 0.59 percent, compared with Massachusetts' 0.65 percent. To put it in context, the national average was a mere 0.08 percent. Clearly, California and Massachusetts are hotbeds for innovation with venture capital pouring into the states. Third-place Colorado lags far behind the leaders, with VC investment of 0.26 percent of GSP, followed by Washington and Utah, with 0.22 percent and 0.20 percent, respectively.

Yet another indicator that serves as evidence of California's strong innovation capacity is the net number of business starts per 100,000 people. With almost 463 net business starts per 100,000 people, California ranked second in the country. Wisconsin tops the list with 609 net business starts compared to the national average of just 38. With 320 net business starts, North Carolina ranks a distant third, followed by South Carolina and Texas, with 251 and 226, respectively.

Nanotechnologies and clean technologies are gaining recognition as drivers of sustainable growth, and California clearly shows its forward-looking stance in these fields, ranking third in both VC investment in nanotechnologies and VC investment in clean technologies. At $0.37 and $0.31 invested per $1,000 of GSP. California's performances far surpassed the national averages of $0.05 and $0.07, respectively.

In VC investments in nanotechnology, Massachusetts and New Mexico topped the list at the first and second, respectively, with $0.61 and $0.49 invested per $1,000 GSP. In VC investments in clean technology, South Dakota and Massachusetts ranked first and second, respectively, with $0.68 and $0.40 invested per $1,000 of GSP.

Funding from the Small Business Investment Company (SBIC) program promotes incubator-type establishments that support small businesses with services ranging from financial capital to management consulting. SBICs, which are able to provide these services because they are leveraged by the Small Business Association, behave similarly to venture capitalists; their goal is to identify profit potential in unleveraged small businesses and fund it in hopes of obtaining high returns on their investment.

Ranked 14th, California performed fairly well in average annual SBIC funding. The state obtained $0.19 in funding per $1,000 of GSP compared to the national average of $0.15. The top five states in this measure were South Dakota ($0.72), Massachusetts ($0.49), Utah ($0.39), Colorado ($0.36), and New Hampshire ($0.35).

Despite some strong performances, California also faces some challenges in risk capital and entrepreneurial infrastructure. The state ranks 45th in the number of business incubators per 10,000 business establishments, with just 0.66 incubators compared with the national average of 1.27. In fact, California has declined in this indicator every year since the index began, ranking fourth with 2.56 incubators per 10,000 business establishments in 2002, slipping to 13th and 1.68 incubators in 2004, and declining further still to 33rd and 1.29 incubators in 2008. The continuous slide suggests entrepreneurship in California may be oriented around start-ups managed by experienced officers.

Business formation is important to a state's local economy because it is an indicator of entrepreneurship, innovative spirit, and optimistic expectations. Among the indicators are business starts and initial public stock offerings, which occur when a company decides to sell shares to the public. Companies that go public typically have established a proven track record by means of revenues or sales history.

California slid from 15th to 16th in IPO proceeds as a percent of GSP At 0.18 percent of GSP, its IPO proceeds lag the national average of 0.35 percent. The state's ranking has been declining since the first index in 2002. The top five states in this measure were Delaware (2.35 percent), Wyoming (1.63 percent), Massachusetts (1.42 percent), New York (1.23 percent), and Oklahoma (0.73 percent).

Finally, in the new indicator, sum of equity invested in green technologies, California placed second with $123.67 invested per $100,000 of GSP compared with the national average of $25.18. Wisconsin leads in this measure, with $250.42 invested per $100,000 of GSP. Massachusetts, Vermont, and New Hampshire complete the top five with $75.16, $71.67, and $34.08 invested, respectively.

Overall, the Risk Capital and Entrepreneurial Composite Index reflects a state's capabilities in supporting entrepreneurial activities and its ability to generate and attract risk capital funding. The high-tech industry is premised on innovation, and its success is therefore dependent on entrepreneurship and risk capita. Although California has maintained its success in this component, it faces challenges in some areas as discussed. Addressing these challenges may open up further opportunities for the state to reclaim the top ranking in this composite Index and enhance its high-tech economy.

Human Capital Investment

Background and Relevance

Jane Jacobs draws on social and natural science theories to explain the importance of human capital: "Beginning with the very start of a settlement and continuing for as long as the place maintains an economy, human effort is combined with imports. … And the most important ingredient qualitatively—although not always quantitatively—is human capital. That means skills, information, and experience—cultivated human potentialities—resulting from investments made by the public, by parents, by employers, and by individuals themselves."[16] Human capital represents the source of technological innovation in the knowledge-based economy. While the industrial era saw the importance of capital and land as key productive forces, talent is the driving force in this new era.

At the firm level, successful businesses are able to leverage the knowledge base from human capital to innovate, building new knowledge in the process. This knowledge base is often tied to technological knowledge, as the ubiquity of and reliance on information technology continually increases on the global industrial landscape. Extrapolating this to the regional level, an area with innovative output led by higher-value human capital is likely to be more competitive. Alan Greenspan, former chairman of the Federal Reserve, has said one notion that was "virtually unimaginable a half-century ago was the extent to which concepts and ideas would substitute for physical resources and human brawn in the production of goods and services."[17]

Companies sometimes locate their operations where highly skilled human capital is readily available.[18] For example, Google has operations in Pittsburgh, Pennsylvania, to tap the talents at Carnegie Mellon University and the University of Pittsburgh,[19] and Google has recently announced its plans to expand its base there.[20] This behavior explains the formation of clusters in a region: Firms are attracted to the same pools of talent.[21] By the same token, knowledge workers are attracted to the same locations because of the knowledge work. As businesses migrate toward these pools of talent, so do knowledge workers to take advantage of the opportunities.

Richard Florida studied the geography of human capital and found that creative classes of workers influence the level of economic growth in a region.[22] Thus, education, learning, training procedures, and outcomes, as determinants of human capital, also influence economic growth.[23]

Collaboration is vital to knowledge growth. Knowledge thrives in clusters that have heavy concentrations of connected educational and research institutions and large research-based businesses. The contrasting economic performances of California's Silicon Valley and Boston's Route 128 highlight the importance of this collaborative characteristic to economic growth. Silicon Valley was characterized by establishments that were inter-connected

16 Jane Jacobs, *The Nature of Economies* (New York: First Vintage Books Edition, 2001).
17 Alan Greenspan, (paper presented at the The Conference Board's 80th Anniversary Dinner, 1996).
18 Edward E. Leamer and Michael Storper, "The Economic Geography of the Internet Age," *NBER Working Paper*, no. 8450 (2001).
19 Perry Wong, Benjamin Yeo, and Ross DeVol, "Pittsburgh Technology Strategy: SWOT Analysis," Milken Institute Research Report (2006).
20 "Google in Pittsburgh signals tech burst," September 7, 2010. http://marketplace.publicradio.org/display/web/2010/09/07/am-tech companies-set-up-shop-in-pittsburgh/?refid=0
21 Edward Glaeser, "Are Cities Dying?," *Journal of Economic Perspectives* (1998).
22 Richard Florida, *The Rise of the Creative Class and How It's Transforming Work, Leisure, Community and Everyday Life* (New York: Basic Books, 2002).
23 Ross Devol, "State Technology and Science Index. Comparing and Contrasting California," Milken Institute Research Report (2002).

and collaborative. In contrast, Route 128 housed longstanding businesses that operated independently.[24]

With the transition toward knowledge-based production, traditional models of economic growth have become less applicable. As a result, New Growth Theory emerged to include intangible factors of production such as ideas and creativity as determinants of economic growth.[25] As Paul Romer argued, "What is important for growth is integration not into an economy with a large number of people, but rather one with a large amount of human capital."[26] Knowledge workers possess more complex skill sets and have bigger roles in the innovation process. Therefore, in the knowledge-based economy, these workers are paid more because they are the human capital necessary to trigger economic growth.

Creating a concentrated presence of human capital facilitates economic growth of the region.[27] Among states, the percentage of adults with a bachelor's degree is closely associated with variations in per capita income,[28] suggesting that, collectively, these individuals are more productive.[29] Regions and states alike must create pools of human capital to generate and leverage knowledge to gain competitive advantages in today's knowledge-driven economy. Knowledge assets that generate and attract human capital include mainly universities and research institutions that create innovation. These are critical to economic growth.

24 Annalee Saxenian, ed., *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA: Harvard University Press, 1996).

25 Paul M. Romer, "Endogenous Technological Change," *Journal of Political Economy* 98, no. 5 (1990), ———, "Increasing Returns and Long-Run Growth," *Journal of Political Economy* 94, no. 5 (1986).

26 Paul Romer, "Increasing Returns and Long Run Growth," *Journal of Political Economy* 94 (1986).

27 Paul D. Gottlieb and Michael Fogarty, "Educational Attainment and Metropolitan Growth," Milken Institute Research Report (1999).

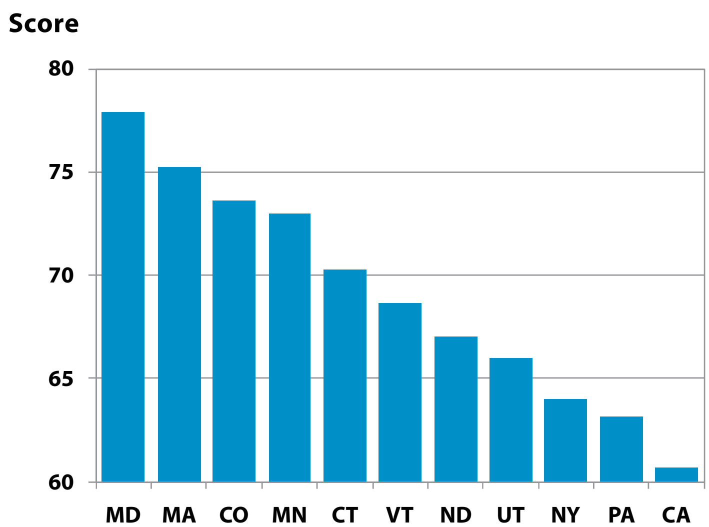
28 Ross DeVol, "The New Economics of Place," Milken Institute Review (2001).

29 Paul Plummer and Mike Taylor, "Theories of Local Economic Growth (Part 2): Model Specification and Empirical Validation," *Environment and Planning A* 33, no. 3 (2001).

California and Other State Rankings

With a score of 60.67, California remained at 13th on this year's Human Capital Investment Composite Index. While California shows strengths in R&D and risk capital, human capital is yet another area that is critical to the high-tech industry and can facilitate sustainable economic growth. The top 10 states in this component are Maryland (77.90 points), Massachusetts (75.24), Colorado (73.62), Minnesota (72.95), Connecticut (70.29), Vermont (68.67), North Dakota (67.05), Utah (66.00), New York (64.00), and Pennsylvania (63.14). Overall, the Golden State was just 2.5 points from a top 10 finish in this composite index. Figure 6 shows California's performance and the national average in the 20 indicators that make up the Human Capital Investment Composite Index.

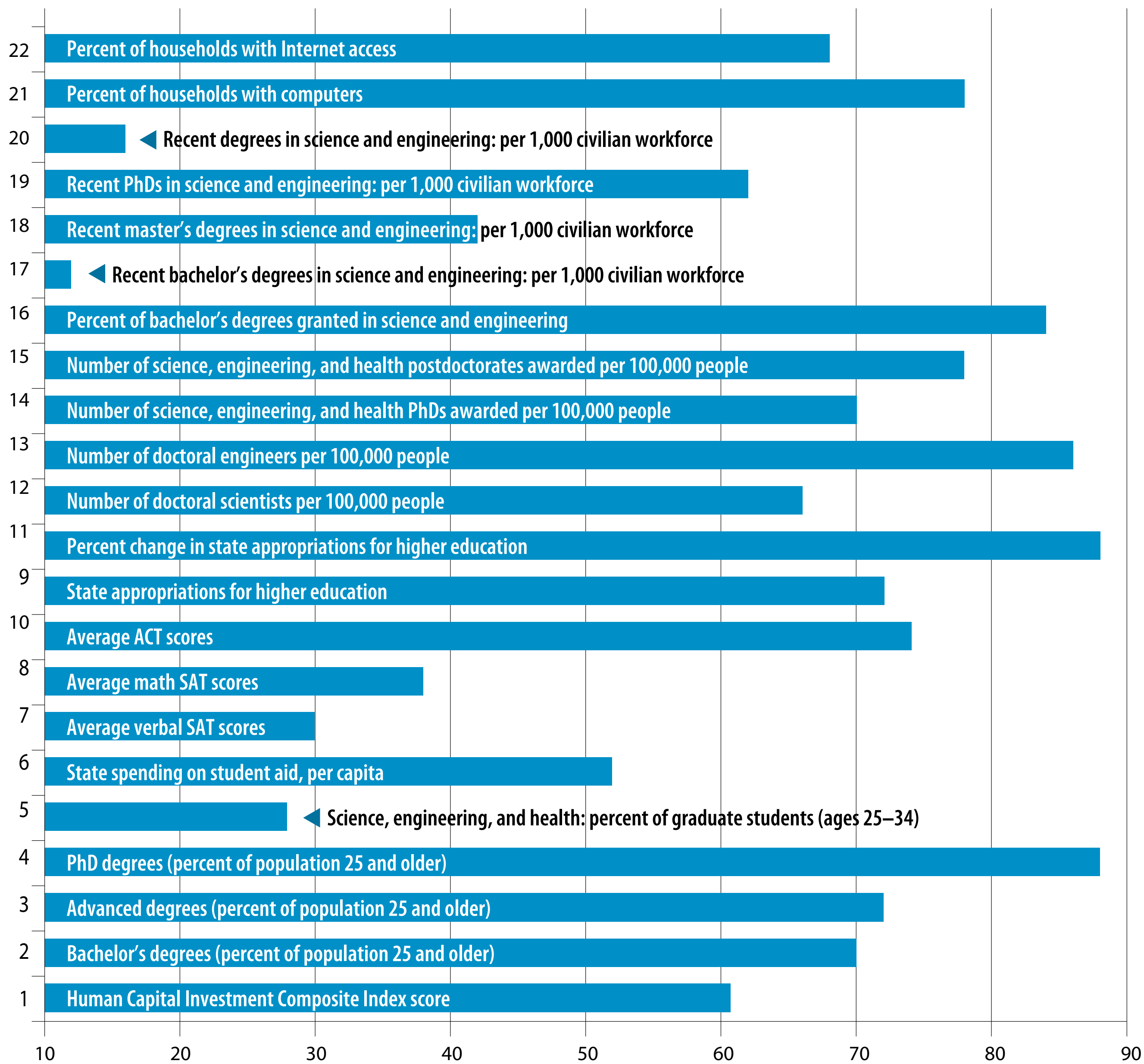
Figure 5. Human Capital Investment Composite Index
Top 10 states and California, 2010



Source: Milken Institute. *California ranked 13th.

The HCI Composite Index attempts to measure the stock of human capital and rate of investment (flow) between states by gauging the concentration and momentum of various science and engineering fields. It also tries to capture how well R&D investments are being utilized by analyzing student scores. These indicators are meant to give a snapshot of how adequately the state is prepared to sustain employment in science and technology fields. Scores are calculated by totaling the state's rankings in each indicator and dividing it by the number of indicators. The accompanying table highlights California's position in each of the 21 individual indicators that make up the composite index, plus its overall score.

Figure 6. California's scores in human capital investment components



California's statistics, 2010

	1	2	3	4	5	6	7	8	9	10	11
California	60.67	26.46%	9.62%	1.28%	1.01%	$23.22	500	513	22.2	$295.14	3.4%
U.S. avg.	51.16	24.29%	8.71%	1.01%	1.34%	$30.52	536	541	21.6	$272.46	-4.4%

12	13	14	15	16	17	18	19	20	21	22
133.74	41.00	82.70	146.23	17.98%	1.85	0.70	0.21	2.75	66.3%	73.6%
127.99	25.87	75.30	108.29	16.12%	2.62	0.79	0.20	3.61	62.3%	71.7%

California's Performance by Indicator

California performed best in the indicators related to the percentage of the population with Ph.D.s, state appropriations for higher education (percent change), number of doctoral engineers per 100,000 people, and the percentage of bachelor's degrees granted in science and engineering. In each of these indicators, California scored in the top 10. The state's worst performances include average verbal Scholastic Aptitude Test (SAT) scores, average math SAT scores, and recent bachelor degrees in science or engineering as a percentage of the civilian workforce.

Verbal SAT scores are important to state education analysts because they allow them to measure the verbal competence of high school students on a time-series and cross-sectional basis. Similarly, average math SAT scores are evidence of the strength and effectiveness of mathematics and critical-thinking curriculum. American College Testing Assessment (ACT) scores, like SAT scores, provide colleges and universities with a means of measuring students' aptitude as well as an instrument to predict academic performance during the first year of college. States that have large university systems—such as California, Florida, and New York—have a large proportion of students (usually at or above 50 percent of all high school graduates) who take the SAT.

In average verbal SAT scores, California climbed one position to 36th this year, with an average of 500 points, compared to the national average of 535.82 points. The top five states in this indicator are Iowa (610 points), Minnesota, Missouri (both 595 points), Wisconsin (594 points), and North Dakota (590 points). California's relatively poor performance in this indicator can be partially explained by its large and diverse immigrant population. With many first-generation immigrant test-takers, it is not surprising to find low verbal SAT scores. On another note, in states such as Iowa, North Dakota, and Wisconsin, less than 10 percent of graduates take the SAT, so the averages are generally higher.

California, in 45th position, also performed far below the national average in recent bachelor degrees awarded in science or engineering. About 1.85 degrees per 1,000 civilian workers have recently been awarded in science or engineering compared with the U.S. average of 2.62. This places the state at a disadvantage as other states with better-educated science and engineering workforces expand their high-tech industries. The top five states in this indicator are North Dakota (4.58), South Dakota (4.02), Utah (3.84), Rhode Island (3.79), and West Virginia (3.77).

California's best performance in this composite index was in the percentage of Ph.D. holders age 25 and older. With 1.28 percent of this population holding a Ph.D., California ranked seventh again this year. Massachusetts and Maryland placed first and second, respectively, with 1.93 percent and 1.92 percent, while New Mexico came in third at 1.47 percent. Virginia ranked fourth with 1.43 percent, and Connecticut placed fifth with 1.38 percent. The national average in this indicator was 1.01 percent.

Another strength for California was eighth in the number of doctoral engineers per 100,000 people. California had 41.00 doctoral engineers per 100,000 people vs. the national average of 25.87. New Mexico topped the list with 93.92 doctoral engineers by the same measure. Rounding out the top five were Massachusetts (56.03), Delaware (47.04), Vermont (45.15), and Oregon (45.10).

Taken together, California clearly has a wealth of human capital in advanced degree holders. In an innovation-driven economy, these talents form the foundation for sustainable economic growth. Although the state falls short comparatively in bachelor degree holders in science and engineering, it offsets this shortfall with a relatively large percentage of advanced degree holders. However, this does not mean science and engineering bachelor degrees are not important. The types of jobs for these two categories of graduates are different. While advanced degree holders are better suited for knowledge-oriented work that requires higher cognitive processing, bachelor degree holders with the right blend of skills can facilitate and support the execution of these technical tasks. To boost California's Human Capital Investment ranking, the state must find ways to cultivate more bachelor degree holders in science and engineering despite its current budget challenges.

State appropriations for higher education reflect the extent of funding for university systems and shifts in spending patterns. This indicator shows the extent to which states are investing in building human capital. California spent $295.14 per capita on higher education compared with the national average of $272.46 and ranked 15th. The top five states in this measure were Wyoming ($582.94 per capita), Alaska ($473.77 per capita), North Dakota ($467.97 per capita), Hawaii ($454.81 per capita), and New Mexico ($442.49 per capita). California has some ground to cover to even crack the top 10, given that No. 10 Alabama spent $333.62 per capita on higher education.

However, the percent change in state appropriations for higher education suggests a shift in California's priorities. From 2009 to 2010, California increased higher education appropriations by 3.4 percent to rank seventh in that indicator. The top five were North Dakota (18.51 percent), Texas (7.19 percent), North Carolina (5.16 percent), Montana (4.97 percent), and Vermont (4.60 percent). The national average was negative 4.4 percent.

California also performed well in the percentage of bachelor degrees in science and engineering. It placed ninth, with 17.98 percent of bachelor's degrees being in science and engineering vs. the national average of 16.12 percent. The top five were Wyoming (23.53 percent), Montana (21.72 percent), Maryland (21.07 percent), South Dakota (20.69 percent), and Colorado (19.65 percent).

As in the 2008 index, California's strong performances in R&D inputs and risk capital and entrepreneurial infrastructure are not replicated in human capital investments. The findings sound the alarm that California may not produce the right workforce for its high-tech industries despite its world-renowned educational institutions and high-tech anchors. In an era when innovation is increasingly a key factor of production, being able to produce, harness, and retain human capital is critical to not only high-tech industries but also overall sustainable economic growth.

Budget constraints may have restricted California's efforts in this respect. California is experiencing educational budget reductions and teacher layoffs. The University of California and California State University systems are also affected. Because of tuition hikes and the economic downturn, higher education may be less accessible to some of the state's population. The state also was bypassed for federal Race to the Top grants that helped other states shore up their education budgets. For instance, Tennessee and Delaware received $600 million in the first round of grants, and Florida, Georgia, Hawaii, Massachusetts, Maryland, New York, North Carolina, Ohio, Rhode Island, and Washington, D.C. received $350 million in the second round.[30]

Still, California showed some signs of life in higher education. To reiterate, the increase in state appropriations for higher education was large enough to place California in the top 10 in this measure. Given time, California can address its budget challenges and bolster human capital development.

30 "Nine States and the District of Columbia Receive Race to the Top Grants," press release, U.S. Department of Education. http://www.ed.gov/news/press-releases/nine-states-and-district-columbia-win-second-round-race-top-grants (accessed February 8, 2011).

Technology and Science Workforce

Background and Relevance

Transforming innovation into commercial products and services requires a skilled technical and scientific workforce. This process is most successful in a dynamic and collaborative setting that brings research, design, and production together.[31] If concentrated in a specific region, this skilled workforce represents a labor pool with skill sets that are relevant to high-tech industries.[32] Companies near these labor pools can leverage the multitude of skills and lower production costs.

Extrapolating this to the societal level, regions with a strong technology and science workforce are more competitive and better positioned for economic growth, and the high-tech industry can benefit.[33] With a concentrated, skilled labor pool, companies reduce search costs. In the process, new firms are formed, and mature high-tech firms are sustained.[34]

California's Silicon Valley is an example of a flexible, knowledge-sharing, high-tech cluster. Workers move from company to company and maintain informal contact with their ex-colleagues. This leads to informal labor-market networks [35] that can be a source of knowledge accumulation and transfer, boosting the overall knowledge capacity of the region.

Retaining this pool of skilled technical and scientific workers is critical to a region's economic well-being. However, these workers are the hardest to retain because they are flexible and mobile, gravitating to the center of innovation and opportunities. Silicon Valley, with one of the greatest concentrations of innovation in the world, has a highly fluid workforce. Companies there understand that, without challenging work, their employees will change employers.[36] This understanding has helped companies retain workers, which has bolstered Silicon Valley's high-tech leadership.

The definition of a worker in science and technology fields can go beyond the technician. By examining the role of a skilled and valuable workforce, this component focuses on work roles that require higher order cognitive processing. This requires more than simply applying technical know-how to get things done. It involves leveraging existing knowledge and creating new concepts and processes. By generating new knowledge, these workers contribute to the innovation process and transfer these new products and services to the market.

Given the complex work, these employees often operate in a collaborative, interdependent environment. Knowledge is cumulative, so knowledge work flourishes in collaborative systems, highlighting the importance of industry clusters. Over time, these workers create professional communities that maintain a unique body of knowledge that is not easily transmitted via information technologies.

These skilled workers are scientists, engineers, and skilled technicians who are highly trained in disciplines related to science and engineering and/or work in these fields. Although these workers constitute just 5 percent of the workforce on average, their outsized influence on their regional economies belies their small numbers.[37] The quality of this workforce is vital to the attraction and retention of high-tech firms and, in turn, the industry's growth in a region.[38]

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31 Ross DeVol et al., "Manufacturing Matters: California's Performance and Prospects," in Milken Institute Research Report (2002).

32 Paul Krugman, "What's New About the New Economic Geography?," *Oxford Review of Economic Policy* 14, no. 2 (1998).

33 Chris Benner, *Work in the New Economy: Flexible Labor Markets in Silicon Valley* (Blackwell Publishers, 2002).

34 David P. Angel, "High-Technology Agglomeration and the Labor Market" in *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region,* ed. Martin Kenney (Stanford: Stanford University Press, 2000).

35 Kenneth J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in *The Rate and Direction of Inventive Activity: Economic and Social Factors* (Princeton: Princeton University Press, 1962).

36 Gary Hamel, *Leading the Revolution*. Plume.

37 Jarle Moen, "Is Mobility of Technical Personnel a Source of R&D Spillover?," *NBER Working Paper*, no. 7834 (2000).

38 Joel Kotkin, *The New Geography: How the Digital Revolution Is Reshaping the American Landscape* (New York: Random House, 2002).

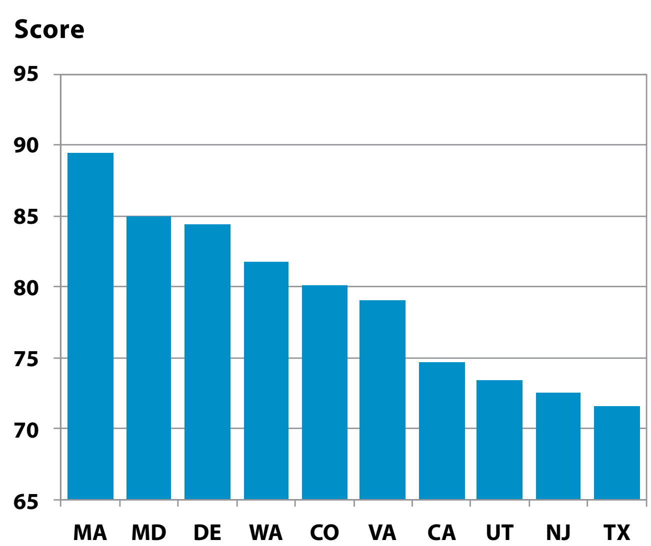
For example, according to the National Association of Colleges and Employers, entry-level engineers continued to be in demand among manufacturing firms in 2010 despite layoffs during the recession.[39] Such demand is why the salaries (adjusted for inflation) of computer and mathematical scientists have jumped 23 percent and those of engineers have climbed 20 percent in the past decade—substantially more than the average 15 percent increase in all science and engineering fields.[40]

California and Other State Rankings

California inched down in the Technology and Science Workforce rankings, dropping from sixth to seventh. California's strongest performances in this component were second in both the concentration of medical scientists and computer hardware engineers. Though its score far exceeded the national average of 56.10 points, that number has been consistently slipping, from 83.56 points (and a ranking of third) in 2004, to 75.00 points in 2008, to 74.67 in 2010. California needs to develop strategies to not only reverse this downward trend but also expand its science and technology workforce. The top five states in this composite index were Massachusetts (89.41 points), Maryland (84.94 points), Delaware (84.40 points), Washington (81.78 points), and Colorado (80.12 points). Figure 8 shows California's overall performance and the national average in the 18 indicators that make up the Technology and Science Workforce Composite Index.

Figure 7. Technology and Science Workforce Composite Index

Top 10 states, 2010

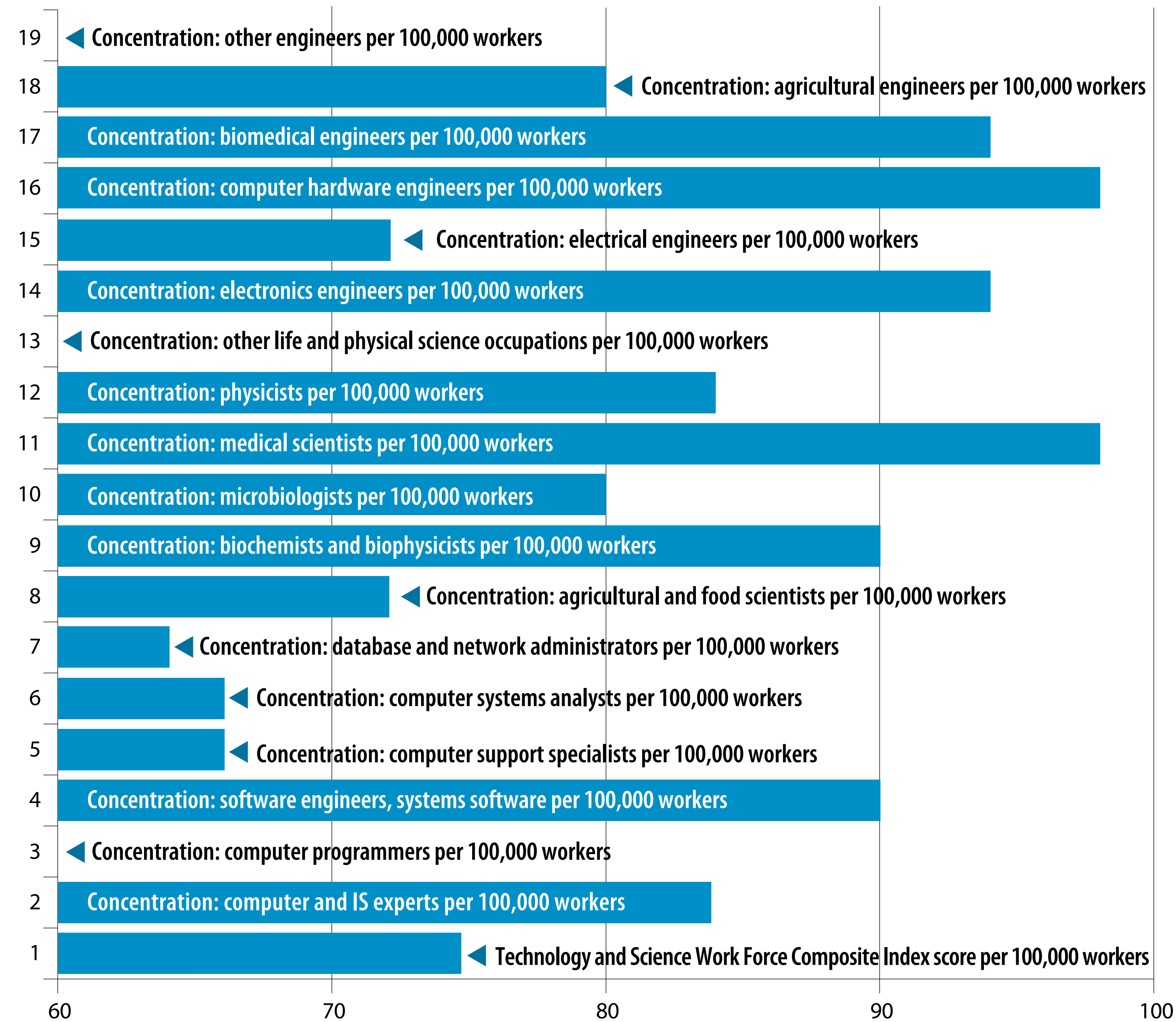


Source: Milken Institute

39 "10 Highest Paying Degrees 2010 – Best Majors in Demand Now." http://www.darwinsfinance.com/top-10-college-degrees-2010 best-majors/ (accessed October 12, 2010).

40 "Science and Engineering Indicators–2008," ed. National Science Board (National Science Foundation, 2008). See also: http://www.nsf.gov/statistics/seind08/c3/c3s1.htm.

Figure 8. California's scores in technology and science workforce components



California's statistics, 2010

	1	2	3	4	5	6	7	8	9	10
California	74.67	27.21	216.99	456.99	414.59	351.16	320.26	18.80	32.87	15.84
U.S. avg.	56.10	21.14	262.20	223.79	377.93	314.17	299.57	18.72	21.97	13.29

	11	12	13	14	15	16	17	18	19
	155.13	13.21	10.71	191.62	127.33	133.44	23.07	1.84	183.40
	56.96	11.16	13.76	90.86	110.72	41.97	11.55	3.71	228.56

The Technology and Science Workforce component measures each state's concentration of workers in key high-tech jobs to determine a region's innovation capacity, ability to supply research, and support for high-tech entrepreneurial activity. Concentration or "intensity" refers to the percent share of employment in a particular industry or occupation as it relates to total state employment.

The Technology and Science Workforce component was divided into three broad fields for analysis: computer and information science, life and physical science, and engineering. This allows us to paint an overall picture of the high-tech workforce in California in comparison to the other states.

The intensity of computer and information science experts was obtained by computing the percentage of these workers relative to total state employment. This category includes computer and information scientists, computer programmers, software engineers, computer support specialists, systems analysts, and database and network administrators.

Similarly, the intensity of life and physical scientists indicator was obtained by computing the percentage of six different types of life and physical science–related jobs relative to total state employment. This category includes agricultural and food scientists, biochemists and biophysicists, microbiologists, medical scientists, physicists, and miscellaneous life and physical scientists.

By the same token, the intensity of engineers was calculated by computing the percentage of six different types of engineering-related jobs relative to total state employment. This category includes electronics engineers, electrical engineers, computer hardware engineers, biomedical engineers, architectural engineers, and other engineers.

California's Performance by Category and Indicator

In the broad category intensity of computer and information science experts, California ranked 15th with a score of 67.00 points. In 2004, California was ranked within the top 10 when it occupied the eighth place. Following the dot-com downturn, it appears that computer and information science experts moved out of California, resulting in its decline in these workers. In addition, several IT jobs have been outsourced to China and India where labor costs are much lower. The top five states in this measure are Virginia (96.00 points), Massachusetts, Maryland (both with 89.00 points), Washington (86.00), and New Jersey (84.00 points).

In intensity of life and physical scientists, California climbed from 11th in 2008 to seventh this year and improved its score to 79.00 points from 77.33 points in 2008. A slight increase in R&D expenditures per capita in life and biomedical sciences could in part explain this improvement. The top five were Delaware (93.33 points), Alaska (91.00 points), Massachusetts (88.33 points), Maryland (86.33 points), and Vermont (84.00 points).

In the category intensity of engineers, California ranked seventh, with an average score of 78.00 points. California clearly has a cache of engineers to propel its high-tech industries. However, it must be noted that in 2008's computation, California ranked fourth with a score of 79.33 points. The top five states in this measure were Massachusetts (91.20 points), Colorado (85.60 points), Virginia (84.00 points), Washington (81.67 points), and New Mexico (78.80 points).

Breaking down these three categories to individual indicators, California's best performances came in concentrations of medical scientists, biomedical engineers, electronics engineers, and computer hardware engineers. In each of these indicators, California ranked in the top five. The state's worst performances were in concentrations of other engineers and computer programmers. In these two indicators, California ranked 36th and 35th, respectively.

In terms of medical scientists, California scored second, with 155.13 medical scientists per 100,000 workers, compared with the U.S. average of 56.96 medical scientists. Still, the state lags far behind Massachusetts, which tops this indicator with 241.74 medical scientists per 100,000 workers. Pennsylvania occupies the third place with 139.00 medical scientists by the same measure. Rounding out the top five were Washington (134.20) and Connecticut (133.70).

California was fourth in concentration of biomedical engineers, with 23.07 per 100,000 workers compared with the national average of 11.55. The state barely bested fifth-place Maryland, which had 23.03 biomedical engineers by the same measure. The top three were Massachusetts (40.19), Utah, (39.83), and Minnesota (28.84). Taken together, California has clear strengths in the medical sector.

California was also fourth in electronics engineers, with 191.62 per 100,000 members of its workforce. The national average was 90.86 electronics engineers per 100,000 workers. Still, California was far outpaced by third-place Rhode Island, with 227.83 electronics engineers by the same measure. The top two states were Colorado with 264.08 and New Mexico with 231.85, while Kansas clocked in at fifth with 166.60.

Computer hardware engineers constitute a relatively large proportion of California's workforce, with 133.44 computer hardware engineers per 100,000 workers. California ranked second to Colorado, which had 172.00 computer hardware engineers per 100,000 workers, compared with the national average of 41.97. Massachusetts was nipping at California's heels, with 132.93 computer hardware engineers. Lagging substantially behind the leaders were fourth-place Utah (90.22) and fifth-place Maryland (88.23). Taken together, these figures show engineering remains important in California's high-tech economy.

However, California turned in relatively weak performances in other life and physical science occupations and other engineers that placed the state in the lower half of these rankings. In the former, California ranked 26th, with 10.71 of these workers per 100,000 members of its workforce vs. the national average of 13.76. In the latter, California ranked 36th, with 183.40 per 100,000 workers vs. the national average of 228.56. As an explanation for this weak performance, it is possible that California's high-tech jobs are so well-defined that there is little need for the "other" category in its workforce makeup.

Overall, California's technology and science workforce shows great strengths. The state has a legacy of high-tech industries and well-defined occupational categories that accommodate the abundance of high-tech workers. The state is about 10 points behind the top three in this component, arguing for effective policies to further develop California's high-tech workforce.

Technology Concentration and Dynamism

Background and Relevance

In the 21st century, high-tech industries play a key role in a region's economy. Their expansion is critical to the region's economic development strategy, so it is not surprising to note that states with strong high-tech clusters perform better than those without. The component on technology concentration and dynamism applies several metrics to ascertain the intensity and presence of high-tech businesses in each state. Intensity refers to the percent share of employment in a particular industry or occupation as it relates to total state employment.

High-tech clusters are the locus of technological activities where new technologies emerge and companies are formed. Within the close geographic proximity of these clusters, knowledge can be efficiently shared[41] and new knowledge formed. Clusters are also characterized by informal social networks, which promote the sustainability of technological clusters.

In the knowledge-based economy, states with vibrant technology clusters are well-positioned for economic growth. Today, regional economic viability depends at least partially on the ability to create these high-tech industry clusters. These industry clusters must be able to leverage local competencies such as customer and supplier relationships, entrepreneurial infrastructure, management practices, motivation, and quality-of-place attributes that allow firms to thrive.[42]

Businesses in close proximity can benefit from the interactions of workers. For example, engineers are likely to have informal relationships with scientists in the region based on university relationships or past collaborations. Their interactions facilitate the possibility of further collaboration[43] that could result in innovation. From a firm's perspective, these constitute contacts that have the potential to develop into formal working relationships.[44]

In a global economy based on technology, regions must develop strong high-tech clusters and support infrastructure to be competitive. With productive use of inputs, these clusters can create innovative competencies that trigger a value chain of sustainable growth. By creating value links to other regions, these clusters gain access to best practices and industry trends.[45] As a result, local firms and talents can grow, while attracting investments and innovation to the region.

The spatial component of economic activities cannot be ignored to understand how an economy functions.[46] This notion of space is captured in innovative industry clusters. Spatial analyses of economic activities show that businesses and workers tend to be in geographical proximity to each other so as to leverage mutual advantages. These agglomeration effects are primarily the result of labor-force pooling, supplier networks, and technology spillovers. These are all part of cluster activities and suggest the importance of high-tech activity concentrations in today's economy.

41 Ross DeVol, "Blueprint for a High-Tech Cluster: The Case of the Microsystems Industry in the Southwest," Milken Institute Policy Brief (2000).

42 Rosabeth Moss Kanter, *Thriving Locally in the Global Economy*, World View: Global Strategies for the New Economy (Boston: Harvard Business School Publishing, 2000).

43 Rupert Waters and Helen Lawton Smith, "Social Networks in High-Technology Local Economies: The Cases of Oxfordshire and Cambridgeshire," *European Urban and Regional Studies* 15, no. 1.

44 Albert-Laszlo Barabasi, *Linked: How Everything Is Connected to Everything Else and What It Means* (Plume, 2003).

45 Diane Coyle, *Paradoxes of Prosperity: Why the New Capitalism Benefits All* (New York: TEXERE, 2001).

46 Mashisa Fujita, Paul Krugman, and Anthony J. Venables, *The Spatial Economy: Cities, Regions, and International Trade* (Cambridge: The MIT Press).

Industry clusters comprise multiple industries that are linked to each other through production value chains and supplier networks, creating a geographic concentration of industry activities.[47] An industry cluster is different from the traditional definition of an industry group. Clusters are made up of research-oriented companies and institutions that contribute to a complex production chain. Clusters also encompass universities, and governmental and other nongovernmental entities such as public-private partnerships, trade associations, and think tanks that provide high-value skills training, education, and research.[48] Entities in these clusters enjoy advantages in efficiency, effectiveness, and flexibility.[49] Together, they facilitate wealth creation through the development and exportation of goods and services.

High-tech concentrations of firms, universities, and research institutions must not merely have a few dominant anchor players. To be effective in facilitating economic growth, they must be sufficiently dynamic to include newly formed entrepreneurial firms that tap the flow of technologies and play a role in the value-added networks. The presence of these smaller firms may help quicken the pace of innovation and provide avenues for new entrants to the networks. This results in a flexible and sustainable conglomeration that continues to produce innovation and create new market opportunities.

To be sustainable, technology clusters require a diverse base of industries. Clusters composed of a few technology industries run the risk of becoming a liability during an economic downturn.[50] In addition, this diversity serves as an engine of innovation in the cluster, creating a competitive advantage for the region. Diversity also facilitates the fast adoption of technologies in a collective cumulative fashion.[51] According to R.N. Kostoff, "An advanced pool of knowledge must be developed in many fields before synthesis leading to innovation can occur."[52] Furthermore, this diversity supports cross-industry collaborations that have been the hallmark of new and top-performing inter-disciplinary industries such as biotechnology.

47 Joel Kotkin and Ross DeVol, "Knowledge-Values Cities in the Digital Age," Milken Institute Research Report (2001).
48 Porter, *On Competition*.
49 Porter, *Clusters and the New Economics of Competition*.
50 Ross DeVol, "America›s High-Tech Economy, Development, and Risks for Metropolitan Areas," Milken Institute Research Report (1999).
51 Jane Jacobs, *The Economies of Cities* (New York: Vintage Books, 1968).
52 R.N. Kostoff, "Successful Innovation: Lessons from the Literature," *Research-Technology Management* 60, no. 1 (1994).

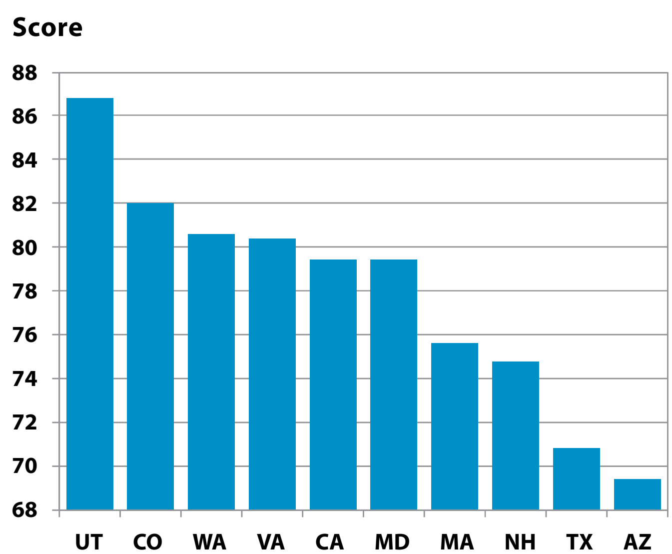
California and Other State Rankings

California improved its performance substantially in technology concentration and dynamism since the 2008 index. California climbed from seventh to fifth in this composite index with a score of 79.40, a significant jump from 72.60 points in 2008. The top five states in this component are close in terms of average scores. Utah topped the list with 86.80 points, followed by Colorado (82.00), Washington (80.60), Virginia (80.40), and California and Maryland (tied for fifth).

Figure 10 shows California's overall performance and the national average in each of the 10 indicators that make up the Tech Concentration and Dynamism Composite Index. This component departs from the preceding ones, focusing instead on payroll, business formation, and growth in high-tech industries. The four preceding components—R&D inputs, risk capital, human capital, and tech and science workforce—act as fuel for the Technology Concentration and Dynamism component, which reflects each state's success in its high-tech sector.

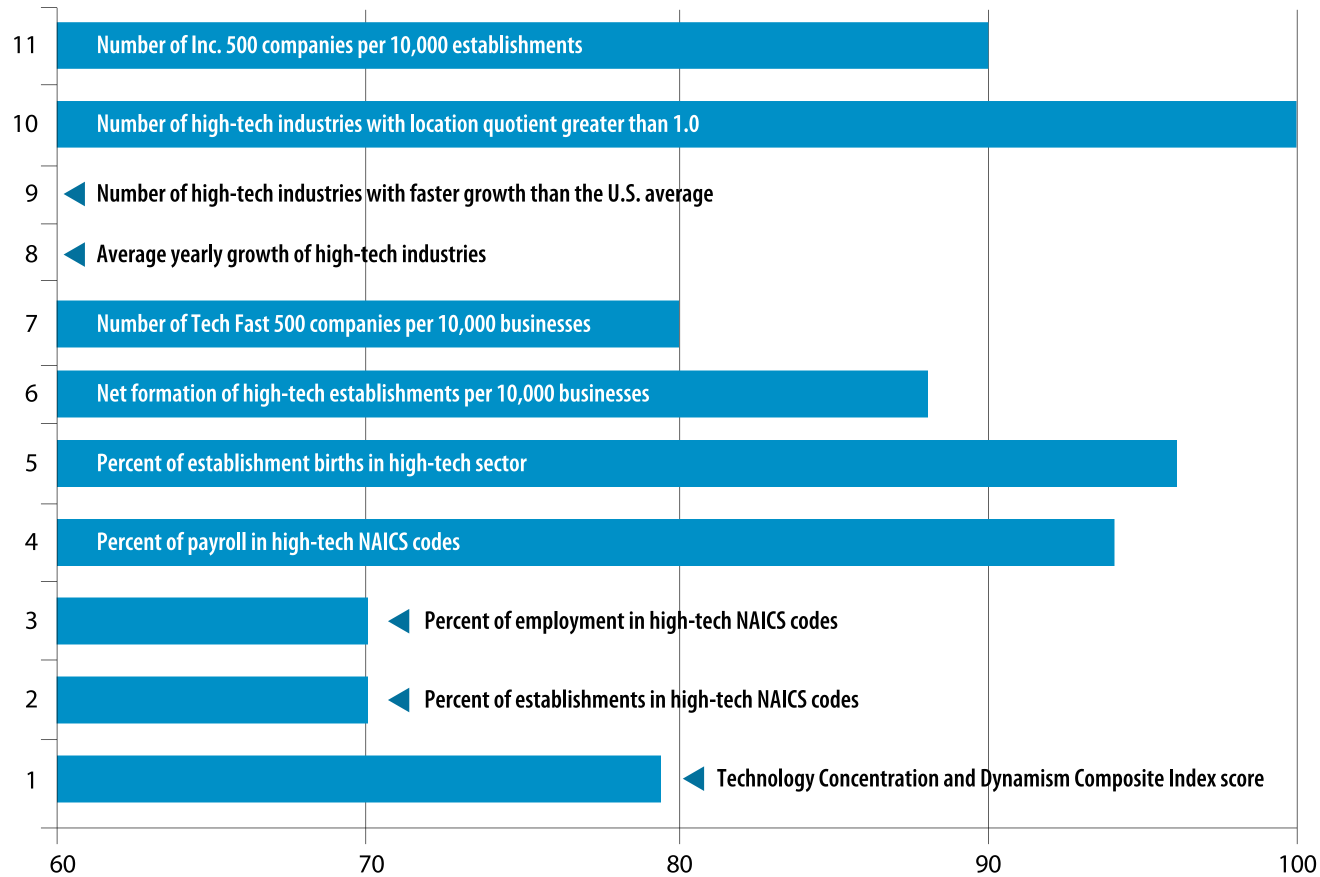
Figure 9. Technology Concentration and Dynamism Composite Index

Top 10 states, 2010



Source: Milken Institute.

Figure 10. California's scores in technology concentration and dynamism components



California's statistics, 2010

	1	2	3	4	5	6	7	8	9	10	11
California	79.40	6.98%	10.43%	15.73%	11.46%	30	1.50	-0.19%	10	18	0.9
U.S. avg.	53.50	6.27%	5.84%	8.72%	9.11%	17	0.38	1.88%	10.9	5.5	0.5

California's Performance by Indicator

California performed remarkably well in three indicators—percentage of payrolls in high-tech industries, number of high-tech industries with a location quotient of more than 1.0[53], and number of Tech Fast 500 companies per 10,000 business establishments—ranking in the top three. Its worst performances came in average annual growth of high-tech industries and number of high-tech industries growing faster than the U.S. average. In these two indicators, the state ranked 36th and 26th, respectively.

With 15.73 percent of its payroll stemming from high-tech industries, California ranked third in this indicator, just steps behind Massachusetts, where high-tech industries make up 16.40 percent of payrolls. Washington had the highest percentage in this indicator with 17.76 percent. Rounding out the top five are Virginia with 15.65 percent and Colorado with 14.90 percent.

At the same time, California has 18 high-tech industries with location quotients of more than 1.0., giving the state a first-place finish for the second consecutive index. This finding is not surprising, given the Golden State's dominant high-tech clusters, particularly in San Jose. Trailing California were Massachusetts (15 industries), Utah (14), Colorado (11), and Connecticut (10).

California ranked in the top six in measurements involving Tech Fast 500 and Inc. 500 companies. The Tech Fast 500, a list of the fastest-growing tech companies, can reflect the dynamism of a region's high-tech sector. Similarly, the Inc. 500 also lists the fastest-growing companies, but it is not specific to high-tech. Together, they can depict how well a region's high-tech companies are performing against other companies in general.

With 1.5 Tech Fast 500 companies per 10,000 business establishments, California ranked third in this indicator, far surpassing the national average of 0.38 companies. Though it had the same number of companies in 2008's index, California ranked fourth that year. The top two states in this indicator are Massachusetts (2.5 companies) and Connecticut (1.6 companies). Maryland occupied fourth with 1.4 companies, and New Jersey and Virginia shared fifth with 1.3 companies apiece.

In terms of Inc. 500 companies, California tied with Colorado, Massachusetts, Minnesota, and Texas for sixth, with 0.9 companies per 10,000 business establishments. The top five were Utah (two companies), New Hampshire, Virginia (both with 1.8), Maryland (1.4), and Washington (1.0).

The number of new high-tech businesses also reflects how dynamic a region's tech industries are. California ranked seventh in percentage of business births in high-tech industries, with 11.46 percent. The top five in this indicator were Virginia (14.86 percent), Delaware (14.26 percent), Colorado (13.15 percent), Maryland (12.72 percent), and Massachusetts (12.46 percent). Although California lagged these states, the state's top 10 finish proves its ability to sustain its high-tech industries that continue to play an important role in driving the state's economy.

High-tech industries stimulate the economy differently in different locations, depending on the size of the region and the corresponding multiplier effect. [54] A region may have a strong high-tech presence, but the sector may not be growing quickly. Presence and growth are two different concepts. While the former reflects the current strength of a sector, the latter shows its dynamism. The indicator number of high-tech industries growing faster than the U.S. average seeks to measure this dynamism by looking at high-tech performances in the past five years.

Although they constitute much of the state's economy, just 10 of California's high-tech industries are growing faster than the U.S. average, compared with 11 in 2008's index. However, while California ranked 36th in 2008, it

53 An industry's location quotient measures a location's (in this case, a state's) level of employment concentration relative to the industry average across the United States. A high-tech industry in a state with an employment LQ higher than 1.0 is more densely concentrated in that state than in the nation on average.

54 Yujeung Ho, "Contribution of High-Technology Industry to Regional Economic Growth at Different Positions in the Distribution of a Region's Size," International Review of Public Administration, vol. 12, no. 1 (2007).

leaped to 26th this year, tied with six other states. The leaders in this indicator are North Carolina (18 industries), Alaska (17), South Carolina (16), and Mississippi, Montana, and Oregon (tied, with 15 companies).

In average annual growth among the high-tech industries, California ranked 36th nationwide with a decline of 0.19 percent—a marked improvement from 41st with a 3.2 percent decline in the 2008 index. The top five states in this measure are Alaska (18.44 percent), Idaho (12.87 percent), South Dakota (6.89 percent), New Hampshire (6.41 percent), and Montana (5.95 percent).

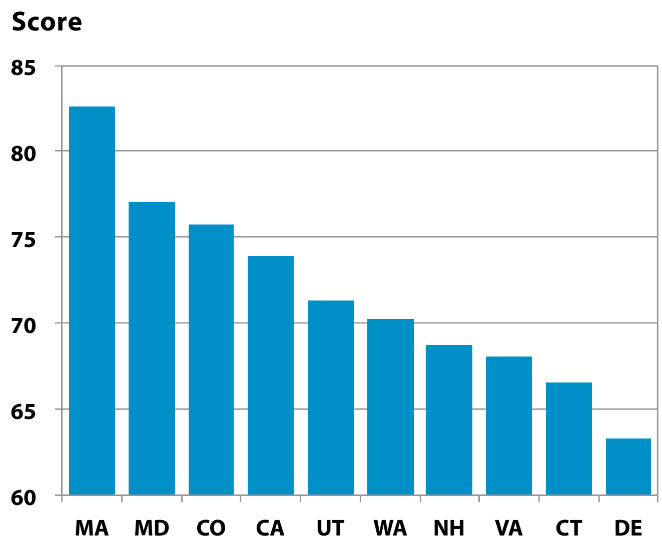
Taken together, these indicators show some weaknesses in technology concentration and dynamism but also significant improvements since 2008's index. Further, 10.43 percent of California's employment and 6.98 percent of its establishments are in the high-tech sector compared with the national averages of 5.84 percent and 6.27 percent, respectively. There is reason for optimism that the state has the right elements in place to sustain the high-tech assets that help drive its economy.

Overall Findings and California's Performance

The overall State Technology and Science Index incorporates the results of the five composite indexes discussed above: Each state's scores in each component are averaged to produce an overall performance measure in the Index.

- Research and development capabilities that can be commercialized
- Entrepreneurial capacity and risk capital infrastructure that determine the success rate of converting research into viable technology services and products
- Human capital, the most important intangible asset
- Technology and science workforce, the high-end technical talent on the ground
- Technology concentration and dynamism, an indicator of outcomes, growth, and effectiveness in transforming regional assets into regional prosperity

Figure 11. State Technology and Science Index
Top 10 states, 2010



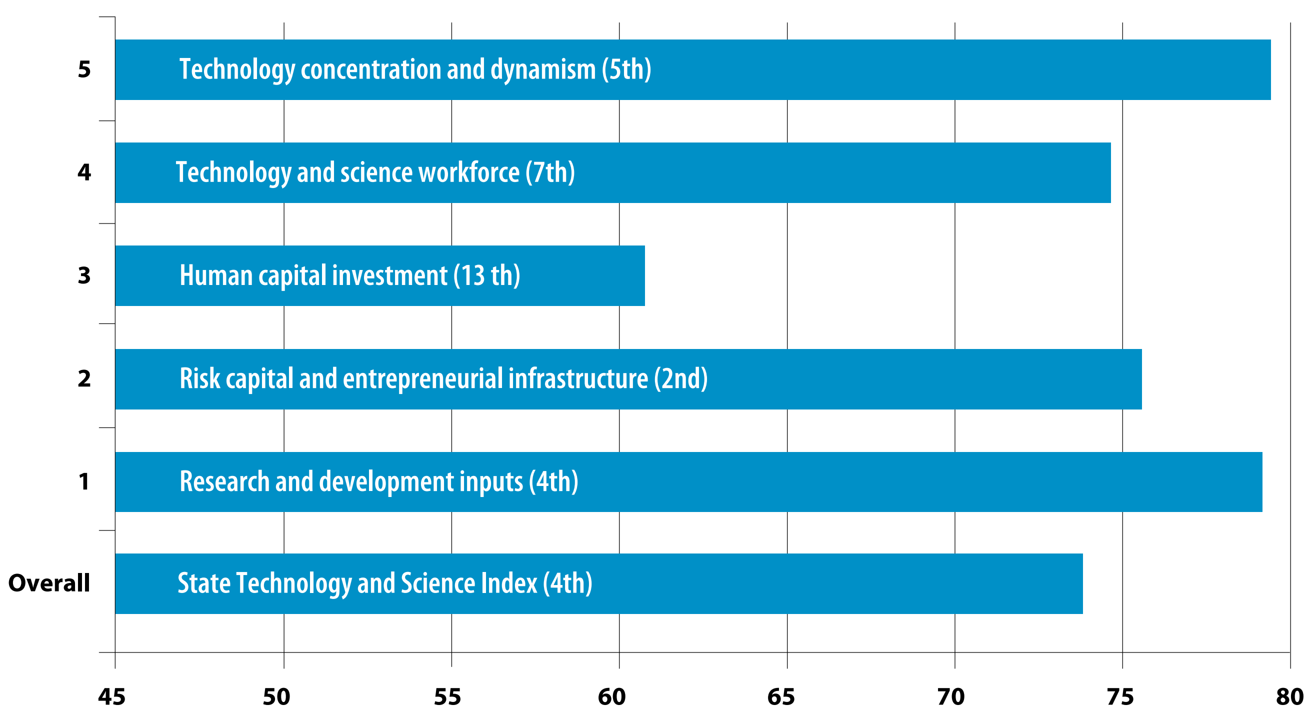
Source: Milken Institute

California continues to rank fourth overall in the 2010 State Technology and Science Index. With a score of 73.85 points, the state far exceeded the U.S. average of 52.38 points. The top three states overall are Massachusetts (82.61 points), Maryland (77.05 points), and Colorado (75.73 points). Rounding out the top 10 are Utah (71.26 points), Washington (70.23 points), New Hampshire (68.69 points), Virginia (68.05 points), Connecticut (66.56 points), and newcomer Delaware (63.26 points).

California maintained its top five position through its strong, established foundations in technology concentration, R&D, and ability to attract risk capital. These strengths are not surprising, given California's vibrant high-tech clusters in San Jose and elsewhere. California's weaknesses were in human capital investments and, to a lesser extent, science and technology workforce, largely because California's budget deficit has led to cuts in the education budget. While the state attracts highly educated experts in science and technology, California needs to improve its home-grown human capital so it can produce a continuous flow of workers to the state's high-tech industries.

Fast-growing developing countries are becoming havens for high-tech industries seeking lower labor costs. China and India are two notable examples whose high-tech industries are growing rapidly, thanks largely to outsourcing. California still has many strong high-tech industries, as shown in its performance in Technology Concentration and Dynamism. But to sustain its strength and retain its attractiveness to risk capital and entrepreneurship, the state must not only encourage R&D but also develop sustainable processes for homegrown talents.

Figure 12. California's overall performance



California, 2010

	1	2	3	4	5	Overall
California	79.06	75.45	60.67	74.67	79.40	73.85
U.S. avg.	51.09	50.06	51.16	56.10	53.50	52.38

State Technology and Science Index: Components

California's Position in Technology and Science

Definition

California's overall position in technology and science is derived from its performance in five major composite indexes: Research and Development Inputs, Risk Capital and Entrepreneurial Infrastructure, Human Capital Investment, Technology and Science Workforce, and Technology Concentration and Dynamism. Each component that goes into these indexes is described in detail in the following pages. The five indexes are weighted equally in determining each state's overall performance. The data was collected from governmental agencies, foundations, and private sources, and has been compiled and analyzed by the Milken Institute.

Why Is It Important?

This overall ranking represents an inventory of each state's technology and science assets. Its value lies in the breadth, depth, and relevance of the indicators. The first set of indicators calculated, research and development inputs, draws a relationship between levels of R&D spending and which fields of research are hotbeds for technological innovation. The Risk Capital and Entrepreneurial Infrastructure Composite Index reveals a state's capabilities for supporting entrepreneurial activity and its comparative success in risk capital funding. The indicators for Human Capital Investment show how each state is positioned to attract and sustain high-tech industries based on the educational preparedness of its residents and its financial commitment toward higher education. The Technology and Science Workforce Composite Index drills down further to show whether each state has a sufficient base of high-end technical talent. The final set of indicators on Technology Concentration and Dynamism essentially measures technology outcomes—that is, how successfully the other sets of indicators produced tangible results by creating a sizable population of high-tech firms and workers.

The Index and California

Overall, California scored 73.85 points to retain fourth place in the 2010 index. The Golden State is about eight points behind the leader, Massachusetts, and 21 points higher than the U.S. average of 52.53 points. The following sub-sections provide additional details about California's strengths and weaknesses.

Figure 13. State Technology and Science Index
2010

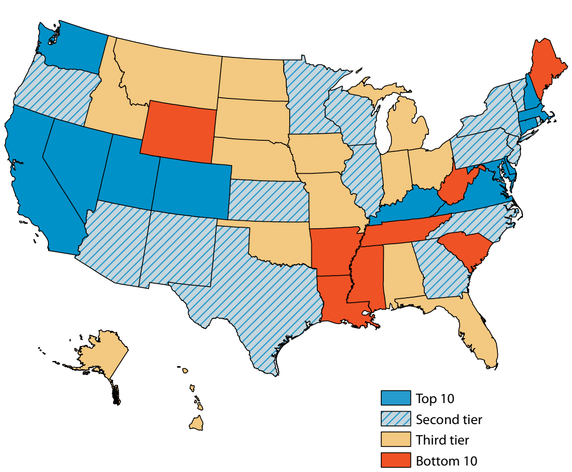
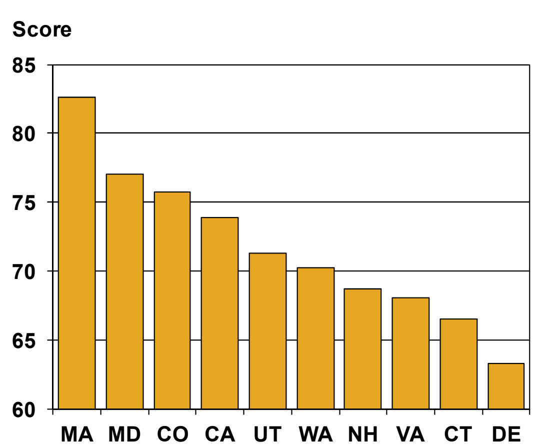


Figure 14. State Technology and Science Index Results
Top 10 states, 2010



Source: Milken Institute.

Research and Development Inputs Composite Index

Definition

The Milken Institute's assessment of California's position in technology and science is based on its performance in five composite indexes, the first of which is Research and Development Inputs (RDI). The RDI Composite Index score is derived by averaging each state's performance in 18 separate indicators. The three basic types of R&D funding (academic, industry, and federal) are assigned weights of 1.15, 6.04, and 2.81, respectively. This adjustment is necessary to appropriately capture the differences in funding levels among the three sources. The component data is collected from various agencies and compiled by the Milken Institute.

Why Is It Important?

Investments in R&D fuel scientific discoveries that lead to regional economic growth in the form of new companies and new products. R&D is carried out at the federal, industry, and academic levels. Each type has the ability to spark specific technological progress, either at the firm level by encouraging infant business starts or by targeting universities that excel in different scientific fields. The magnitude of the impact varies, according to the number of nodes and linkages the recipient has to the region. The more links, the more significant the impact to the economy.

The RDI Composite Index measures R&D activity across states by examining differing types of R&D funding, as well as where and how these funds are spent. The RDI helps us assess each state's research and development legacy as well as opportunities for future technological success.

R&D Inputs and California

In this component, California scored 79.06 points, one point less than in 2008. However, the Golden State slid from third to fourth this year, displaced by New Hampshire, which crept up two spots in the rankings. Once again, Massachusetts and Maryland led the pack, scoring 93.15 and 84.91, respectively. California lost some ground in funding received from the National Science Foundation (NSF). New Hampshire's excellent performance in this measure helped it leapfrog the Golden State.

Figure 15. Research and Development Inputs Composite Index
2010

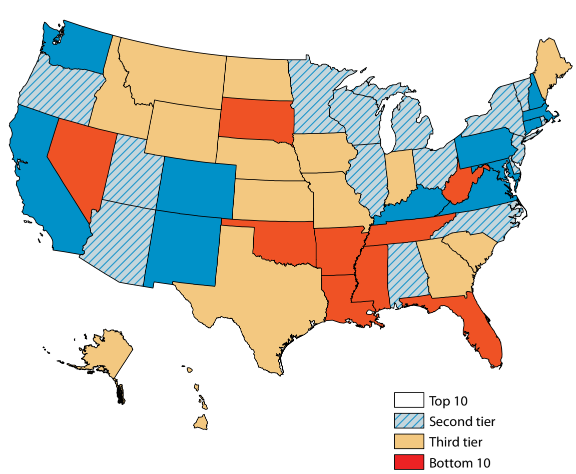
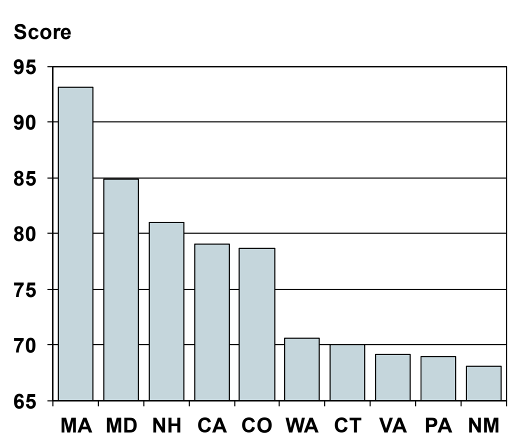


Figure 16. Research and Development Inputs Composite Index
Top 10 states, 2010



Source: Milken Institute.

Federal R&D Dollars per Capita

Definition

The indicator for federal research and development dollars per capita is calculated by dividing each state's federal R&D total by its population. Federal R&D is the sum of all spending for basic and applied research in projects pertaining to national defense, health, space research, technology, energy, and general science. The data is collected by the National Science Foundation. Population figures represent a state's total population and are collected by the U.S. Census Bureau.

Why Is It Important?

This indicator illustrates the role of federal R&D in a state's economy. The latest figures show that federal R&D for all 50 states totaled $103.3 billion, an average of $319.74 per capita. The top two states in this category, Maryland and New Mexico, retained the top two positions they have enjoyed since the 2004 index. Maryland received more than $2,230 per resident, while New Mexico received nearly $1,600 per resident in 2006, the most recent figures available.

The leading recipients of federal R&D dollars have heavy concentrations of health and national security. Maryland, New Mexico, Virginia, and Massachusetts all serve as bases for major government research programs. Government research programs function as a public good but can have tremendous potential to plant the seeds for new technology ventures.

Federal R&D spending supports stand-alone research institutions such as Maryland's National Institutes of Health and New Mexico's Los Alamos National Laboratory as well as the work of research universities. As with financial support of scientific research in general, the real value of federally funded R&D is not only in its dollar amount but also in its ability to foster and sustain a state's pool of skilled human capital.

Federal R&D and California

In this measure, California gained four points since 2008 for a score of 90 and climbed two spots in the rankings to sixth, behind first-place Maryland, New Mexico, Virginia, Massachusetts, and Washington. In both the 2008 and 2010 indexes, California attracted considerable R&D funding from federal sources. In the latest index in particular, the state received $585 per capita vs. $503 in the 2008 index. Still, the Golden State lags far behind fifth-place Washington, with $635 in funding per capita, and first-place Maryland, with a remarkable $2,231 per capita.

Figure 17. Federal R&D spending
Dollars per capita, 2006

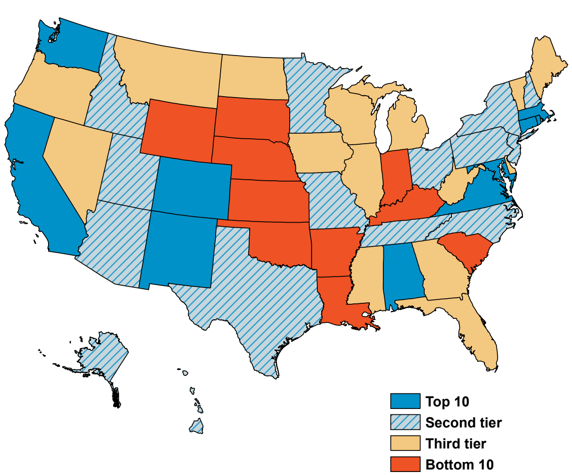
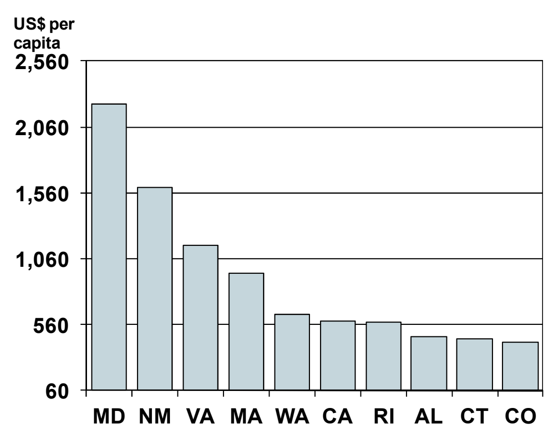


Figure 18. Federal R&D spending
Top 10 states, 2006



Sources: Milken Institute, National Science Foundation, U.S. Census Bureau.

Industry R&D Dollars per Capita

Definition

This indicator measures each state's level of commercial industry financial support for R&D adjusted for total population. The indicator is calculated by adding up the amount each state's nonfarm industry sector spends on R&D and dividing the sum by population. Industry R&D is the sum of all amounts spent by corporations on basic and applied research, including those amounts spent by corporations on federally funded R&D centers. Spending data is provided by the National Science Foundation. Population data comes from the U.S. Census Bureau.

Why Is It Important?

This indicator illustrates the role of industry R&D in a state's economy. Latest figures indicate that total industry R&D for all 50 states exceeds $265 billion, for an average of $694 per capita.

Industry R&D is by far the largest of the three R&D types (federal, industry, and academic), representing slightly more than 65 percent of total spending. As a result, its weight in the Research and Development Composite Index is roughly six times that of academic R&D and three times that of federal R&D.

Corporate R&D is a strong indicator of how companies are investing in their future. Firms spend their R&D dollars primarily in states with talented and educated workforces. The fruits of R&D often take years to materialize, but without this investment, companies eventually lose their competitive edge.

Industry R&D and California

California received $1,764 per capita in industry R&D funding—about three times what it received from the federal government. Despite a remarkable $464 increase from the 2008 index, California remained fifth, behind first-place Massachusetts, Connecticut, New Jersey, and Washington. Thanks to Silicon Valley, it is no surprise that California performed well in this measure. Meanwhile, New Jersey gained significant ground, with an $800 increase to $2,068 per capita, propelling it from seventh to third.

Figure 19. Industry R&D spending
Dollars per capita, 2007

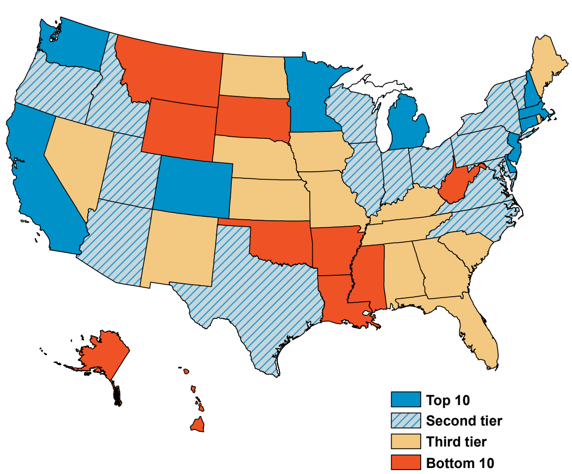
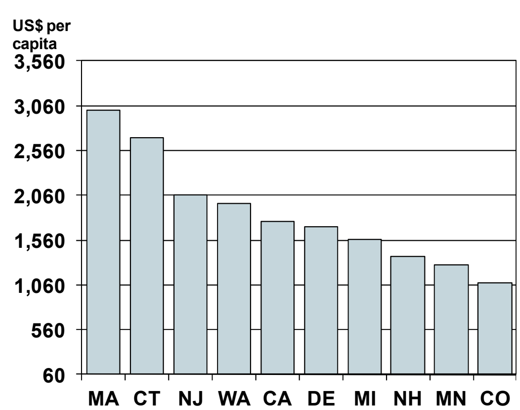


Figure 20. Industry R&D spending
Top 10 states, 2007



Sources: Milken Institute, National Science Foundation, U.S. Census Bureau.

Academic R&D Dollars per Capita

Definition

Academic research and development dollars per capita is calculated by dividing the amount of money spent on R&D by each state's colleges and universities by that state's population. All research, basic and applied, performed by colleges and universities may be funded by a combination of federal, industry, and academic sources; that data is collected by the National Science Foundation. Population statistics are collected by the U.S. Census Bureau. R&D figures reported by academic institutions from federal sources will differ from those reported by the federal government for academic institutions because the funds are not necessarily spent in the same year they are awarded.

Why Is It Important?

This indicator illustrates the importance of university research as well as the strength and competence of each state's university system. In contrast to R&D performed by the private sector, academic R&D tends to focus primarily on basic rather than applied research. The latest figures indicate that the nation's total academic R&D spending exceeds $49 billion, or an average of $164 per U.S. resident.

R&D performed by colleges and universities differs from government and industry R&D because it typically focuses on fundamental scientific discoveries rather than product or technology development. Although academic research has traditionally been somewhat divorced from the marketplace, academic R&D can serve as a magnet for fostering and attracting knowledge-intensive businesses that seek to hire academic researchers and benefit from their discoveries.

Academic R&D and California

California spends considerably less on academic R&D compared to federal and industry R&D funding. At a slightly improved $185 per capita, the state gained a spot to rank 18th, placing it in the second tier of states in this measure. Maryland and Massachusetts again led the pack, followed by North Dakota, Alaska, and New Hampshire.

Figure 21. Academic R&D spending
Dollars per capita, 2007

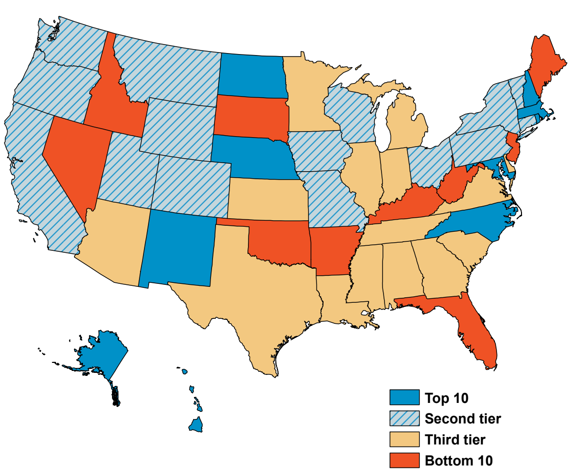
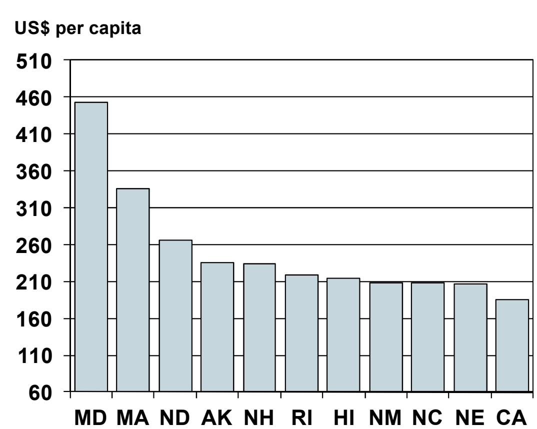


Figure 22. Academic R&D spending
Top 10 states and California, 2007



*California is ranked 18th.
Sources: Milken Institute, National Science Foundation, U.S. Census Bureau.

National Science Foundation Funding

Definition

This indicator shows the dollar amount of funding awarded by the National Science Foundation (NSF) per $100,000 of each state's gross state product (GSP). The NSF is an independent agency of the U.S. government that funds research and education in science and engineering through grants, contracts, and cooperative agreements. The largest beneficiaries of NSF awards are universities and nonprofit nonacademic institutions, such as museums and research laboratories. Data on NSF funding comes from the NSF itself. GSP figures are provided by the Bureau of Economic Analysis in the U.S. Department of Commerce.

Why Is It Important?

This indicator measures the impact of NSF funding on a state's economy. NSF funding is the second-largest source of federal funding, to the tune of roughly $5.38 billion in 2007.

Since 1950, the NSF has invested in the key driver of technological progress: intellectually creative people. Its financial support of world-class research and education has led to multiple breakthroughs in science, engineering, and other fields. NSF-supported researchers have been awarded more than 100 Nobel Prizes in physics, chemistry, physiology, and economics.

NSF Funding and California

California slid in the rankings from 15th to 18th in the rankings, receiving almost $60 for every $100,000 of gross state product (GSP), or about $6 less than the U.S. average. Still, the state's per capita funding was markedly higher than the $50 it received in the last index and that year's national average of $48. These findings suggest that despite the increase in NSF funding, California's relative performance in this area has weakened.

The leaders were Alaska ($560), Colorado ($153), Massachusetts ($141), Rhode Island ($129), and Virginia ($125). All these states except Virginia saw improvements in both ranking and NSF funding received. Given the importance of NSF's role in supporting innovation, it is vital for California to continue attracting NSF funding to support its world-renowned R&D facilities.

Figure 23. National Science Foundation funding
Per $100,000 of GSP, 2009

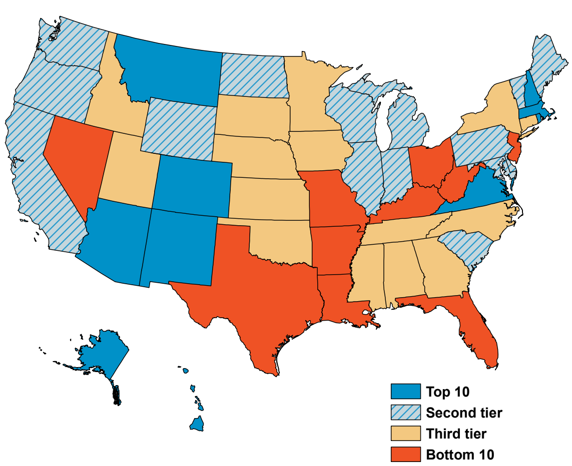
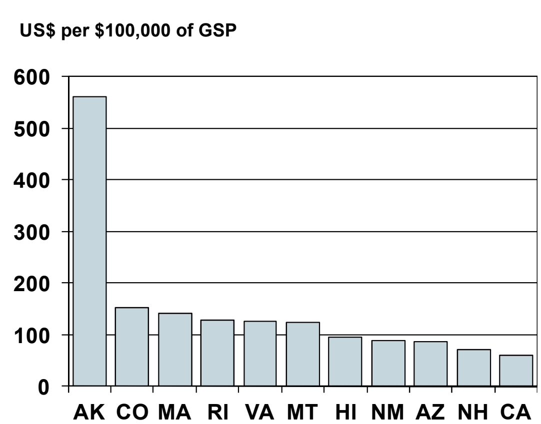


Figure 24. National Science Foundation funding
Top 10 states and California, 2009



*California ranked 18th.

Sources: National Science Foundation, U.S. Bureau of Economic Analysis.

National Science Foundation Research Funding

Definition

NSF research funding per $100,000 of GSP is calculated by deriving the dollar amount of funds awarded by the NSF specifically for research for every $100,000 of GSP. As discussed, the NSF is an independent agency of the U.S. government that funds research and education in science and engineering through grants, contracts, and cooperative agreements. The largest beneficiaries are universities and nonprofit nonacademic institutions, such as museums and research laboratories. The data is provided by the NSF itself. GSP data is collected by the Bureau of Economic Analysis in the U.S. Department of Commerce.

The difference between NSF funding, described on the previous page, and NSF *research* funding is that the former is more inclusive, representing funds awarded for both research and education, while this component isolates funding awarded for research only.

Why Is It Important?

The indicator measures the impact of NSF funding on a state's economy. In 2009, NSF research awards exceeded $4.5 billion.

Through their work, recipients of NSF research funding develop and expand a state's R&D track record and future capacity—elements that heighten recognition of a state's science and technology capabilities and attract more support for R&D activities. The NSF acts on the premise that institutions and their science and engineering experts are valuable resources that can influence a state's development.

NSF Research Funding and California

California received $50 in NSF research funding per $100,000 of GSP in the 2010 index, about $7 more than in the last index. However, in the 2008 edition, the state received $6 per $100,000 of GSP more than the national average of $37. This time it virtually matched the national average of $50. As a result, its ranking fell from 12th to 20th. The top five states in this measure are Colorado ($142), Alaska ($138), Rhode Island ($125), Massachusetts ($121), and Montana ($97). The top four obtained more than double the amount of NSF research funding that California received.

Figure 25. National Science Foundation research funding
Per $100,000 of GSP, 2009

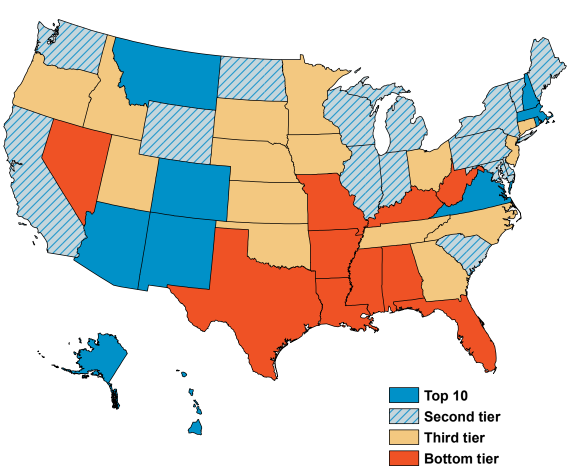
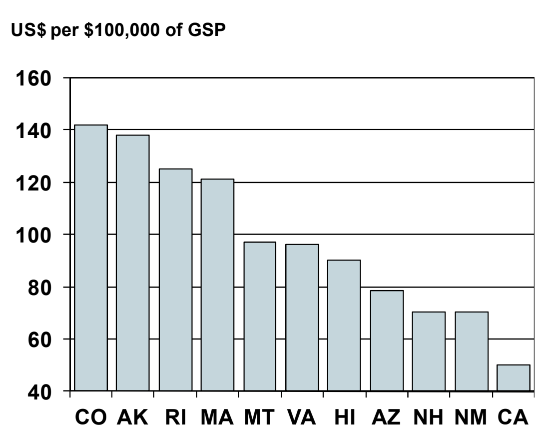


Figure 26. National Science Foundation research funding
Top 10 states and California, 2009



*California ranked 20th.

Sources: National Science Foundation, U.S. Bureau of Economic Analysis.

R&D Expenditures on Engineering

Definition

The indicator for R&D expenditures on engineering is measured in dollars per capita. It is calculated by dividing the statewide funds spent at doctorate-granting institutions on various basic and applied engineering programs by each state's respective population. All recognized engineering programs that spend funds on research are accounted for here. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation.

Why Is It Important?

This indicator illustrates each state's relative level of institutional R&D spending on engineering research projects. More than $7.5 billion of all R&D funding at doctorate-granting institutions was spent on engineering research in 2007, for a national average of $25.77 per capita. While R&D expenditures on life sciences dominate at doctorate-granting universities, accounting for 60 percent of all R&D funding, engineering research was the second-highest priority, accounting for 15 percent.[55]

Advances and discoveries across multiple engineering disciplines—especially in areas such as computer science and nanotechnology—are important drivers of a state's high-tech economy, not to mention important contributors to improving national security capabilities. Universities in states with world-class engineering programs will continue to be well-positioned to attract research funding and produce a highly educated labor force.

Engineering R&D and California

California spends $22.73 per capita on engineering R&D, about $3 less than the national average, to rank 23rd. California's position in this measure has fallen since its 12th place finish in the first index in 2002, dropping to 21st in the 2004 edition and recovering slightly to 19th in 2008. The top five in this measure were Maryland ($114.35), New Mexico ($78.00), North Dakota ($67.44), Massachusetts ($61.55), and Delaware ($50.10).

Figure 27. R&D expenditures on engineering
Per capita, 2007

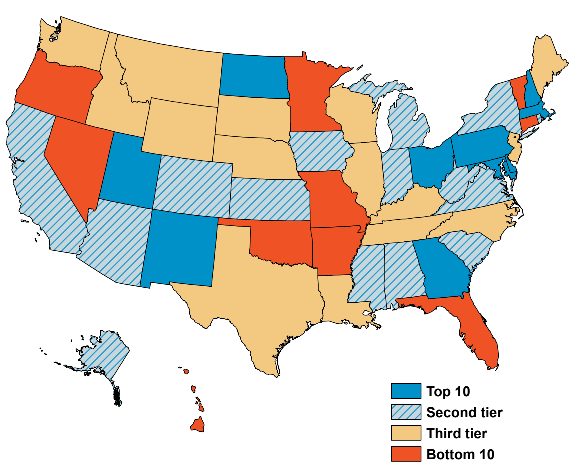
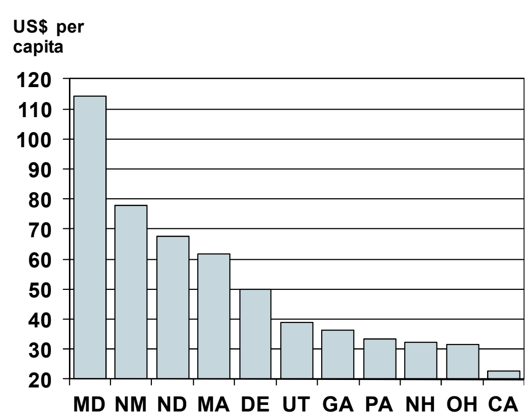


Figure 28. R&D expenditures on engineering
Top 10 states and California, 2007



*California ranked 23rd.
Sources: National Science Foundation, U.S. Census Bureau.

55 National Science Foundation/National Center for Science and Engineering Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007.

R&D Expenditures on Physical Sciences

Definition

The indicator for R&D expenditures on physical sciences is measured in dollars per capita. It is calculated by dividing the statewide funds spent at doctorate-granting universities on various basic and applied physical sciences programs by each state's respective population. All physical science research programs, from mathematics and physics to astronomy and materials research, are accounted for here. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation.

Why Is It Important?

Some $3.8 billion of all R&D at doctorate-granting universities was spent on research relating to the physical sciences in 2007 (the most recent data available), for an average per capita of nearly $12.00. Almost 8 percent of all institutional R&D at doctorate-granting universities was spent on research in the physical sciences, making it the third-best-funded category of R&D expenditures.

Significant advances in physical sciences, such as the continuing discovery of planets that exhibit similar characteristics to Earth's and the discovery that pressurized nitrogen can act as a semiconductor, continue to open new frontiers for science and technology. University-based research expenditures in this area help attract and retain highly qualified individuals who contribute to the innovative dynamics of a state's economy. Even when carrying out basic research, they may eventually have an immense impact on advances in commercial technology.

Physical Science R&D and California

California fell two places in 2010 to 10th, though it spent roughly the same amount on physical science R&D as in the previous index ($18.36 per capita vs. $18.41 in 2008). Still, this static spending is more than the national average of $11.99 per capita. The top five states in this measure were Massachusetts ($37.95), Maryland ($36.65), Hawaii ($31.63), New Mexico ($26.95), and Arizona ($26.79). The top two—knowledge-intensive states with world-renowned R&D assets—spend about twice as much as California in physical science R&D.

Figure 29. R&D expenditures on physical sciences
Per capita, 2007

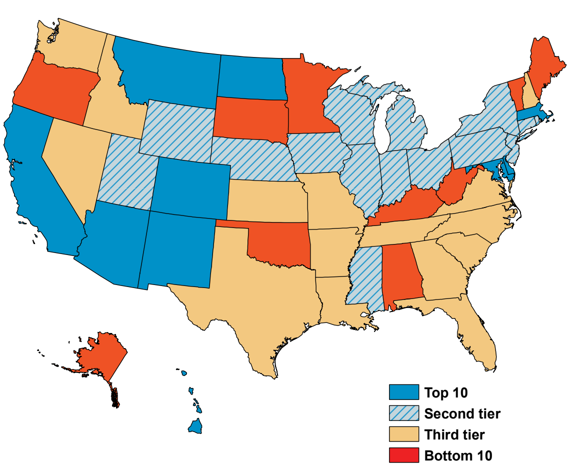
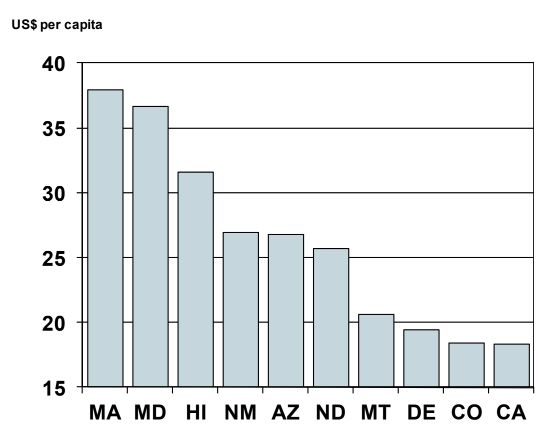


Figure 30. R&D expenditures on physical sciences
Top 10 states, 2007



Sources: National Science Foundation, U.S. Census Bureau.

R&D Expenditures on Environmental Sciences

Definition

The indicator for R&D expenditures on environmental sciences is measured in dollars per capita. It is calculated by dividing the statewide funding at doctorate-granting universities on various basic and applied environmental science programs by each state's respective population. All funded research programs, from studies on environmental biocomplexity to analysis of climate change, are captured in the data, collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The population statistics are provided by the U.S. Census Bureau.

Why Is It Important?

This indicator measures relative spending levels for institutional R&D in the environmental sciences. More than $2.7 billion of all R&D at doctorate-granting universities was spent on research in this field in 2007, an average of $13.31 per capita, accounting for 5.5 percent of all institutional R&D.

Environmental science supports such highly valued commercial fields as environmental technologies and even genomics. Regarding the latter, projects are exploring genomic approaches to environmental issues, gaining understanding of how organisms interact with or adjust to their environment. Further discoveries in environmental sciences will potentially heighten attention to the field, allowing it to obtain even higher amounts of funding.

Environmental Science R&D and California

At 17th, California continued to rank among the top 20 in R&D spending on environmental science. The state spent $10.72 per capita, significantly less than the national average of $13.31. The top five states in this measure were Alaska ($119.24), Hawaii ($53.10), New Hampshire ($43.27), Colorado ($38.67), and Rhode Island ($32.54). Although these states are not traditional knowledge-intensive powerhouses, they all spend more than twice what California does on environmental science R&D. In fact, the top nine states all spend at least twice as much as California in this regard.

Figure 31. R&D expenditures on environmental sciences
Per capita, 2007

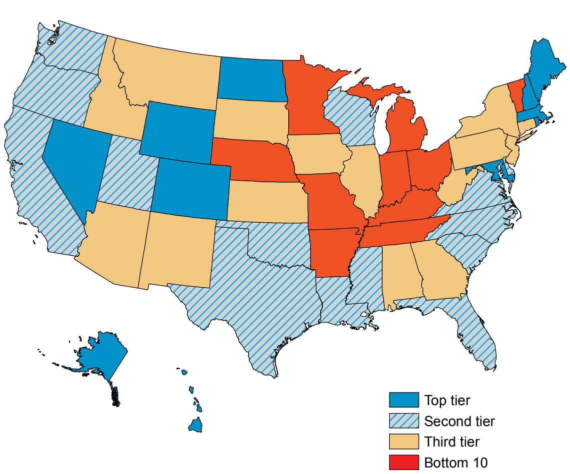
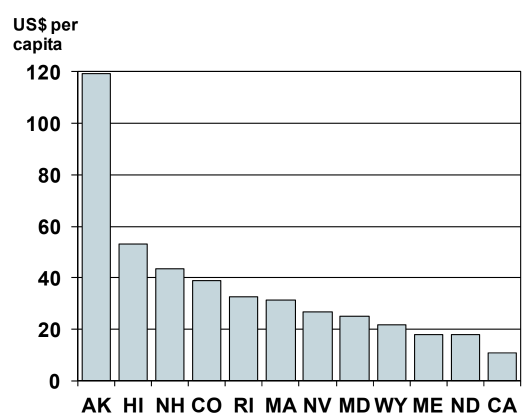


Figure 32. R&D expenditures on environmental sciences
Top tier states and California, 2007



*California ranked 17th.

Sources: National Science Foundation, U.S. Census Bureau.

R&D Expenditures on Math and Computer Science

Definition

The indicator for R&D expenditures on math and computer science is measured in dollars per capita. It is calculated by dividing statewide funding at doctorate-granting universities on various basic and applied math and computer science programs by each state's respective population. All math and computer science programs are included here, as determined by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The population statistics are collected by the U.S. Census Bureau.

Why Is It Important?

This indicator shows institutional R&D dollars spent on math and computer science projects. In 2007, nearly $2.0 billion of all R&D at doctorate-granting universities was spent on research relating to these fields, for an average per capita total of $5.88. Four percent of all institutional R&D was spent on math and computer science-related projects, making this the most poorly funded area of research.

Mathematics forms the basis of all quantitative science and is the "core language" of high-tech development. Computer science represents the chief component of what we associate with high-tech today: information technologies. Because advanced computer technologies are influenced by other disciplines (engineering, physics, and even life sciences), expenditures in this category may actually underreport the extent of research money going toward discovery and development in computer-related fields.

Math and Computer Science R&D and California

California slipped from eighth to 10th in this measure, spending $7.97 per capita vs. the national average of $5.88. Research institutions such as UC Berkeley's Mathematical Sciences Research Institute, Caltech's Applied and Computational Mathematics Department, the San Diego Supercomputer Center, and Stanford University are among the spenders in this regard. The top five in this measure were Maryland ($27.77), Hawaii ($26.76), Rhode Island ($18.73), Massachusetts ($15.55), and Pennsylvania ($15.24). These five states spend roughly twice as much as California on R&D in math and computer science.

Figure 33. R&D expenditures on math and computer science
Per capita, 2007

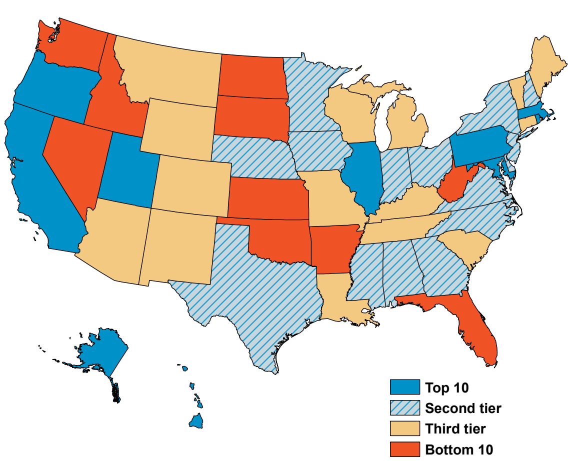
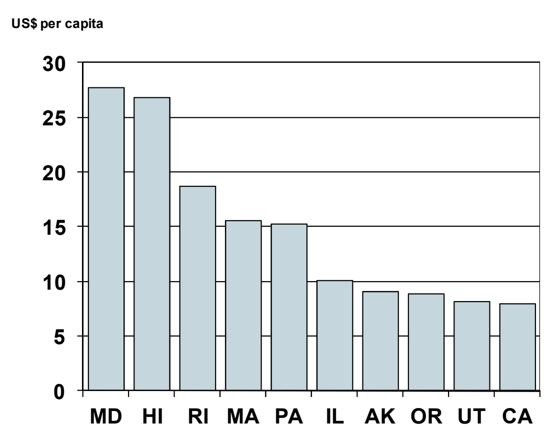


Figure 34. R&D expenditures on math and computer science
Top 10 states, 2007



Sources: National Science Foundation, U.S. Census Bureau.

R&D Expenditures on Life Sciences

Definition

The indicator for R&D expenditures on life sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on various basic and applied life sciences programs by each state's respective population. All funded life science research programs, be they in biology, physical anthropology, oceanography, or horticulture, are accounted for here. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The state population statistics are collected by the U.S. Census Bureau.

Why Is It Important?

This indicator measures the funding each state received for institutional R&D in the life sciences. Nationally, $29.8 billion of all R&D at doctorate-granting universities was spent on research relating to the life sciences, for an average of $92.94 per capita. A majority, about 60 percent, of all institutional R&D was spent on life science projects, making programs in this category by far the largest recipients of R&D funds.

The concept of high-tech originated with advanced electronics, a field that has historically been most directly influenced by such disciplines as engineering, physics, and computer science. Since the field of biotechnology emerged in the 1970s, however, the life sciences have become a growing force in the high-tech economy. The disproportionately high level of R&D funding for life sciences is reflective of this. Among the life science disciplines that show particular economic promise are genomics, biopharmacology, virology, and agronomy.

Life Sciences R&D and California

Ranking 15th for the third consecutive index, California spent $113.66 per capita on R&D in life sciences, a marked increase from $104.90 in 2008. East Coast states dominated this measure, with the top five being Maryland ($221.00), Massachusetts ($162.17), Connecticut ($161.57), North Carolina ($159.12) and Vermont ($159.07). With a strong life sciences cluster in San Diego, California could harness those strengths in biomedical sciences to boost its ranking in this measure.

Figure 35. R&D expenditures on life sciences
Per capita, 2007

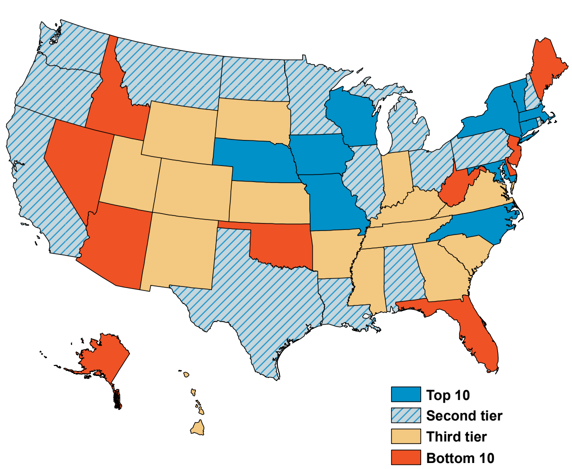
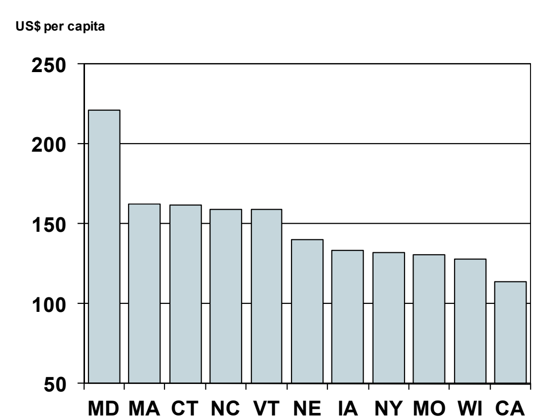


Figure 36. R&D expenditures on life sciences
Top 10 states and California, 2007



*California ranked 15th.

Sources: National Science Foundation, U.S. Census Bureau.

R&D Expenditures on Agricultural Sciences

Definition

The indicator for R&D expenditures on agricultural sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on various basic and applied life agricultural science programs by each state's respective population. According to NSF classifications, 12 scientific disciplines comprise agricultural sciences, including animal sciences, plant sciences, soil sciences, and forestry. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. State population statistics are collected by the U.S. Census Bureau.

Why Is It Important?

This indicator shows institutional R&D spending on agricultural science projects. Some $2.9 billion goes to R&D at doctorate-granting universities for research relating to agricultural sciences—about 10 percent of the total $29.7 billion spent on R&D life science research in 2007. Nationally, the average expenditure for this category of R&D was $15.61 per person in the latest index.

Although agricultural scientific research has something of a low-tech image, agriculture-related studies have long been—and remain—an important component of scientific advancement. Today it is imperative to find innovative solutions to such persistent issues as world hunger and forest degradation, and agricultural R&D is at the forefront of efforts to address these challenges. The way in which agricultural science R&D blends old and new disciplines—such as with innovations in genetically modified crops—also demonstrates how the field is radically modernizing.

Agricultural Sciences R&D and California

Despite its large agricultural industry, California continues to perform poorly in this measure. It slid two spots to 44th, and its per capita expenditures were $6.03, less than half the U.S. average and far short of spending levels by the top five states: North Dakota ($72.74), Montana ($66.31), Wyoming ($35.43), Mississippi ($34.68), and Nebraska ($32.17). These top states are heavily dependent on the agricultural industry, including bio-agriculture and biofuels, while California has a more diversified economy. However, investment in agricultural R&D could further benefit the state, which is a leading source and exporter of agricultural products.

Figure 37. R&D expenditures on agricultural sciences
Per capita, 2007

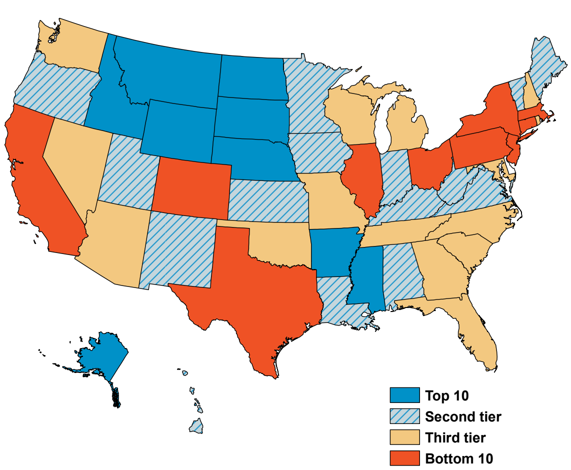
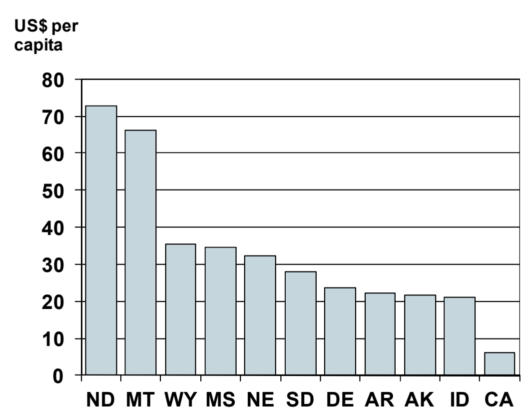


Figure 38. R&D expenditures on agricultural sciences
Top 10 states and California, 2007



*California ranked 44th.

Sources: National Science Foundation, U.S. Census Bureau.

R&D Expenditures on Biomedical Sciences

Definition

The indicator for R&D expenditures on biomedical sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on basic and applied biology and medical science programs by each state's respective population. Research fields in this category include biochemistry, molecular biology, genetics, immunology, clinical medicine, and pharmacy. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The population statistics are collected by the U.S. Census Bureau.

Why Is It Important?

This indicator shows the institutional R&D dollars spent on biological and medical science projects. Nationally, $25.7 billion went to R&D at doctorate-granting universities for research relating to this field in 2007. This figure represents 86 percent of funding for life science research and more than half of all university R&D expenditures. The average expenditure in the United States for biomedical R&D is $72.24 per person.

As reflected in their disproportionately large share of university R&D funding, the biomedical sciences comprise some of the most promising areas for scientific research. There is a virtually unlimited demand for technologies that deliver better health. Moreover, there are enormous attendant benefits, economic and otherwise, that more healthful living brings to individuals and societies. Adequate biomedical R&D funding is a vital component to a well-rounded knowledge-based economic strategy.

Biomedical Sciences R&D and California

California ranked 11th in this measure, with $107.15 expended per capita on R&D expenditures on biomedical sciences. Pennsylvania, having spent $107.88, just edged California out of the top 10. California's performance in this measure is better than the national average of $72.24 per capita. The top five states were Maryland ($199.34), Connecticut ($156.90), Massachusetts ($152.55), North Carolina ($144.38), and Vermont ($126.80).

Figure 39. R&D expenditures on biomedical sciences
Per capita, 2007

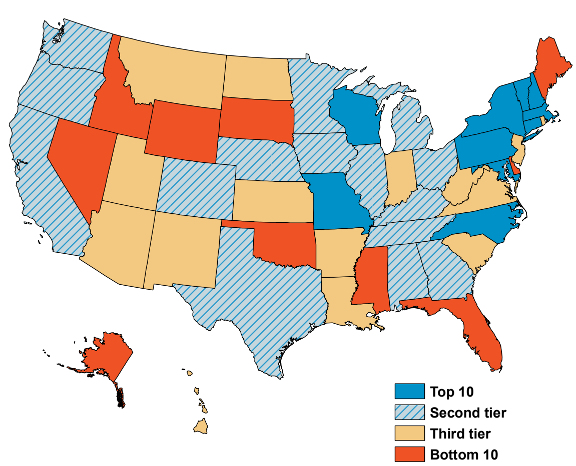
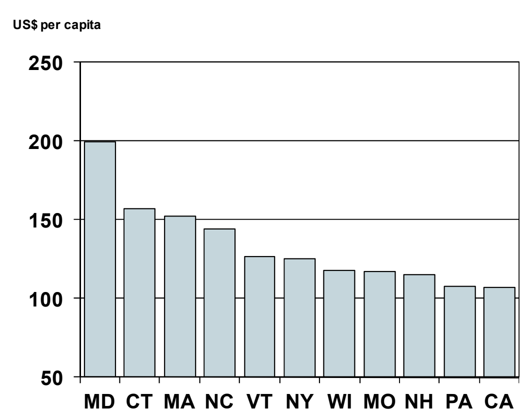


Figure 40. R&D expenditures on biomedical sciences
Top 10 states and California, 2007



*California ranked 11th.

Sources: National Science Foundation, U.S. Census Bureau.

STTR Awards per 10,000 Business Establishments

Definition

Here and on the following five pages, R&D inputs are not evaluated on a per capita basis, but according to larger base figures. The indicator for Small Business Technology Transfer (STTR) awards per 10,000 businesses is calculated by taking the average of the number of STTR awards in each state for the years 2004, 2005, and 2006, and dividing them by units of 100,000 business establishments active in the state.

STTR awards are the total of phase I and phase II federally funded research awards granted to small businesses and nonprofit research institutions with fewer than 500 employees. STTR award data is collected by the Small Business Administration (SBA), and data on the number of establishments is collected by the U.S. Census Bureau.

Why Is It Important?

This indicator illustrates the synergy between small businesses or nonprofit research institutions and federally funded R&D resources. The latest figures indicate that the average annual number of STTR awards granted in the United States from 2004 through 2006 was 710.

The STTR program seeks to increase the participation of small businesses in federally funded R&D and to increase private-sector commercialization of technology. Many newly chartered firms play an increasingly instrumental role in the commercialization of technology innovations. Unencumbered by other core technology assets, small firms can bring new products and services to market quickly. One of the unique features of the STTR program is its requirement for participating small businesses to formally collaborate with a research institution in phase I and phase II. STTR awards play a significant role in supporting the innovation of small firms and research organizations while helping to bolster the nation's scientific and technological capabilities.

STTR Awards and California

California received 1.31 STTR awards per 10,000 businesses to rank 10th. In the 2008 index, California was also in 10th place, but with 1.12 STTR awards per 10,000 businesses. The findings suggest that more STTR awards were received but did not offset those of other states for California to climb in the rankings. With its research universities, supply of venture capital, and number of start-ups, California should fare better in this measure. The top five states were Massachusetts (5.01), New Mexico (2.44), Virginia (2.26), Colorado (2.08), and Maryland (2.02).

Figure 41. Average annual STTR awards per 10,000 business establishments
2004–2006

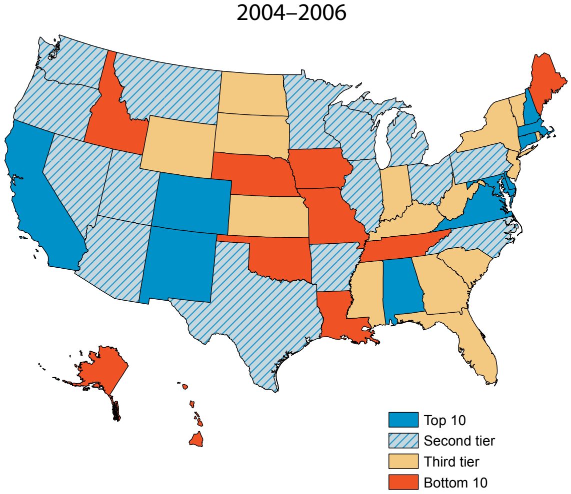
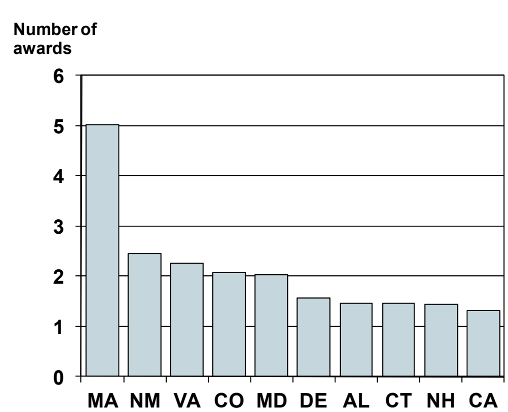


Figure 42. Average annual STTR awards per 10,000 business establishments
Top 10 states, 2004–2006



Sources: Small Business Administration and U.S. Census Bureau.

STTR Award Dollars per $1 Million of GSP

Definition

The indicator for Small Business Technology Transfer (STTR) award dollars per $1 million of GSP is calculated by taking the average amount of STTR awards won during the years 2004, 2005, and 2006 (the latest data available when our calculations were completed), and dividing the result by each state's respective average GSP for those three years. STTR awards are the total of phase I and phase II federally funded research awards granted to small businesses and nonprofit research institutions with fewer than 500 employees. STTR award data is collected by the Small Business Administration (SBA). GSP data is collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

This indicator quantifies the magnitude of federal investment in the country's small businesses and research institutions. Each year, five federal departments are required to reserve part of their R&D funds for STTR awards. Latest figures indicate that average annual total for federal funds spent on R&D in the small-business and nonprofit institution sectors was $223.2 million during the last three years, or $20 for every $1 million of GSP.

Small businesses have long been drivers of entrepreneurial dynamism and innovation capacity. However, the risk and expense of undertaking R&D efforts is beyond the means of many small commercial operations. This applies even more so to small nonprofit research laboratories. STTR awards incentivize these components of a state's economy and can help support a state's overall innovation infrastructure.

STTR Awards and California

Climbing two spots to 13th, California received $25.77 in STTR awards per $1 million of GSP, an improvement from $15.60 in 2008's ranking. The top five states were Massachusetts ($98.13), Colorado ($47.07), New Mexico ($45.85), Montana ($44.83), and Virginia ($43.95). These five states received at least $18 more in STTR awards per $1 million GSP than California did. Although California has a large technology base, its performance was simply adequate in this measure. Small businesses tend to use more traditional financing from banks, angel investors, and venture capital, and many are unaware of STTR awards. Training for small-business owners and heightened awareness may help increase the visibility of STTR awards and encourage businesses to apply.

Figure 43. Average annual STTR award dollars per $1 million of GSP
2004–2006

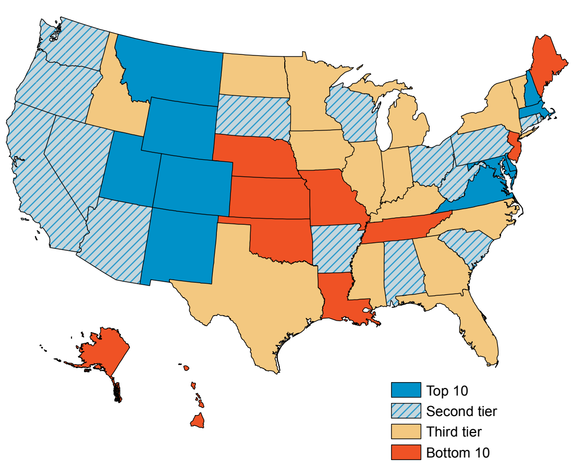
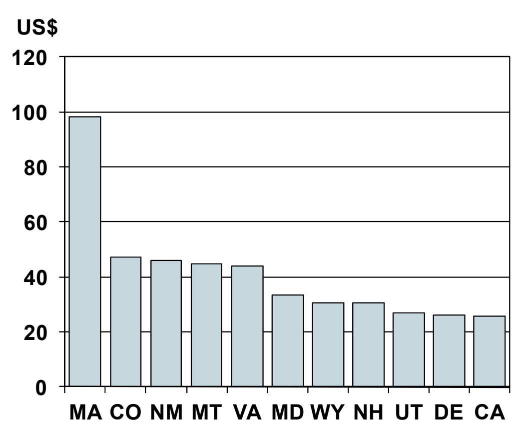


Figure 44. Average annual STTR awards per $1 million of GSP
Top 10 states and California, 2004–2006



*California ranked 13th.

Sources: Small Business Administration, U.S. Bureau of Economic Analysis.

SBIR Awards per 100,000 People

Definition

The indicator for Small Business Innovation Research (SBIR) awards per 100,000 people is derived by taking the average number of annual awards received by each state from 2004 through 2006 and dividing that by the average state population for those three years, times 100,000. Like STTR awards, SBIR awards are split into phase I and phase II, and this component pools both phases. SBIR awards fund a small enterprise's often costly start-up and development stages as well as encouraging the commercialization of research findings. SBIR awards data is collected by the Small Business Administration (SBA). Population figures are collected by the U.S. Census Bureau.

Why Is It Important?

SBIR awards are granted on the basis of need and creative ideas that have commercialization potential, so this indicator partially illustrates each state's level of entrepreneurial creativity. SBIR funds the often costly start-up and development stages, and encourages commercialization of the research findings. For a firm to qualify for an SBIR award, it must be a for-profit entity; it must be American-owned and independently operated; it must employ the principal researcher; and it must have no more than 500 employees. Funding for the program comes from the federal government's 10 largest departments and agencies.

SBIR Awards and California

With 2.74 SBIR awards received per 100,000 people, California ranked seventh in this measure, the same as in the 2008 rankings, when the state racked up more with 3.54 SBIR awards per 100,000 people. The top state in this measure was Massachusetts, which earned 9.79 SBIR awards per 100,000 people—a full five awards more than second-place Colorado, with 5.02 awards. Rounding out the top five were Maryland (4.64), New Hampshire (3.87), and Virginia (3.78). The national average was 1.6 awards. More details about SBIR awards are given in the following sections as we look at Phase I and II SBIR awards.

Figure 45. Average annual SBIR awards per 100,000 people
2004–2006

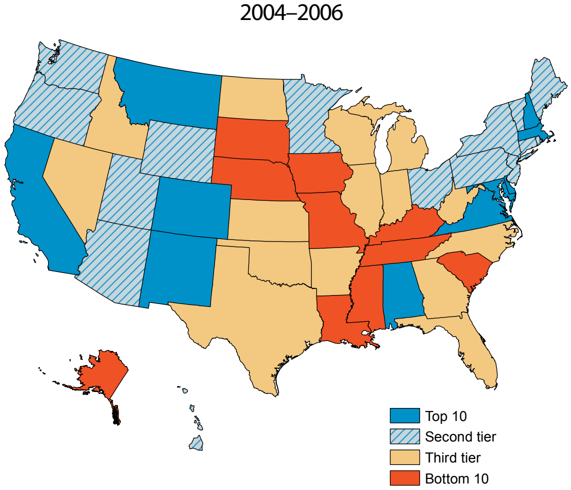
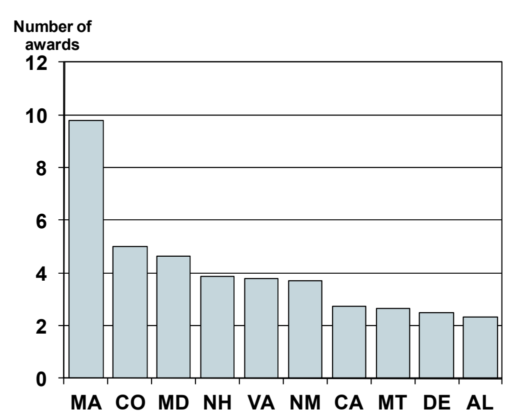


Figure 46. Average annual SBIR awards per 100,000 people
Top 10 states, 2004–2006



Sources: Small Business Administration and U.S. Census Bureau.

Phase I SBIR Awards per 10,000 Business Establishments

Definition

The indicator for Phase I SBIR awards per 10,000 businesses is calculated by adding the number of Phase I awards per state and dividing them by units of 10,000 business establishments active in the state. This calculation allows us to derive a standard measurement. Phase I SBIR awards data is collected by the NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). Data on the number of business establishments is collected by the U.S. Census Bureau.

Why Is It Important?

SBIR programs fund R&D efforts of a high-risk nature that have commercialization potential. Through funding, the program seeks to stimulate technological innovation, use small businesses to meet federal R&D demand, and encourage R&D participation by minority-owned or otherwise potentially disadvantaged firms.

Phase I awards are granted on the basis of research capability. A typical Phase I award funds approximately six months of research and does not exceed $100,000.

During these six months, the researching firm must establish the technical feasibility of the project as well as justify reasons for further federal, and sometimes private, financing. Not all Phase I SBIR awards lead to further funding; however, obtaining one creates the opportunity to initiate research and provides firms with the opportunity to market themselves to potential investors.

Phase I SBIR Awards and California

California ranked seventh with 8.34 Phase I SBIR awards per 10,000 business establishments, compared to a ranking of sixth and 10.53 awards in the 2008 index. The top five states in this measure were Massachusetts (26.96), New Mexico (12.84), Maryland (12.55), Colorado (11.58), and Virginia (11.25).

Figure 47. Phase I SBIR awards per 10,000 business establishments
2006

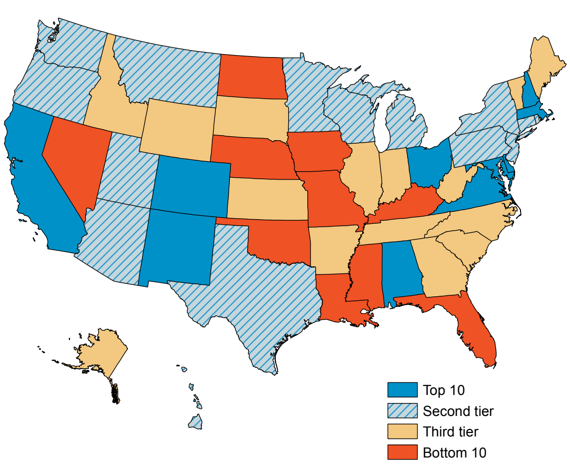
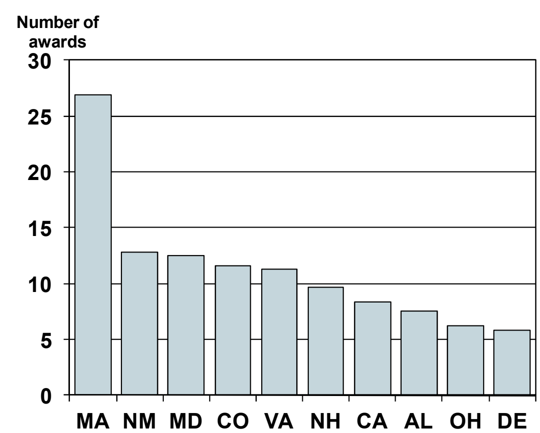


Figure 48. Phase I SBIR awards per 10,000 business establishments
Top 10 states, 2006



Sources: EPSCoR and U.S. Census Bureau.

Phase II SBIR Awards per 10,000 Business Establishments

Definition

The indicator for Phase II SBIR awards per 10,000 businesses is calculated by adding the number of phase II awards per state and dividing them by units of 10,000 business establishments active in the state. This calculation allows us to derive a standard measurement. Phase II SBIR awards data is collected by the NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). Data on the number of business establishments is collected by the U.S. Census Bureau.

Why Is It Important?

To be eligible for a Phase II award, a firm must have secured a Phase I SBIR award. Phase II awards are granted on the basis of findings from Phase I research and are meant to continue the R&D launched in the initial stage. Typically, Phase II awards fund approximately two years of research and do not exceed $750,000. Phase II awards are fewer and harder to come by than are Phase I awards. On average, 2.34 Phase II SBIR awards per 10,000 businesses were granted in 2006 (the latest data available) as opposed to 4.43 Phase I awards.

As the statistics indicate, Phase II is highly competitive. The purpose of a Phase II award is to facilitate advanced R&D efforts moving closer to the stage of commercialization than would be the case in most Phase I projects. A Phase II award allows a small business to reach a higher level in its innovation efforts. Without such funding, many small firms would lack the means to carry out promising research activities.

Phase II SBIR Awards and California

California's performance and ranking both slid in this measure since the 2008 index. The state received 4.24 Phase II SBIR awards per 10,000 business establishments in this index, compared to 5.25 two years ago. As a result, it slipped from seventh to eighth in the rankings. Still, its SBIR awards numbered almost twice the national average of 2.34 awards per 10,000 business establishments. The top five states in this measure were Massachusetts (13.56), New Hampshire (7.36), New Mexico (6.09), Colorado (6.02), and Virginia (5.42). California could improve its rankings in the SBIR-related measures by creating more awareness among small businesses about these forms of support. Other kinds of support such as application assistance could also be helpful in boosting the state's rankings.

Figure 49. Phase II SBIR awards per 10,000 business establishments
2006

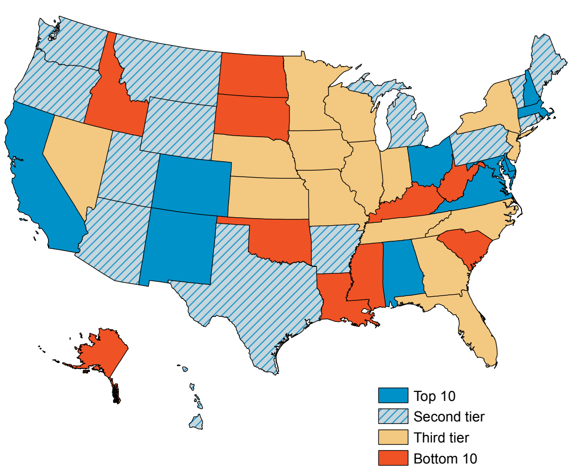
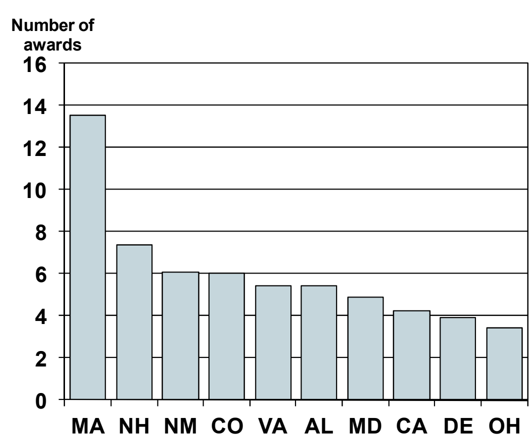


Figure 50. Phase II SBIR awards per 10,000 business establishments
Top 10 states, 2006



Sources: EPSCoR and U.S. Census Bureau.

Competitive NSF Proposal Funding Rate

Definition

The indicator for the funding rate of competitive National Science Foundation project proposals is calculated by taking the total number of competitive NSF awards granted in 2009 and dividing it by the total number of competitive NSF proposals submitted. Most NSF funding opportunities are in the areas of biology, computer sciences, education, engineering, geosciences, physical sciences, and social and behavioral sciences. Data on competitive NSF proposals and awards are collected by the Experimental Program to Stimulate Competitive Research (EPSCoR), a division of the NSF.

Why Is It Important?

The NSF accounts for approximately one-quarter of total federal funds awarded for basic research to all U.S. colleges and universities. The average national funding rate for competitive NSF proposals in 2009 was 31 percent. Without support from organizations such as the NSF, the range and quality of research in colleges and universities would be severely limited. In addition, funding often supports highly theoretical "basic" or "blue-sky" research, the sort of R&D that private industry is reluctant to undertake due to its high risks and limited immediate commercial applicability. Awards and grants such as those provided by the NSF thus help support the bedrock of American scientific research and knowledge, an area that is crucial to maintaining the nation's edge in knowledge-based economic competitiveness over the long term.

NSF Proposal Funding and California

California achieved a 38 percent success rate in NSF funding received compared with 28 percent in the 2008 index. That improvement propelled it to sixth in this measure (tied with Colorado and Montana) vs. seventh in the prior index. For some historical perspective, the state enjoyed a 38 percent success rate in the first index in 2002, placing fifth in this measure. This means that, while California has maintained its ability to attract NSF funding due to its renowned research institutions, other states are making progress in this measure and are performing better in relative terms. The states that make up the top five are Rhode Island (50 percent), New Hampshire (43 percent), Alaska, Minnesota (tied with 41 percent), and Hawaii (39 percent).

Figure 51. Competitive NSF proposal funding rate
2009

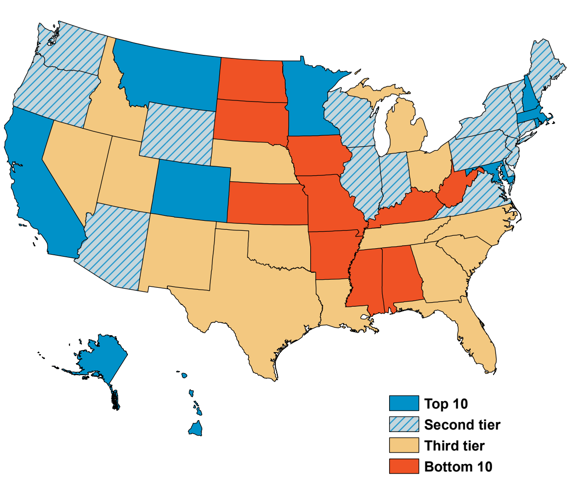
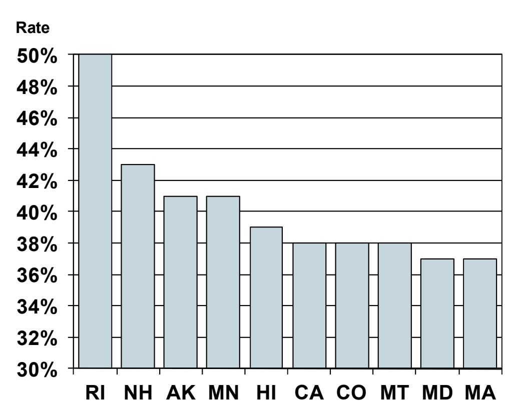


Figure 52. Competitive NSF proposal funding rate
Top 10 states, 2009



Source: EPSCoR.

Risk Capital and Entrepreneurial Infrastructure Composite Index

Definition

The Risk Capital and Entrepreneurial Infrastructure (RCEI) Composite Index is the second major component of the State Technology and Science Index. The RCEI measures each state's entrepreneurial capacity by examining such indicators as venture capital investment, IPO activity, business starts, and patent issuance. VC investment in the cutting-edge fields of clean technology and nanotechnology was first included in the 2008 index. This year, sum of equity invested in green technologies was added to reflect the current shift in the high-tech industry toward clean technologies. A state's score on the RCEI Composite Index is calculated by totaling its score on each individual RCEI indicator and dividing it by the number of indicators. (Scores are based on state rankings.) In the pages that follow, we will describe the individual components that make up the RCEI and discuss California's performance in each category.

Why Is It Important?

The Research and Development Inputs Composite Index, described in the previous section, measures the raw material of knowledge-based economic growth. The RCEI index adds technological commercialization and entrepreneurial activity to the mix, analyzing both marketplace funding mechanisms (such as VC flows) and government funding disbursed by the Small Business Investment Company program.

We have measured items relating to that facilitating infrastructure such as the number of business incubators in each state, patents issued, and business starts. A state's level of risk capital funding and its entrepreneurial infrastructure work in tandem to provide an environment that is conducive to firm growth.

Risk Capital and California

With a score of 75.45, California slipped to second in this composite index, after surpassing Massachusetts to take first in 2008. Massachusetts reclaimed the top spot with a score of 79.67. Rounding out the top 10 were Connecticut (66.39), New Jersey (66.08), Utah (65.33), Colorado (64.24), New Hampshire (62.69), North Carolina (62.61), Arizona (62.52), and Washington (62.28). California's dominance is due to the investment drawn to its universities as well as its open policy toward cultivating new technologies in computers, biotechnology, and green technology. California performs well in VC investment, whether measured by its percentage of GSP or by the number of companies receiving VC investment.

Figure 53. RCEI Composite Index
2010

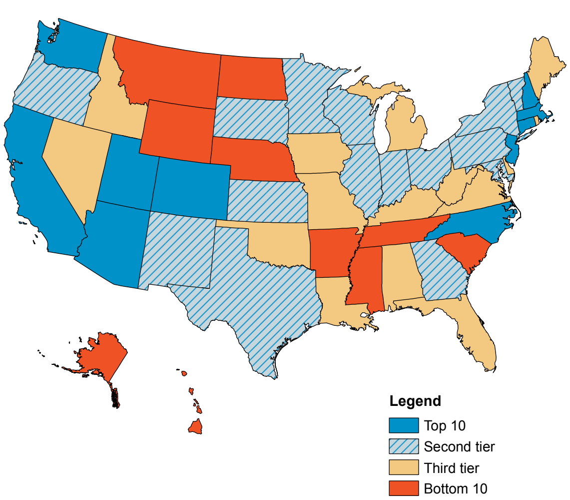
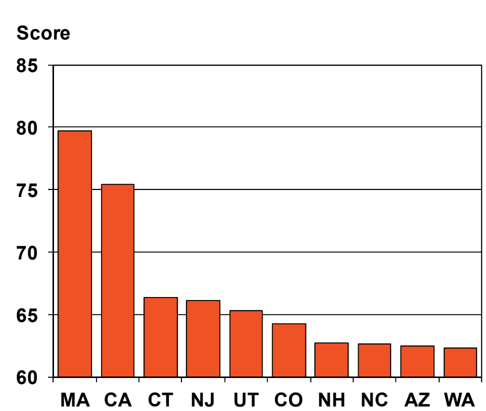


Figure 54. RCEI Composite Index
Top 10 states, 2010



Source: Milken Institute.

Total Venture Capital Investment Growth

Definition

The indicator for total venture capital investment growth is calculated by taking total VC investment for each state in 2009, dividing it by total VC investment for the previous year, and multiplying the result by 100. (VC refers to specially accumulated funds invested in or available for investment in a new or unproven business endeavor. Venture capital is also referred to as "risk capital" in recognition of its high risk coefficient.) VC data used in this report is from the PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters.

Why Is It Important?

The goal for venture capitalists is to invest in young, fast-growing businesses that exhibit potential for high growth and high return on investment. VC has assumed greater importance as a source of equity funding for start-ups as public funding has faltered in recent years.

On the national level, the Great Recession has affected the risk appetite of venture capitalists; total VC funding declined 36.8 percent from 2008 to 2009. Still, more than $17.6 billion was up for grabs in 2009, with California claiming by far the largest share with 50 percent of all VC funding. Venture capital financing remains highly important to a new firm's formation and growth. Former start-ups such as Digital Equipment Corporation, Sun Microsystems, Apple, Microsoft, Intel, Compaq, Federal Express, and Genentech are all examples of companies that benefited from early-stage venture capital investment.

VC Investment and California

Despite a 58 percent drop in California's total VC investments, it ranked 18th in VC growth. In 2008's ranking, the state ranked 21st with 16.03 percent growth in VC. Less investment was largely due to the economic downturn. With the recovery under way, California should continue to leverage its innovative high-tech clusters to attract more venture capital. The top five states in this measure were Connecticut (299.51 percent), Louisiana (247.74 percent), Missouri (91.26 percent), Indiana (54.09 percent), and Oregon (-3.00 percent). Only the top four states experienced growth in total VC investment this time around.

Figure 55. Total venture capital investment growth
2008–2009

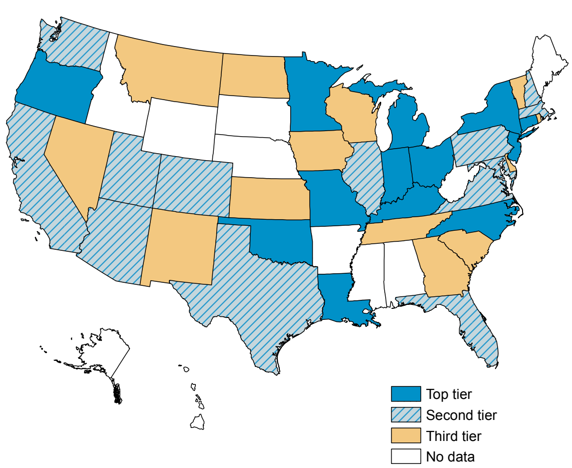
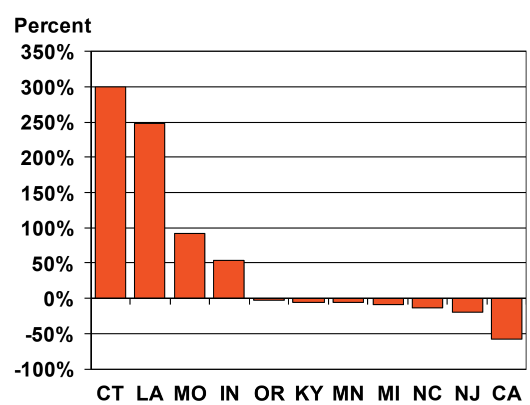


Figure 56. Total venture capital investment growth
Top tier states and California, 2008–2009



*California ranked 18th.

Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report based on data from Thomson Reuters.

Number of Companies Receiving Venture Capital per 10,000 Firms

Definition

The indicator represents the number of companies that received venture capital funding between 1998 and 2009 in each state, normalized by increments of 10,000 business establishments of all kinds. Data on the number of companies receiving VC funding were provided by PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters; data on the total number of business establishments came from the U.S. Census Bureau.

Why Is It Important?

Most new business formation and job creation in the United States comes from the small-business sector. Financing for new business ventures has historically come from family endowments and inheritances. Over the past few decades, however, more and more small enterprises have begun turning to structured credit and private equity opportunities as a source of financial capital.

Venture capital funding reached its peak at the height of the tech bubble. Since the tech bubble burst in 2000, VC has slowly gained traction, even after its progress was interrupted by the Great Recession. It remains a vital source of funding for new firms, especially those that operate in knowledge-intensive sectors. Because it is disbursed in stages, venture capital not only plays a crucial role in getting a firm started but also in supporting its early years of operation before revenue or the sale of shares can sustain it.

Number of Companies Receiving Venture Capital and California

Despite a decline in VC investment, California ranked second, with 19.8 companies receiving VC investments per 10,000 business establishments. In 2008's ranking, California also occupied second with 15.58 companies. However, the state lags far behind top-ranked Massachusetts, which had 26.3 companies receiving VC money per 10,000 establishments. Of course, the other three states in the top five were significantly outpaced by both leaders: Washington had 8.8 companies, Colorado 8.0 companies, and Maryland 7.7 companies.

Figure 57. Companies receiving venture capital investment per 10,000 firms
1998–2009

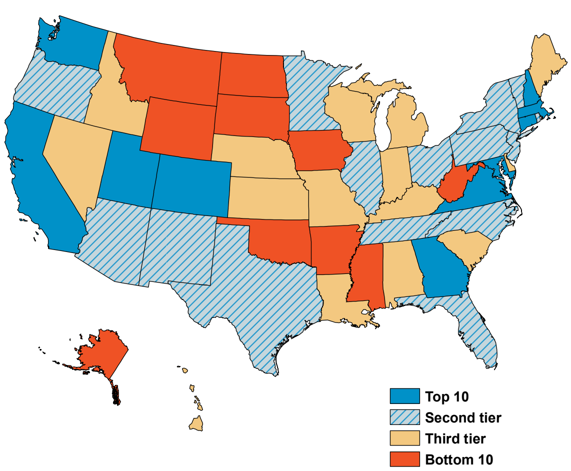
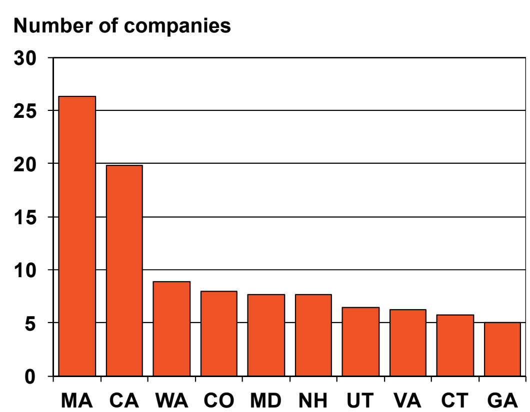


Figure 58. Companies receiving venture capital investment per 10,000 firms
Top 10 states, 1998–2009



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report based on data from Thomson Reuters, U.S. Census Bureau.

Increase in Number of Companies Receiving VC Investment

Definition

Growth in the number of companies receiving venture capital investment was calculated by comparing the number of companies that received VC funding in 2008 to the number in 2009. This variable takes into consideration all firms, small and large, that received any form of VC funding. Data is provided by the PricewaterhouseCoopers/ National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters.

Why Is It Important?

This component allows stakeholders to measure the momentum of this form of risk capital flowing to companies. Growth trends reflect how well those companies' prospects are perceived by the leading class of risk capitalists. In this latest index, the number of companies receiving venture capital investment in the United States fell by 23 percent from 2008 to 2009.

This indicator differs from that for Total VC Investment Growth. Instead of measuring the amount of venture capital disbursed, it looks at the level of participation among a given state's firms in the competition for VC investment and whether its momentum is increasing or decreasing. This indicator illustrates the relative level of potential that the marketplace has assigned to that state's businesses as measured by investors' willingness to take risks there.

Increase in Number of Companies Receiving VC Investment and California

California experienced a 30.07 percent drop in the number of companies receiving VC investments, sliding one position to 23rd. The top five were South Dakota (200.00 percent growth), Maine (66.67 percent), Rhode Island (60.00 percent), Connecticut, and Iowa (both 14.29 percent). Only the top nine states experienced growth in this measure as the economic downturn wreaked havoc in most states across the country. As the economy improves, venture capitalists will invest more—though they will likely be more conservative and strategic in approach.

Figure 59. Increase in number of companies receiving VC
2008–2009

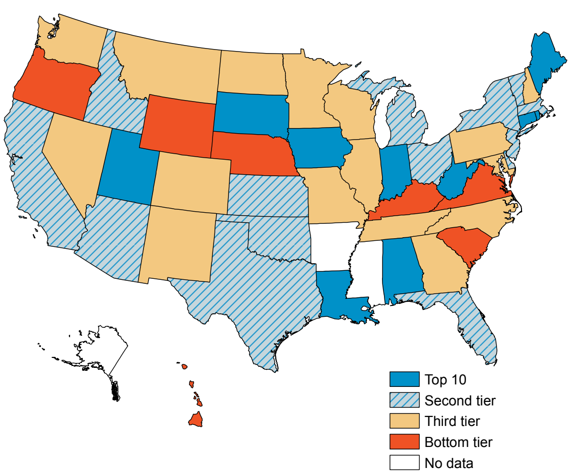
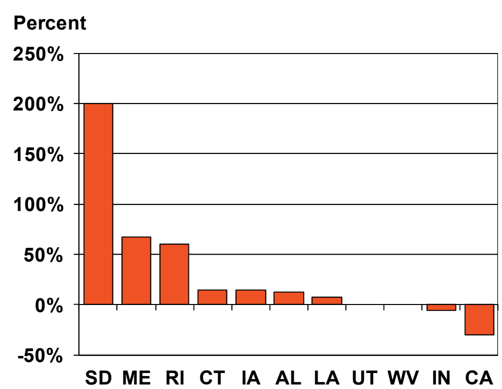


Figure 60. Increase in number of companies receiving VC investment
Top 10 states and California, 2008–2009



*California ranked 23rd.

Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report based on data from Thomson Reuters.

Venture Capital Investment as Percent of GSP

Definition

The indicator for venture capital investment as a percentage of gross state product is calculated by dividing the dollar amount of each state's venture capital investments by its respective GSP. Monitoring VC investment as a percentage of GSP allows us to analyze VC's flow and strength in terms of the total state economy. VC data is from PricewaterhouseCoopers/National Venture Capital Association MoneyTree(tm) Report based on data from Thomson Reuters. GSP data is collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

The proportion of a state's GSP that comes from VC investment reflects the degree to which risk capital figures into the value of a state's overall economic output. The indicator is a proxy of how adventuresome a state's economy is. In 2009, venture capital's share of the nation's GDP was 0.08 percent based on a total of $17.7 billion in VC investments made across all the states. This percentage was heavily skewed by the top three states, which scored above the average by wide margins. This VC concentration may stem from the riskiness of the projects themselves as well as speculative investment being reined in due to economic uncertainty.

Massachusetts, California, and Colorado attract a disproportionate share of VC investment relative to their GSP, serving as a reminder that states eager to foster dynamic high-tech economies should carefully consider the catalytic role of risk capital finance.

VC Investment and California

California performed very well in this measure, with VC investment making up 0.59 percent of GSP. California ranked second, after Massachusetts, where venture capital made up 0.65 percent of GSP. The remaining three states in the top five lag far behind the leaders, with Colorado at 0.26 percent of GSP, Washington at 0.22 percent, and Utah at 0.20 percent. As venture capitalists turn toward emerging markets in Europe and Asia, Massachusetts and California may have to work harder to continue attracting venture capital.

Figure 61. Venture capital investment as percent of GSP
2009

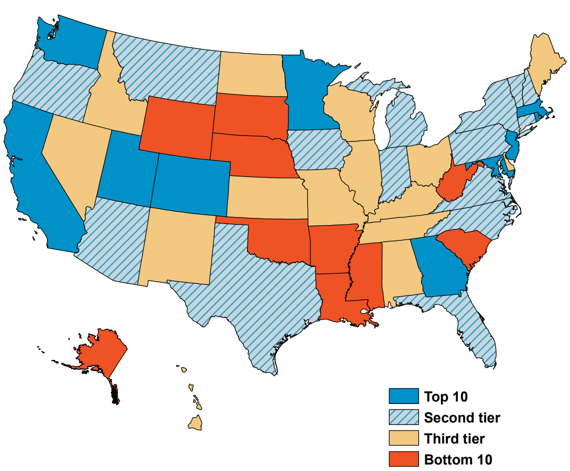
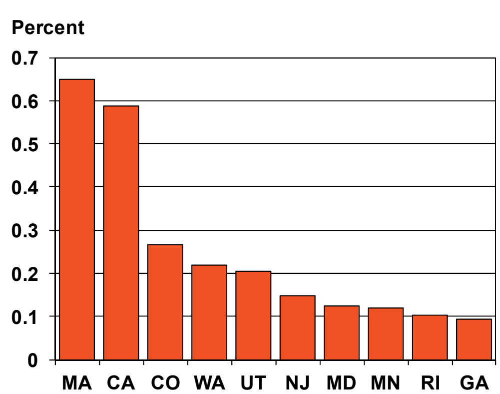


Figure 62. Venture capital investment as percent of GSP
Top 10 states, 2009



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report based on data from Thomson Reuters, U.S. Bureau of Economic Analysis.

SBIC Funds Disbursed per $1,000 of GSP

Definition

The indicator for the average annual Small Business Investment Company program funds disbursed per $1,000 of GSP is calculated by taking the annual average of all SBIC funds invested in 2007, 2008, and 2009, and dividing that amount by each state's GSP times 1,000. Program data is collected by the Small Business Administration (SBA). GSP figures are collected by the U.S. Bureau of Economic Analysis. The SBIC program was created in 1958 by Congress as a facilitating agency between lenders and borrowers.

Why Is It Important?

SBICs are business incubators that provide services to small businesses ranging from financial capital to management consulting. Backed by the SBA, the incubators behave similarly to venture capitalists; their goal is to identify profit potential in small businesses and fund those companies in hopes of high returns on investment. While almost 70 percent of venture capital dollars go to high-tech and life science industries, this program invested heavily in small-business manufacturing. More than half of VC investments are made in California and Massachusetts, but the SBIC program invested more than 70 percent in other states that are often starved for investment capital.[56] On average, $0.15 in SBIC funds are disbursed for every $1,000 of GDP—about a third less than a decade ago.

SBIC funding represents a bridge between government and the private sector. First, it provides government funding to support small enterprises. Second, this funding fills a gap in access to capital, since small businesses may not be able to tap into financial markets on their own. Although people may debate the proper role of government in these contexts, the fact remains that small businesses are supported by the SBIC program and in return contribute to state and national economies.

SBIC Funds and California

With $0.19 of SBIC funds disbursed per $1,000 of GSP, California ranked 14th in this measure, losing ground since the index in 2008, when California ranked eighth with $0.33 in SBIC funds. The top states in this measure were South Dakota ($0.72), Massachusetts ($0.49), Utah ($0.39), Colorado ($0.36), and New Hampshire ($0.35).

Figure 63. Average annual SBIC funds disbursed per $1,000 of GSP
2007–2009

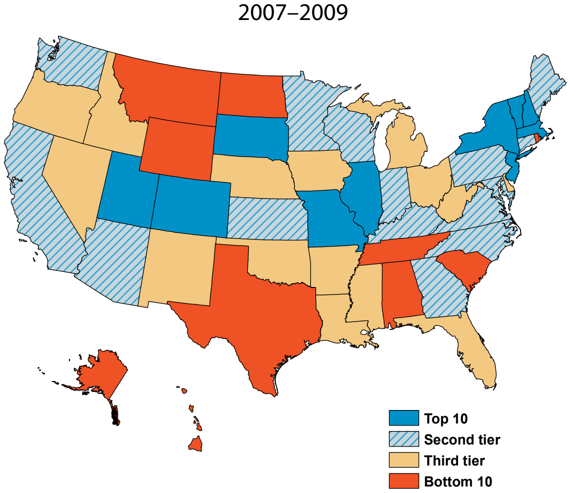
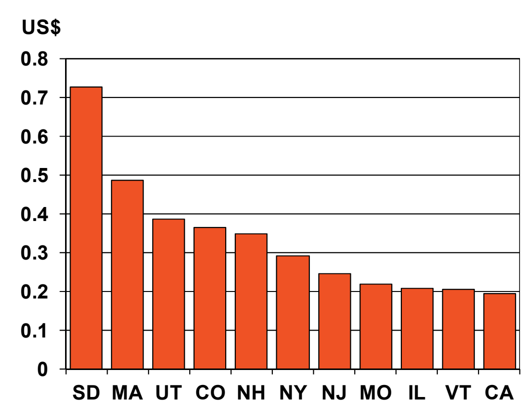


Figure 64. Average annual SBIC funds disbursed per $1,000 of GSP
Top 10 states, 2007–2009



Sources: National Association of Small Business Investment Companies, Small Business Administration Office of Investment, U.S. Bureau of Economic Analysis.

56 Hollis A. Huels, National Association of Small Business Investment Companies, June 10, 2009, http://www.nasbic.org/resource/resmgr/files/holly__huels-small_business.pdf (accessed March 9, 2011).

Business Incubators per 10,000 Establishments

Definition

The number of business incubators per 10,000 business establishments is calculated by adding the total number of incubators in each state and dividing by that state's population of business establishments, tallied in increments of 10,000. Data on the number of incubators for each state are provided by the National Business Incubation Association (NBIA). Although the NBIA data set is the most accurate, the association estimates that it only accounts for approximately half of all U.S. incubators, so the reported figures are likely conservative. Data on the number of business establishments by state is collected by the U.S. Census Bureau.

Why Is It Important?

Business incubators provide embryonic businesses with guidance and resources that assist firm formation and growth. They provide "hard" assets, such as office facilities and equipment, as well as "soft" assets, such as assistance services, and financial and management consulting. The right incubator aid can make a critical difference to companies that otherwise would not survive on their own.

According to the latest NBIA statistics, nearly 1,100 business incubators were operating in the United States in 2009, or an average of roughly 1.27 incubators per 10,000 business establishments. States with increasing numbers of business formations should appreciate the importance of incubators as a resource in addition to more conventional forms of assistance.

Business Incubators and California

In this measure, California fell further below the national average, to 45th with 0.66 incubators, compared to 33rd and 1.29 incubators in 2008. Its performance has consistently declined since 2002's index, when the state ranked fourth with 2.56 incubators per 10,000 establishments. The top five states in this measure are North Dakota (3.28), Wyoming (2.96), New Mexico (2.39), Oklahoma (2.34), and Mississippi (2.31). Interestingly, the top five states are not knowledge-intensive states. A possible explanation is that these states are increasingly showing support for innovative businesses, while states with more mature tech sectors such as California and Washington are less active in utilizing them.

Figure 65. Business incubators per 10,000 business establishments
2009

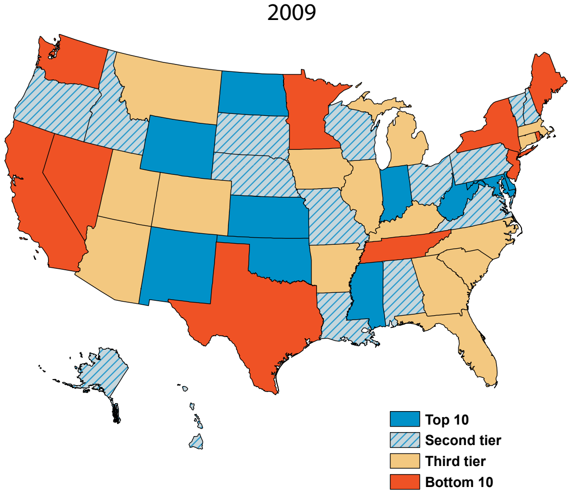
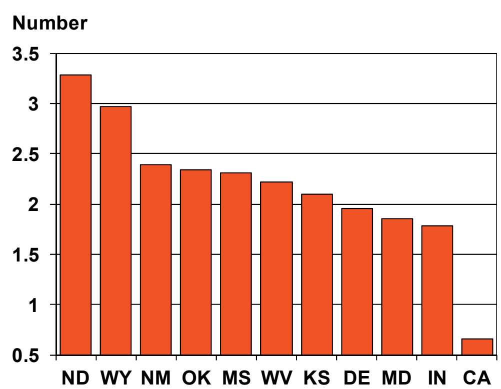


Figure 66. Number of business incubators per 10,000 business establishments
Top 10 states and California, 2009



*California ranked 45th.

Sources: National Business Incubation Association, U.S. Census Bureau.

Patents Issued per 100,000 People

Definition

The indicator for the number of patents issued per 100,000 people is calculated by adding each state's number of named patents, both assigned and unassigned, that are issued to individuals, and then dividing those figures by the respective state's population (in increments of 100,000 residents). Patent documents included in this indicator are utility, design, plant, and reissue patents; defensive publications; and statutory invention registrations. Most patents granted in the United States are utility patents, or patents for invention. Patent data is collected by the U.S. Patent and Trademark Office, while state population figures are collected by the U.S. Census Bureau.

Why Is It Important?

Patents are granted by the Patent and Trademark Office (PTO), a division of the U.S. Department of Commerce. The issuance of a patent aims to preserve and protect various forms of individual and corporate property. Innovation and scientific advancement are protected through patents by prohibiting others to make, use, or sell the invention. The term of a new patent is 20 years from the time the application was filed.

When averaged out for a state's population, the number of patents issued serves as a measure for how innovative and commercially prepared the people of a given state are. More than 77,400 patents were issued in the United States in 2008; on a national basis, that comes out to 22 patents for every 100,000 people.

Patents Issued and California

With 52.18 USPTO patents issued per 100,000 people, California ranked fifth in this measure, a decline from 68.69 patents and a ranking of third in the 2008 index. The findings suggest that California's performance in this measure is slowly weakening. The top four states in this measure were Idaho (76.26), Vermont (70.34), Massachusetts (54.11), and Washington (53.70).

Figure 67. Patents issued per 100,000 people
2008

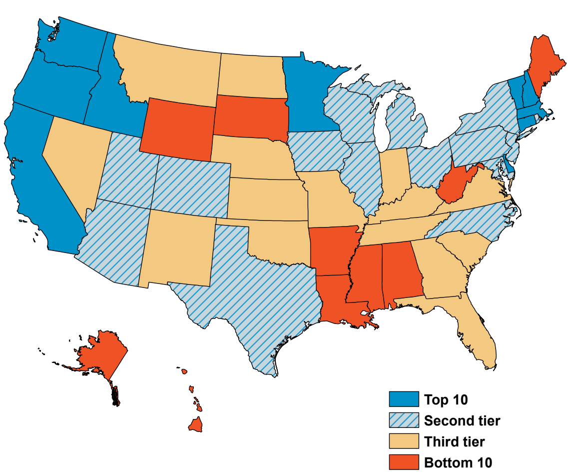
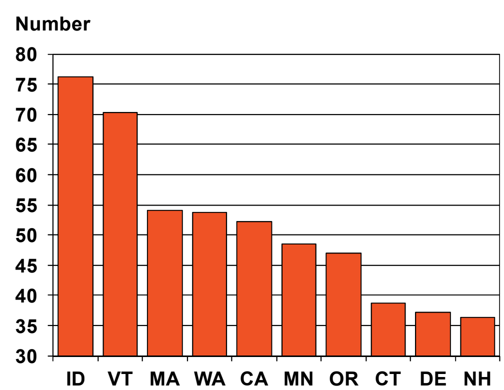


Figure 68. Number of patents issued per 100,000 people
Top 10 states, 2008



Sources: USPTO, Milken Institute, U.S. Census Bureau.

Net Business Starts per 100,000 People

Definition

The indicator for the net number of business starts per 100,000 people is calculated by finding the difference between employers recorded by the U.S. Census Bureau, Small Business Administration, and U.S. Department of Labor at the end of fiscal year 2007 and those recorded at the end of FY 2008. The totals for each state are then divided by 100,000 increments of the state's population. The figure encompasses businesses with at least one employee that began conducting business during the time period evaluated. The U.S. Census Bureau collects the states' population figures.

Why Is It Important?

Net business starts data represent one of the clearest measures of a state's entrepreneurial dynamism. When considered in relation to a state's population, additional layers of meaning concerning a state's overall economic creativity emerge, including factors such as a population's commercially adventuresome spirit and optimistic expectations. A state's performance in new firm formation also reflects positively on its ability to attract financial resources, tolerate risk, and create new jobs.

From 2007 to 2008, there were more than 198,000 net business starts in the United States for an average of 38 per 100,000 people. This number has plummeted since the 2004 State Technology and Science Index, when the average was around 300.

Net Business Starts and California

California had 462.74 net business states per 100,000 people, ranking second in this measure. In 2008's rankings, California also occupied the second position with 195.30 net business starts. This finding suggests that California continues to encourage entrepreneurial activity. Another contributing factor could be high unemployment and fewer available jobs, prompting many to start their own businesses. The leader in this measure is Wisconsin, with a remarkable 609.20 net business starts per 100,000 people. The others in the top five were North Carolina (320.20), South Carolina (251.31), and Texas (226.28).

Figure 69. Net number of business starts per 100,000 people
2007-2008

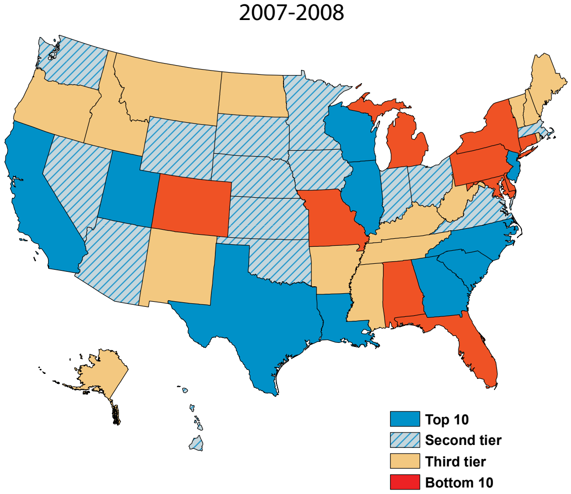
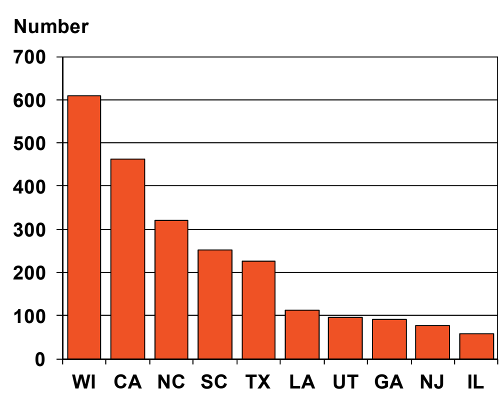


Figure 70. Net number of business starts per 100,000 people
Top 10 states, 2007-2008



Source: Small Business Administration, U.S. Census Bureau.

IPO Proceeds as Percent of GSP

Definition

The indicator for initial public offering (IPO) proceeds as a percentage of gross state product is calculated by totaling the dollar amount raised in each state by companies that issued publicly traded shares in an initial offering in 2007–2009. These figures are then divided by the corresponding state's GSP. An IPO is a company's first sale of stock to the public, and it represents another method available to companies for raising capital to meet corporate goals and for risk capitalists to cash in on their investment. IPO data is provided by both the Securities Data Corporation and Thomson Financial. GSP figures are collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

An IPO occurs when a company decides to sell shares of its common stock to the general public. Companies that go public typically demonstrate a proven track record in revenues or sales and, as is increasingly the case, exciting new technologies. For the period 2007–2009, average IPO proceeds represented 0.35 percent of the national gross domestic product, and total IPO proceeds were almost $104 billion. Except for Delaware and Massachusetts, states' performances in IPO proceeds as a percent of GSP have declined.

IPO Proceeds and California

California's IPO proceeds represent 0.18 percent of its GSP for a ranking of 16th. In 2008's index, the state ranked 15th with IPO proceeds at 0.41 percent of GSP. Although California is home to many leading high-tech firms, its position has consistently weakened in this measure since the index began in 2002, when the state ranked fourth with IPO proceeds at 0.90 percent of GSP. The top five states in this measure were Delaware (2.35 percent), Wyoming (1.63 percent), Massachusetts (1.42 percent), New York (1.23 percent), and Oklahoma (0.73 percent).

Figure 71. IPO proceeds as percent of GSP
2007–2009

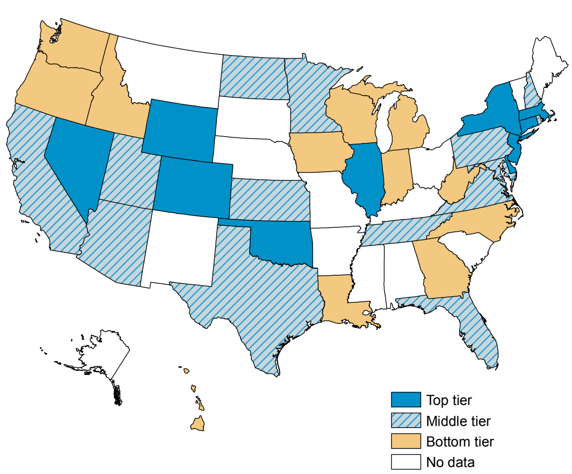
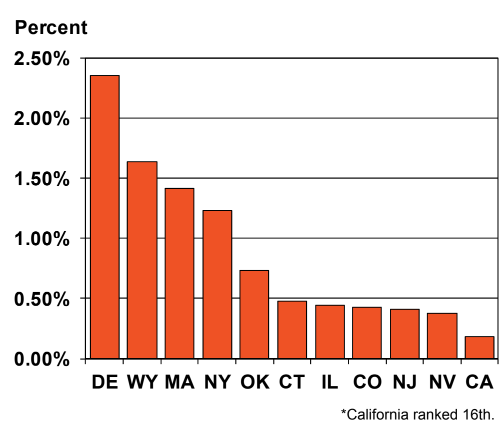


Figure 72. IPO proceeds as percent of GSP
Top tier states and California, 2007–2009



Sources: Security Data Corporation, Thomson Financial, Milken Institute, U.S. Bureau of Economic Analysis

VC Investment in Nanotechnology per $1,000 of GSP

Definition

Venture capital investment in nanotechnology per $1,000 of GSP is calculated by adding up the dollar amount of investment in each state by all companies that fit Thomson Financial's nanotechnology definition during the period 2004-2007. (Nanotechnology concerns the design and manufacturing of electronic circuit and mechanical devices at the molecular level. These are often measured in atomic units and have the potential to revolutionize not just engineering but also biomedical sciences.) The three-year total is divided by each state's GSP for the same time period, and then multiplied by 1,000. GSP figures are collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

Typically regarded as the forefront of technology, nanotechnology is an exciting field that enables greater utility and portability of computers and other electronics. Total venture capital invested in this area amounted to some $4.6 billion for the period 2004–2007. California captured the lion's share—about 48 percent, or $2.2 billion.

Private funds for nanotechnology were added to the State Technology and Science Index in 2008. This component serves to highlight and complement academic R&D in engineering, including nanotechnology. Nanotechnology is characterized by high government involvement because of the sensitivity surrounding its future usage.

VC in Nanotechnology and California

This measure could not be updated because new data have not been released since the 2008 index. In that index, California ranked third in the measure, with $0.37 of VC investments in nanotechnology per $1,000 of GSP. Massachusetts was the clear leader, with $0.61, followed by New Mexico ($0.49), Rhode Island ($0.19), and North Carolina ($0.10). Nanotechnology is an up-and-coming innovation in the high-tech arena. California has top universities and research institutions that can be leveraged for innovative research in nanotechnology.

Figure 73. VC investment in nanotechnology per $1,000 of GSP
2004–2007

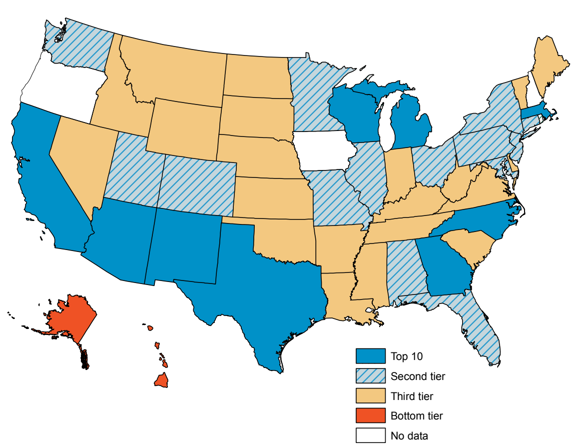
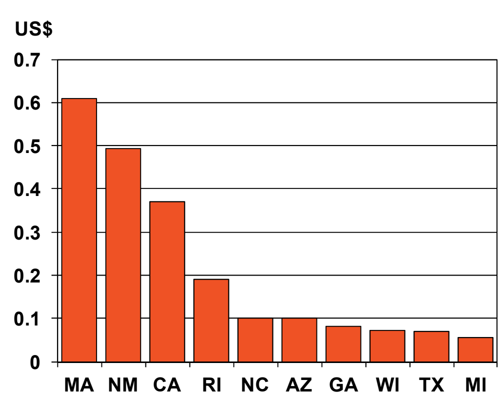


Figure 74. VC investment in nanotechnology per $1,000 of GSP
Top 10 states, 2004–2007



Sources: Thomson Financial, U.S. Bureau of Economic Analysis.

VC Investment in Clean Technology per $1,000 of GSP

Definition

Clean tech seeks to minimize negative ecological impacts of human activity and energy use and improve the productivity and responsible use of natural resources. Clean technology refers to investments in renewables like wind turbines, solar panels, and waste-to-energy enclosures, as well as improving traditional methods with new techniques like coal gasification.

This indicator is calculated by totaling the dollar amount of venture capital investment in clean technology over the period 2004–2007, and then dividing by the corresponding state GSPs. VC data is provided by Thomson Financial in its One Banker product, while GSP figures are collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

Investments in clean technology and nanotechnology are indications of a state's openness to new ideas. They represent a cutting-edge mentality and serve as a measure of each state's willingness to accept risks and take new ideas to commercialization. The strength of a state's clean-technology policy is also indicative of a progressive mind-set.

VC in Clean Technology and California

This measure could not be updated because new data have not been released since the 2008 index. In that index, California places third in VC investment in clean technology with $0.31 per $1,000 of GSP. South Dakota, which has been a hotbed of biodiesel production because of its abundant farmland, and Massachusetts led with $0.68 and $0.40, respectively. The other states in the top 10 were Kansas ($0.28), Iowa ($0.21), Colorado ($0.18), Washington ($0.17), New Mexico ($0.15), and a tie between Texas and North Carolina (both with $0.14).

Most of these top states have wide-open land area, adequate for wind turbines and solar paneling, or access to coastal waters for hydropower like Washington State and California.

Figure 75. VC investment in clean technology per $1,000 of GSP
2004–2007

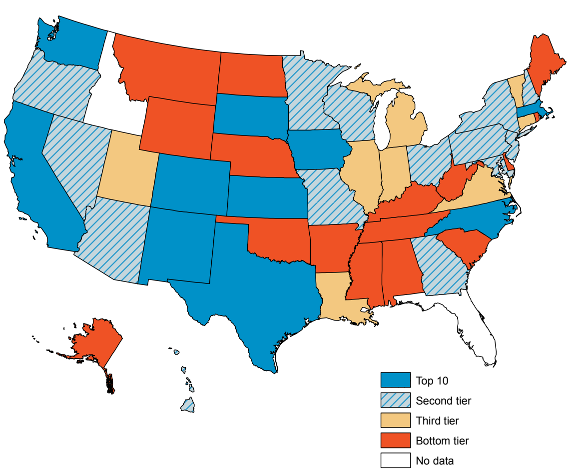
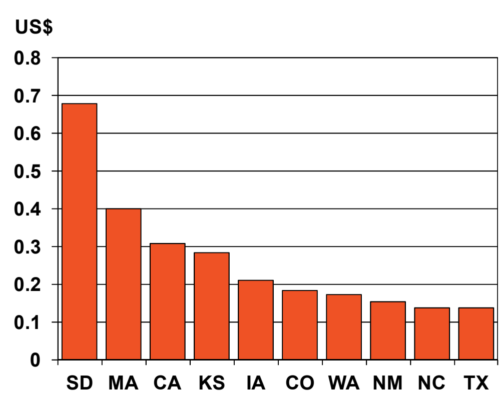


Figure 76. VC investment in clean technology per $1,000 of GSP
Top 10 states, 2004–2007



Sources: Thomson Financial, U.S. Bureau of Economic Analysis.

Sum of Equity Invested in Green Technology per $100,000 of GSP

Definition

This is the first year this indicator is included in the State Tech and Science Index. Green technology seeks to improve methods, techniques, and use of materials that are environmentally friendly to conserve natural resources, increase efficiencies, and reduce the amount of waste and pollution from production and consumption. Green technology refers to investments in sustainable products and processes; alternative fuels and new means of generating energy and energy efficiency are examples.

This indicator is calculated by totaling the dollar amount of venture capital investment in green technology in 2009, then dividing by the corresponding state GSPs. VC data is provided by Thomson Financial in its One Banker product, while GSP figures are collected by the U.S. Bureau of Economic Analysis.

Why Is It Important?

Investments in green technology are indications of a state's openness to new ideas and innovation; its awareness of the negative impacts of depleting natural resources and unsustainable practices to not only the environment but to society as a whole; and the willingness to accept risks and take new products and ideas to commercialization.

Not only is the technology uncertain and untested, but the state and federal tax credits used to subsidize it are volatile. A state that encourages green technology through policies and incentives is able to attract larger amounts of VC investment.

Investment in Green Technology and California

California ranked second in equity invested in green technology, with $123.67 per $100,000 of GSP. Wisconsin leads the pack with $250.42—more than twice as much as California. The other states in the top 10 are Massachusetts ($75.16), Vermont ($71.67), New Hampshire ($34.08), Missouri ($26.62), Georgia ($25.53), Oregon ($22.49), Colorado ($22.11), and Arizona ($20.59). Most of these top states have aggressive policies such as credits and funding that attract investments and innovation in this field.

Figure 77. Sum of equity investments in green technology per $100,000 of GSP
2009

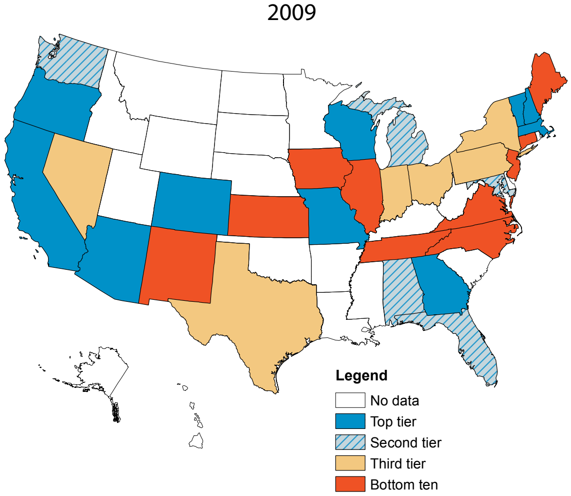
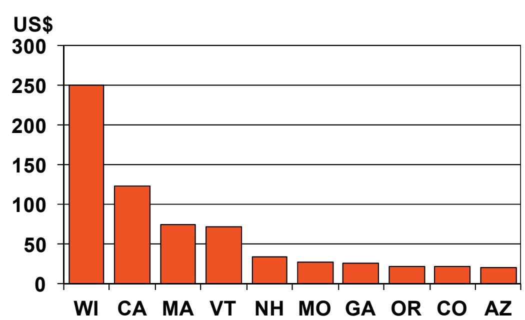


Figure 78. Sum of equity investments in green technology per $100,000 of GSP
Top tier states, 2009



Sources: Thomson Financial, U.S. Bureau of Economic Analysis.

Human Capital Investment Composite Index

Definition

The third major index measuring each state's position in technology and science is the Human Capital Investment Composite Index. This composite is made up of 18 individual indicators that comprehensively assess a state's human capital attainments, especially in various science and engineering fields. The composite index is calculated by totaling each state's scores (which are based on rankings) and dividing by the number of indicators. Data for the various indicators of human capital investment are collected from a variety of sources and compiled by the Milken Institute.

Why Is It Important?

Human capital is arguably the most critical intangible asset of a knowledge-based economy. A state's depth of talent attracts and retains commercial firms, financing, and research organizations. Human capital offers a state the latent creative capacity to build and grow firms indigenously as well. In the high-technology sector, workers educated in science and engineering are especially in demand.

This index assesses such factors as the percentage of the population with advanced degrees, the percentage educated in science and engineering, state support of higher education, average college entrance exam performance, and the diffusion of key information technologies among the population at large. States that score well in this index have succeeded by nurturing a proportionally large base of highly trained people.

Human Capital Capacity and California

With a score of 60.67, California ranked 13th overall, the same as in 2008, when its score was higher at 64.10. Over the years, the state has lost ground in this composite index, ranking seventh with a score of 67.11 in the 2004 index and fourth with a score of 72.60 in 2002. Provided funding for higher education rebounds from recent budget cuts, the state could leverage its world-renowned universities to increase its performance in this measure. The following sections break down this component in more detail to explain California's performance in human capital capacity. The states that make up the top five in this component are Maryland (77.90), Massachusetts (75.24), Colorado (73.62), Minnesota (72.95), and Connecticut (70.29).

Figure 79. Human Capital Investment Composite Index
2010

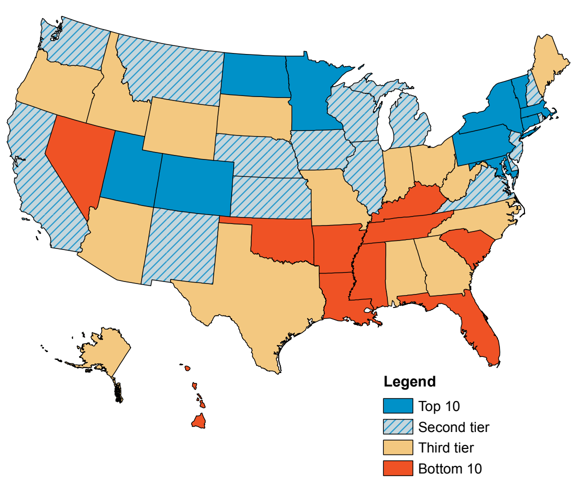
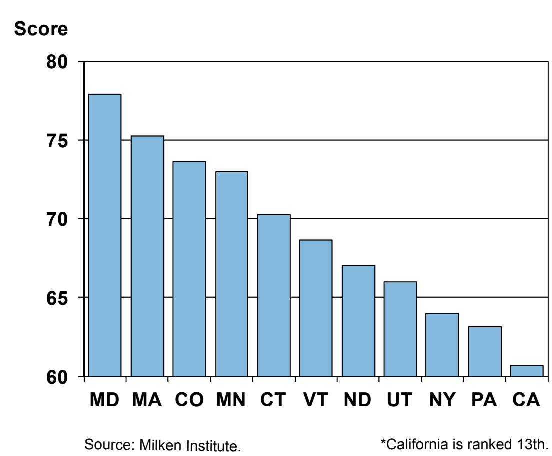


Figure 80: Human Capital Investment Composite Index
Top 10 states and California, 2010



Percentage of Population with Bachelor's Degrees

Definition

This indicator provides a broad measure of higher educational attainment by a state's population. It is calculated by adding up the number of people 25 and older with qualifying degrees and dividing that figure by the state's entire population in that age group. This demographic cohort was selected because current trends show that people are either starting college at a later age or taking longer than the traditional four years to complete a bachelor's degree. Bachelor's degree data is provided by the U.S. Department of Education. Population numbers are provided by the U.S. Census Bureau.

Why Is It Important?

Having a well-educated population is one of the most fundamental requirements for supporting a state's science and technology assets. There are additional benefits to a state as well: Better educated workers tend to earn higher wages that support state finances and feed into the marketplace. A bachelor's degree represents the first rung on the ladder of advanced learning that is required for much of the high-end work in a knowledge-based economy.

The latest available figures indicate that a quarter of all people in the United States 25 and older have bachelor's degrees. Twenty-two states meet or exceed the national average. Amassing a well-educated pool of human capital can be accomplished either by providing an adequate educational system to state residents or importing talent from outside. All states engage in both approaches to varying degrees.

Bachelor's Degrees and California

With 26.46 percent of California's population 25 and older holding at least a bachelor's degree, the state ranked 16th overall. California's standing was the same in the 2008 index, with 29.80 percent having at least a bachelor's degree. California has a strong university system and could benefit from promoting greater awareness among high school students about the importance of tertiary education. The five states that make up the top five are Massachusetts (34.43 percent), Colorado (32.36 percent), Connecticut (32.21 percent), Maryland (31.67 percent), and New Jersey (31.25 percent).

Figure 81. Percentage of population age 25+ with bachelor's degree or higher
2008

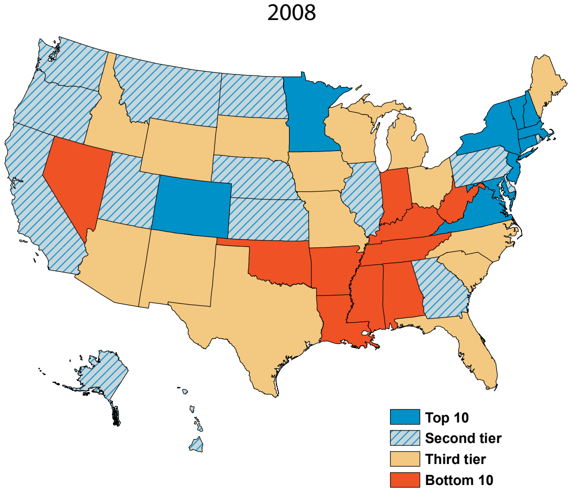
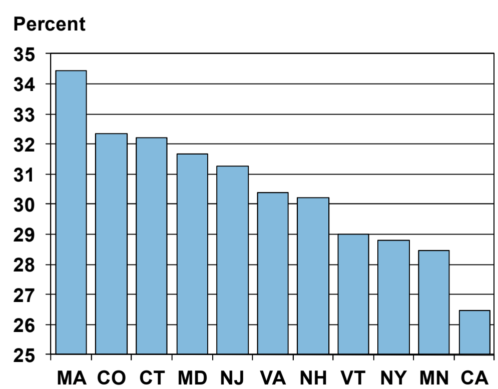


Figure 82. Population age 25+ with bachelor's degree or higher
Top 10 states and California, 2008



*California ranked 16th.

Sources: U.S. Census Bureau, Department of Education.

Percentage of Population with Advanced Degrees

Definition

This indicator measures the percentage of the population with a master's degree or higher, including professional degrees and doctorates. It is calculated by totaling the number of people 25 and older with an advanced degree, and then dividing by the total population 25 and older. That age cohort was selected because people are taking longer than four years to complete a bachelor's degree and taking longer breaks between completing their bachelor's and starting their advanced degrees. Advanced degree data come from the U.S. Department of Education. Population numbers are provided by the U.S. Census Bureau.

Why Is It Important?

The percentage of the population with advanced degrees is a reliable indicator of a state's capacity to support a knowledge-based economy. Advanced degrees are often an important qualifier for upper-management positions, especially in high-tech fields.

The cost of education is a factor, however, and states eager to cultivate a high-tech economy must consider the impact of student aid and general appropriations for higher education (which we analyzed separately as components of human capital investment). Some 20.2 million Americans hold advanced degrees, for an average of 8.71 percent of all U.S. residents 25 and older. Twenty-one states exceed the national average.

Advanced Degrees and California

In California, 9.62 percent of those 25 and older have an advanced degree for a ranking of 15th. In the 2008 index, the state ranked 15th and the percentage was 10.35. The smaller percentage this time around suggests that California is not attracting and retaining advanced degree holders compared to other states—although it is important to note that the U.S. average and all top five states' percentages declined as well. An outreach program that promotes the state's universities and lucrative job market for advanced degree holders could help attract talent from around the world. The top five states in this measure were Massachusetts (14.78 percent), Maryland (13.88 percent), Connecticut (13.77 percent), New York (12.46 percent), and Virginia (12.43 percent).

Figure 83. Percentage of population age 25+ with advanced degrees
2008

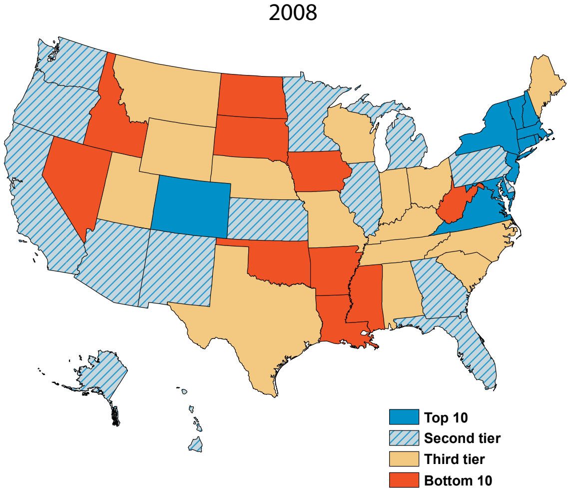
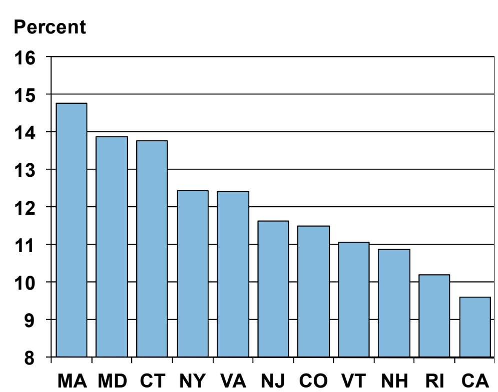


Figure 84. Population age 25+ with advanced degrees
Top 10 states and California, 2008



*California ranked 15th.
Sources: U.S. Census Bureau, Department of Education.

Percentage of Population with Ph.D.s

Definition

This indicator measures the percentage of the population with Ph.Ds. It is calculated by adding up the number of people age 25 and older who have attained a Ph.D., then dividing it by the total population 25 and older. This age cohort was selected because people are taking longer than four years to complete bachelor's degrees and taking longer breaks between completing their bachelor's and starting an advanced degree. Ph.D. data come from the U.S. Department of Education. Population numbers are provided by the U.S. Census Bureau.

Why Is It Important?

The percentage of a state's population with Ph.D. degrees is another reliable indicator of that state's capacity to support a knowledge-based economy. States with a highly educated population such as Massachusetts and Maryland are well-known for their knowledge-intensive economies. Although doctorates are not widely required, various specialized knowledge-intensive occupations in the area of high-technology R&D do require this level of education.

As mentioned, people are taking longer to complete degrees than in the past. Part of the reason is systemic, but cost is also a factor. States eager to cultivate a high-tech economy must consider the impact of student aid and general appropriations for higher education (also analyzed here as components of human capital investment). About 2.3 million U.S. residents hold Ph.D.s, an average of 1.01 percent of the population age 25 and older. Twenty states meet or exceed the average percentage.

Ph.D.s and California

California performed much better in this measure than in bachelor's and advanced degrees, with 1.28 percent of those 25 and older holding a Ph.D. The state ranked seventh for a second consecutive index despite a drop in Ph.D. holders from 1.33 percent. The top five in this measure were Massachusetts (1.93 percent), Maryland (1.92 percent), New Mexico (1.47 percent), Virginia (1.43 percent), and Connecticut (1.38 percent).

Figure 85. Percentage of population age 25+ with Ph.D.s
2008

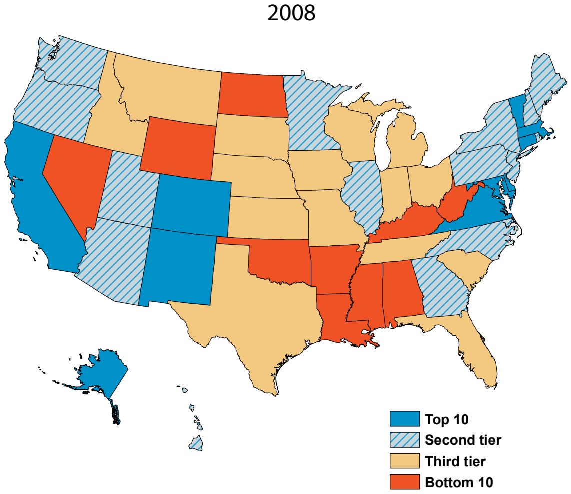
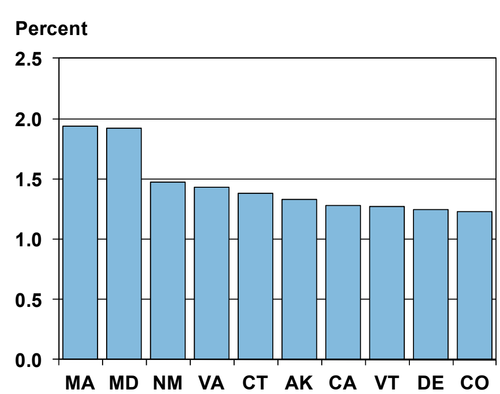


Figure 86. Population age 25+ with Ph.D.s
Top 10 states, 2008



Sources: U.S. Census Bureau, Department of Education.

Graduate Students in Science, Engineering, and Health

Definition

This indicator quantifies the percentage of graduate students ages 25 to 34 in science, engineering, and health. It measures the degree to which a state is training people with skills specific to those fields. The indicator is calculated by taking the number of individuals in that age cohort enrolled in each state's science, engineering, and health graduate studies programs and dividing that number by each state's population of 25- to 34-year-olds. Those enrolled in graduate programs have already completed a bachelor's degree and are pursuing a master's or Ph.D. Data on the number of students in graduate schools in those fields are collected by the NSF's Experimental Program to Stimulate Competitive Research. Population numbers are from the U.S. Census Bureau.

Why Is It Important?

Measuring a state's level of graduate students in science, engineering, and health provides one of the more direct indicators of how well that state is preparing its population for the work that lies at the core of a high-tech economy. Strong, well-attended graduate programs in science and engineering also act as one of the most effective means of attracting high-tech companies to a state.

In 2006 (the most recent data available), 1.34 percent was the national average for percentage of 25- to 34-year-olds in science, engineering, and health. Twenty-two states exceeded the national average. South Dakota, at 1.35 percent, came closest to the average among these higher-performing states.

Science, Engineering, and Health and California

California came in below the national average, with just 1.01 percent of 25- to 34-year-olds enrolled in science, engineering, and health graduate programs compared with 1.03 percent in the 2008 index. The state slid one spot to 37th in the latest calculation. Science, engineering, and health programs form the foundation for high-tech development, so stable growth in workers educated in these areas is necessary for a state to be competitive. The states that make up the top five were Massachusetts (3.29 percent), North Dakota (2.38 percent), Minnesota (2.37 percent), Maryland (1.95 percent), and New York (1.90 percent).

Figure 87. Percentage of graduate students in science, engineering, and health, ages 25–34
2006

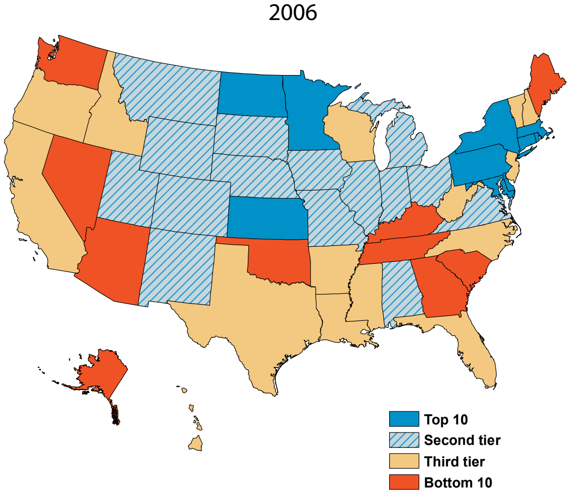
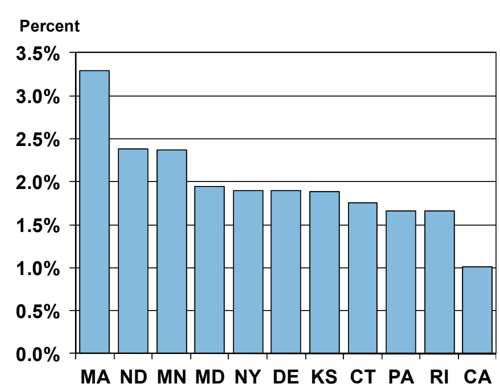


Figure 88. Percent of graduate students in science, engineering, and health, 25-34 age cohort
Top 10 states and California, 2006



*California ranked 37th.
Sources: EPSCoR, U.S. Census Bureau.

Per Capita State Spending on Student Aid

Definition

Per capita state spending on student aid is calculated by taking the total amount spent by each state on student aid and dividing by the state's total population. Student aid is defined as funds spent by a state on any form of financial assistance for a student to attend its colleges, universities, or research institutions. Data on student aid come from the National Science Foundation's EPSCoR division. Population figures are collected by the U.S. Census Bureau.

Why Is It Important?

State-sponsored financial aid can open the door to higher education. State student aid typically complements federal forms of financial assistance. As with any human capital resource, states must compete with one another for talent. State-sponsored student aid is one of many factors that can encourage advanced learning and attract out-of-state talent to contribute to a knowledge economy.

In terms of economic indicators, state spending on student aid per capita can provide a useful gauge for just how committed a state's leadership is to facilitating access to higher education. In 2008, $9.9 billion was spent by the 50 states on student aid for an average of $30.52 per U.S. resident. Twenty-two states provide per capita levels of aid to their populations that exceed the national average.

Student Aid Spending and California

California spent $23.22 per capita on student aid to rank 25th in this measure, a slight improvement from $21.92 per capita and 26th in the 2008 index. With the cost of higher education increasing, the state may need to increase student aid to keep its education system competitive. The top five states in this measure were Alaska ($120.91), New Jersey ($70.43), South Carolina ($66.66), Nebraska ($66.01), and Indiana ($62.47).

Figure 89. Per capita state spending on student aid
2007-2008

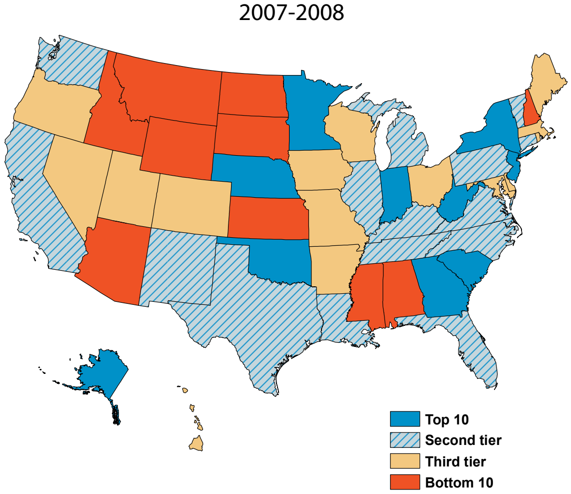
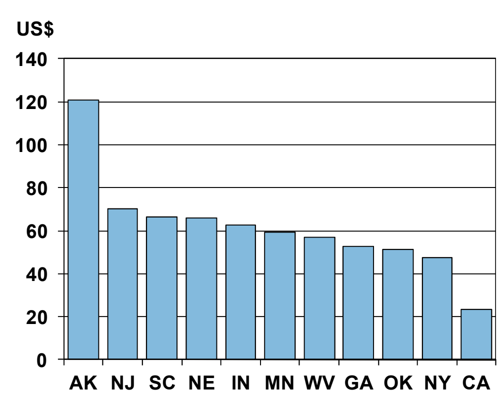


Figure 90. Per capita state spending on student aid
Top 10 states and California, 2007-2008



*California ranked 25th.

Sources: EPSCoR, U.S. Census Bureau.

Average Verbal SAT Scores

Definition

This indicator measures each state's average verbal scores on the Scholastic Aptitude Test (SAT), the most widely used form of college admissions testing. The indicator is calculated by averaging the verbal scores reported by each high school in each state. The SAT is composed of three sections, covering verbal (critical reading), math skills, and writing. We focus on the first two sections because of their historical usage. Individually, verbal and math are worth 800 points each, for a maximum combined score of 1600. SAT data is collected by the Experimental Program to Stimulate Competitive Research at the NSF.

Why Is It Important?

Verbal SAT scores reflect how well a state's high school students are prepared for competitive college admission in terms of reading comprehension and language skills. In states with large university systems—such as California, Florida, and New York—generally 50 percent or more of high school graduates have taken the SAT. Because so many students, including a significant number of first-generation immigrants, take the test, scores tend to be lower in those states. In states such as Iowa, North Dakota, and Wisconsin, where less than 10 percent of all graduates take the SAT, students tend to score higher because of "selection bias," i.e. only high-performing students tend to take the test.

Although the verbal portion of the SAT is not as directly relevant to science and technology fields as the math portion, verbal scores still testify to the effectiveness of high school instruction and learning. Verbal skills also relate to an individual's communication and analytical abilities. In 2009, the average verbal SAT score in the United States was 536.

SAT Verbal Scores and California

Students in California scored an average of 500 points on the verbal section of the SAT exam, giving the state a ranking of 36th, compared to an average score of 499 and a ranking of 37th in the 2008 index. One explanation for its relatively weak performance is its large pool of immigrant test-takers. Occupying the top five positions were Iowa (610 points), Minnesota (595 points), Missouri (595 points), Wisconsin (594 points), and North Dakota (590 points).

Figure 91. Average verbal SAT scores
2009

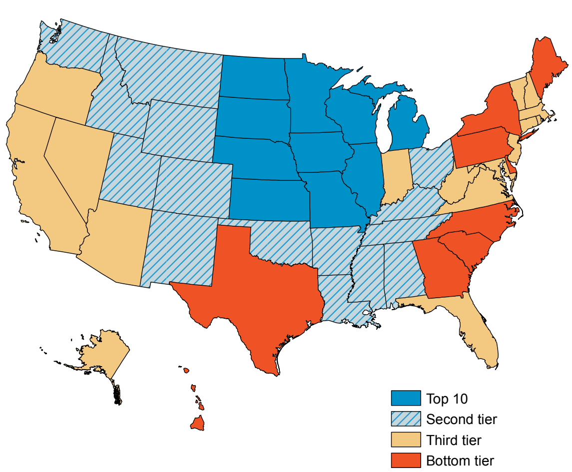
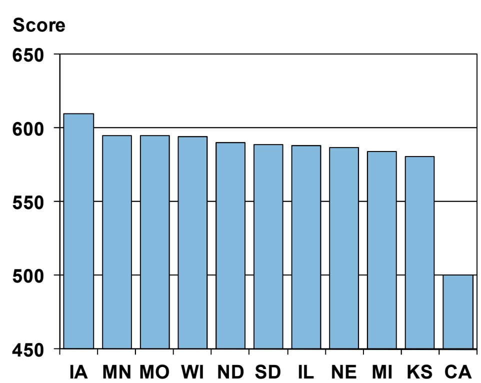


Figure 92. Average verbal SAT scores
Top 10 states and California, 2009



Source: EPSCoR.

*California ranked 36th.

Average Math SAT Scores

Definition

This indicator measures how well each state's high school students perform on the math portion of the SAT, the most widely used form of college admissions testing. The indicator is calculated by averaging the math scores reported by each high school in each state. The SAT math section is worth a possible 800 points. Data on SAT scores is collected by EPSCoR, a division of the National Science Foundation.

Why Is It Important?

Math SAT scores reflect how well a state's high school students are prepared for competitive college admission in regards to mathematical problem-solving and analysis. High math SAT scores are indicative, to some degree, of the quality and the intensity of algebra, geometry, and general quantitative analysis instruction in each particular state and the ability of its students to master this material. States with large populations and university systems generally don't score as well in this indicator as less populous states do because a more select group of students take the exam in smaller states.

The aptitudes tested in the math portion of the SAT are directly relevant to science and technology fields. Students anticipating study in any scientific or quantitatively based discipline must possess the fundamental mathematical ability the SAT is designed to measure. The national average for the math SAT score is 541. Twenty-three states meet or exceed this average.

SAT Math Scores and California

California students scored an average of 513 points on the math portion of the SAT, three points less than in the 2008 index. The state ranked 32nd for the third consecutive index in this measure. Of note, California students performed better on the math portion than the verbal portion of the test. The top five states were Iowa (615 points), Minnesota (609 points), Wisconsin (608 points), Illinois (604 points), and Michigan (603 points).

Figure 93. Average math SAT scores
2009

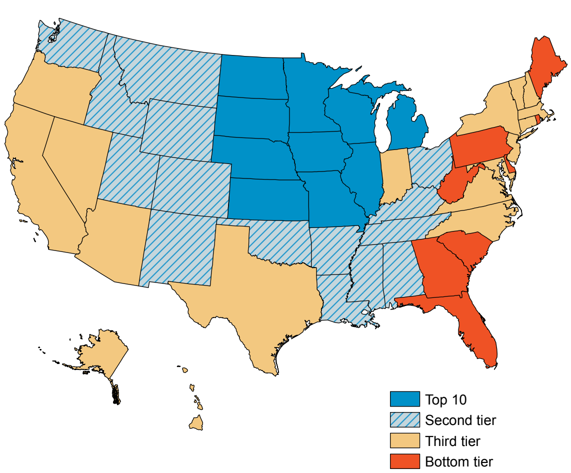
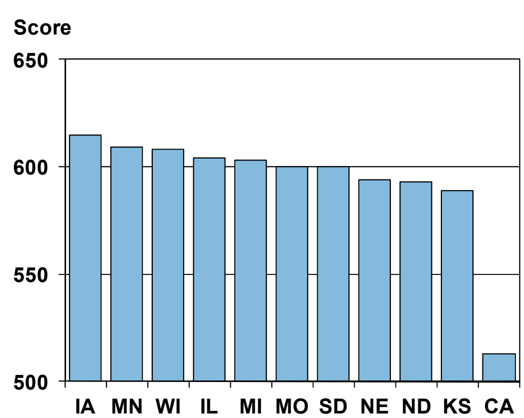


Figure 94. Average math SAT scores
Top 10 states and California, 2009



Source: EPSCoR.

*California ranked 32nd.

Average ACT Scores

Definition

The indicator for the average American College Testing Assessment (ACT) scores measures state-based performance in this college admissions test. The indicator is calculated by averaging the composite ACT scores reported by each high school in each state. Approximately one in 12,000 high school students took the ACT instead of, or in addition to, the SAT. The ACT is composed of four sections: English, mathematics, reading, and science reasoning. The test is scored on a scale of 1 to 36, with 36 being the highest possible score. ACT score data is provided by EPSCoR.

Why Is It Important?

ACT scores, like SAT scores, provide colleges and universities with a means of measuring students' aptitude as well as an instrument to predict academic performance during the student's first year in college. ACT scores provide high schools with a tool to gauge the effectiveness of their curricula in preparing teens for higher education instruction.

Unlike the SAT, the ACT is a curriculum-based exam rather than a psychometric (IQ-type) test. That is, it tests students on their knowledge of specific subjects, not on their aptitude for more broadly defined verbal and quantitative problem-solving. Twenty-eight states scored at or above the 2009 national average of 21.6, with Idaho, Missouri, and North Carolina coming closest to the U.S. average.

ACT Scores and California

With an average ACT score of 22.2 points, California ranked 14th, slipping slightly from 22.1 points and 13th position in the 2008 index. The ACT is taken less frequently by California students than the SAT as a prerequisite for tertiary education. The top five states in this measure were Massachusetts (23.9 points), Connecticut (23.5 points), New Hampshire (23.5 points), Maine (23.1 points), and New Jersey (23.1 points).

Figure 95. Average ACT scores
2009

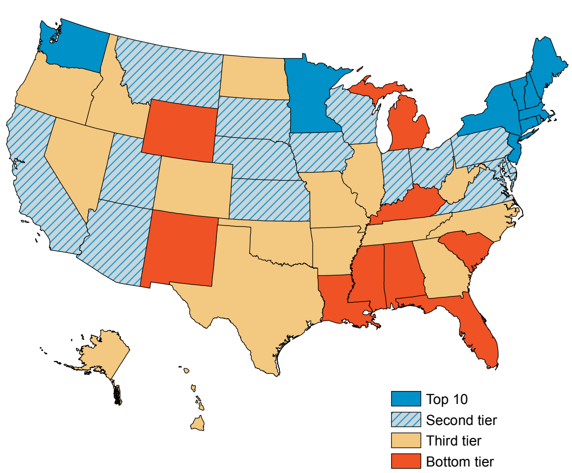
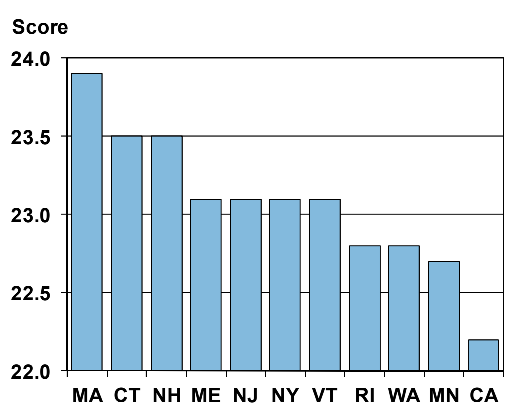


Figure 96. Average ACT scores
Top 10 states and California, 2009



Source: EPSCoR.

*California ranked 14th.

State Appropriations for Higher Education per Capita

Definition

The indicator for state appropriations for higher education is calculated by taking the amount each state spends on higher education and dividing it by state population. Appropriations for higher education include the money spent on faculty and staff wages, building maintenance, athletic programs, and various other allocations that pay for the day-to-day operations of a state's colleges and universities. State appropriations data is provided by EPSCoR, and population numbers come from the U.S. Census Bureau.

Why Is It Important?

When averaged out on a per capita basis, state spending on higher education reveals the extent of each state government's commitment to providing the infrastructure for higher learning for its residents. Somewhat similar to an earlier indicator showing state spending on student financial aid per capita, this component focuses on state money provided directly to institutions of higher learning. These two measures taken together, plus an additional indicator for percent change in appropriations for higher education (found on the following page), offer a composite picture of how successful a state's government is at supporting higher education. In fiscal year 2010, state appropriations for higher education throughout the United States totaled $79.5 billion, or an average of about $272 per U.S. resident.

State Appropriations and California

California spent $295.14 per capita on higher education in 2010 vs. $294.20 in the prior index. Despite this increased spending, California lost ground in the rankings for this indicator, dropping from 12th to 15th. This finding suggests that the state is falling behind other states in this measure, perhaps in part because of its state budget deficit. The top five states in this measure were Wyoming ($582.94 per capita), Alaska ($473.77), North Dakota ($467.97), Hawaii ($454.81), and New Mexico ($442.49).

Figure 97. State appropriations for higher education
Per capita, 2010

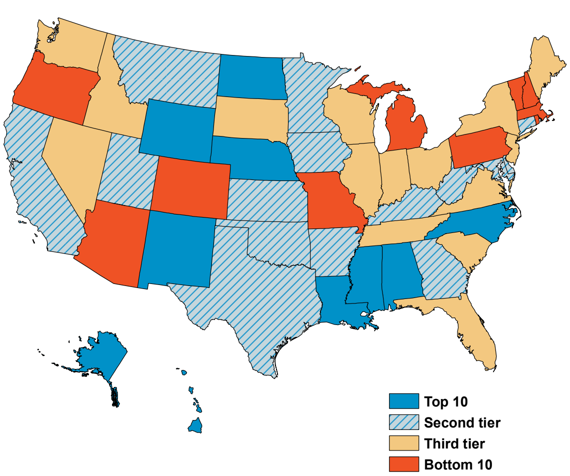
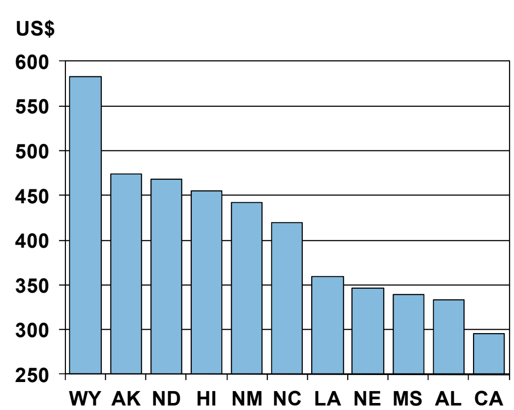


Figure 98. Per capita state appropriations for higher education
Top 10 states and California, 2010



*California ranked 15th.

Sources: EPSCoR, U.S. Census Bureau.

Percent Change in Appropriations for Higher Education per Capita

Definition

The indicator for percent change in state appropriations for higher education measures increases or decreases in per capita state spending on higher education. The indicator is calculated by taking the amount each state set aside for higher education in 2009 and 2010 and determining upward or downward changes. Appropriations for higher education include the money spent on faculty and staff wages, building maintenance, athletic programs, and various other allocations that pay for the day-to-day operations of a state's colleges and universities. State appropriations data is provided by EPSCoR, and population numbers come from the U.S. Census Bureau.

Why Is It Important?

As noted in the previous indicator, appropriations for higher education reveal how much a state's government is committing to providing the infrastructure for higher learning. While the previous indicator gives a static picture of appropriations for a given year, this indicator compares appropriations over the most recent two-year period. Taken in conjunction with the two related indicators (state spending on student aid per capita and state appropriations for higher education per capita), this indicator provides a composite picture of a state's financial commitment to providing advanced education. From 2009 to 2010, the average state reduced appropriations for higher education by a dismal 4.4 percent.

Growth in State Appropriations and California

California increased appropriations for higher education by 3.44 percent from 2009 to 2010, earning seventh place in this measure. In the prior index, California ranked 18th with growth of 6.9 percent in appropriations from 2006 to 2007. California's budget deficit will continue to challenge the state's commitment to supporting higher education. The top five states in this measure were North Dakota (18.51 percent), Texas (7.19 percent), North Carolina (5.16 percent), Montana (4.97 percent), and Vermont (4.60 percent).

Figure 99. Growth in state appropriations for higher education per capita
2009-2010

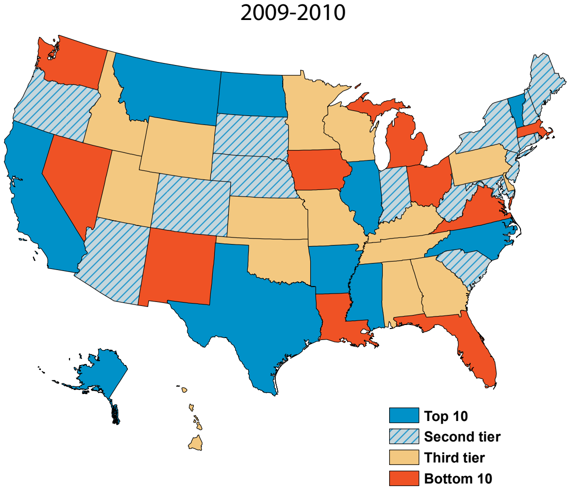
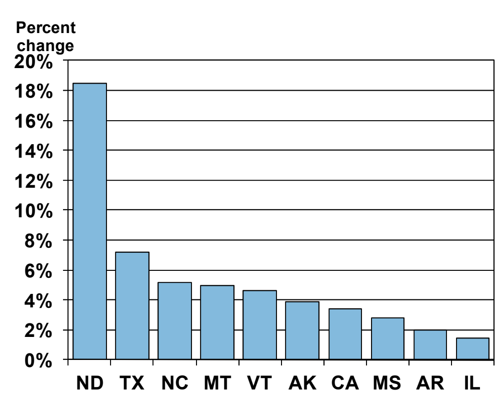


Figure 100. Growth in state appropriations for higher education
Top 10 states, 2009–2010



Sources: EPSCoR, U.S. Census Bureau.

Doctoral Scientists per 100,000 People

Definition

The indicator for doctoral scientists per 100,000 people measures a state's intensity of scientists who have attained the highest level of formal academic training. It is calculated by totaling the number of doctoral scientists in each state and then normalizing it per 100,000 of each state's respective population. Doctoral scientists are professionals with advanced degrees in such fields as biology, chemistry, physiology, astronomy, physics, and the life sciences. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. Population figures are provided by the U.S. Census Bureau.

Why Is It Important?

Doctoral scientists operate at the upper end of creative and managerial work in numerous scientific and technological fields. A noticeable presence of such individuals tends to be conducive to high-tech industry innovation, new firm formation, and growth. A labor pool with a sizable number of such highly skilled workers is also attractive to technology firms when they evaluate locations for their high-end operations.

There were about 361,000 doctoral scientists in the United States in 2006 (the most recent statistics available). This represents an average of 128 doctoral scientists for every 100,000 U.S. residents. Eighteen states exceeded the national average, including California. Doctoral scientists are a valuable human capital resource to any state wishing to perform well in a technology-intensive, knowledge-based economy.

Doctoral Scientists and California

With 133.74 doctoral scientists per 100,000 population, California ranked 18th in this measure. In the 2008 index, California ranked 17th with 215.44 doctoral scientists per 100,000 residents. The top five states in this measure were North Dakota (351.95), Massachusetts (315.98), Maryland (300.95), New Mexico (230.66), and Delaware (222.26).

Figure 101. Doctoral scientists per 100,000 people
2006

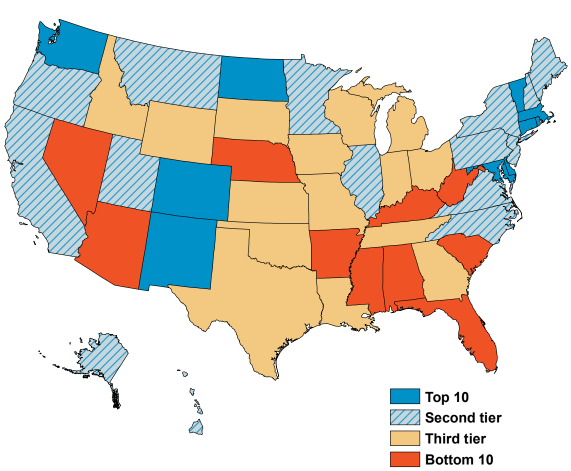
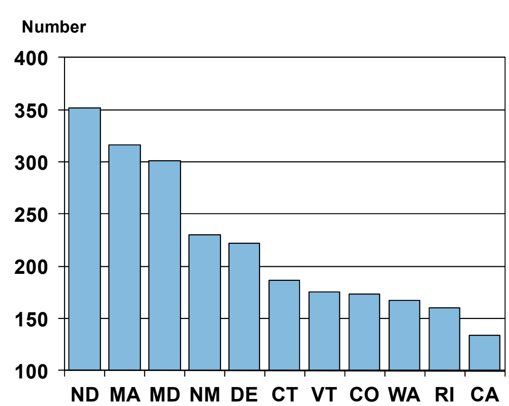


Figure 102. Doctoral scientists per 100,000 people
Top 10 states and California, 2006



*California ranked 18th.

Sources: National Science Foundation, U.S. Census Bureau.

Doctoral Engineers per 100,000 People

Definition

This indicator measures a state's intensity of engineers who have attained the highest level of formal academic training. It is calculated by totaling the number of doctoral engineers in each state and normalizing it per 100,000 state residents. Doctoral engineers specialize in a variety of engineering fields, including electrical, nuclear, molecular, and chemical engineering. The data is collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. Population figures are provided by the U.S. Census Bureau.

Why Is It Important?

Like doctoral scientists, doctoral engineers operate at the upper end of creative and managerial work in numerous scientific and technological fields. Engineering disciplines tend to be more applied and technologically oriented than scientific ones, although both are relevant to a high-tech economy. A noticeable presence of such individuals tends to be conducive to high-tech industry innovation, new firm formation, and growth. A labor pool with a sizable number of highly skilled doctoral engineers is also attractive to technology firms when they evaluate locations for their high-end operations.

There are some 78,000 doctoral engineers in the nation, for an average of 26 doctoral engineers for every 100,000 U.S. residents. Twenty-one states meet or exceed the national average. Washington is one of them, with 26.26 doctoral engineers per 100,000 population, coming closest to the national average.

Doctoral Engineers and California

California ranked eighth in this measure with 41.00 doctoral engineers per 100,000 population. In the 2008 index, California was sixth with 63.86 doctoral engineers. California has a much higher proportion of doctoral engineers than doctoral scientists, reflecting the state's strengths in engineering. The top five states were New Mexico (93.92), Massachusetts (56.03), Delaware (47.04), Vermont (45.15), and Oregon (45.10).

Figure 103. Doctoral engineers per 100,000 people
2006

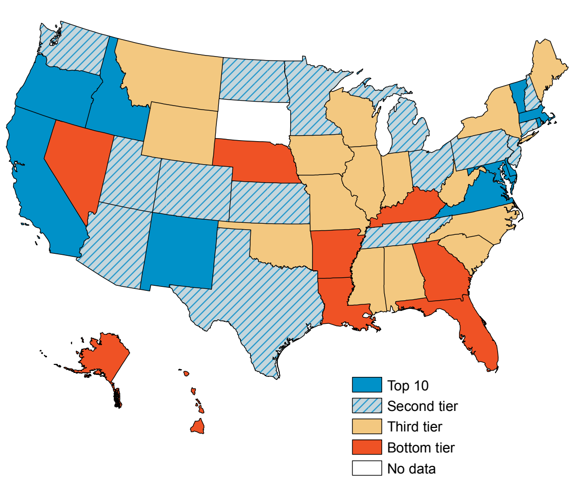
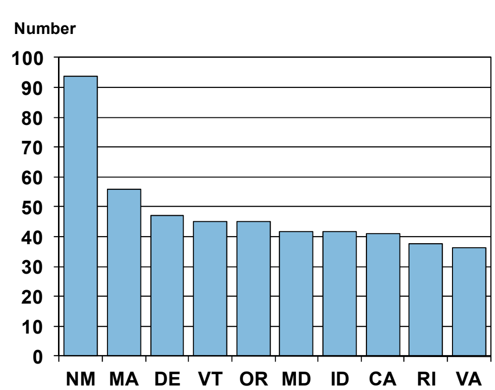


Figure 104. Doctoral engineers per 100,000 people
Top 10 states, 2006



Sources: National Science Foundation, U.S. Census Bureau.

Science, Engineering, and Health Ph.D.s Awarded

Definition

The indicator for the number of science, engineering, and health (SEH) Ph.D.s awarded measures how many doctorate degree-holders a state produces in those disciplines. The indicator is calculated by taking the number of Ph.D.s awarded in the 25- to 34-year-old age cohort and normalizing it per 100,000 people in that demographic. Data on doctoral scientists and engineers include all graduate degree candidates and recipients in SEH fields. It was compiled by the Division of Science Resources Studies of the National Science Foundation. Population figures were provided by the U.S. Census Bureau.

Why Is It Important?

While the previous two indicators measured the number of doctoral scientists and engineers in a state, this indicator assesses how many doctoral scientists and engineers a state's higher education system produces. In this sense, the indicator measures a state's capacity to generate and train highly skilled knowledge workers. Producing such specialized individuals can be conducive to high-tech industry innovation, new firm formation, and growth. Producing a critical mass of science and engineering doctorate degree-holders also attracts technology firms to a state.

Possessing an education system that produces a sufficient quantity of science and engineering doctoral candidates and degree-holders indicates a state's capacity for upper-tier knowledge-based economic activity. There were close to 32,000 science, engineering, and health doctoral degrees awarded in the United States in 2007, for a national average of 75.3 SEH Ph.D.s for every 100,000 people age 25 to 34. Twenty-one states met or exceeded the national average; Nebraska comes closest with 76.7.

Science, Engineering, and Health Ph.D.s and California

California produced 82.70 Ph.D. holders in science, engineering, and health for every 100,000 people age 24 to 34 to place 16th in this measure. This is a significant improvement from the 2008 index when the state produced 68.42 Ph.D. holders and ranked 22nd. Still, California lags far behind the leaders: Massachusetts (231.74 Ph.D. holders), South Carolina (219.13), Delaware (137.44), Connecticut (128.05), and Maryland (119.18).

Figure 105. Science, engineering, and health Ph.D.s awarded per 100,000 people
25–34 age cohort, 2007

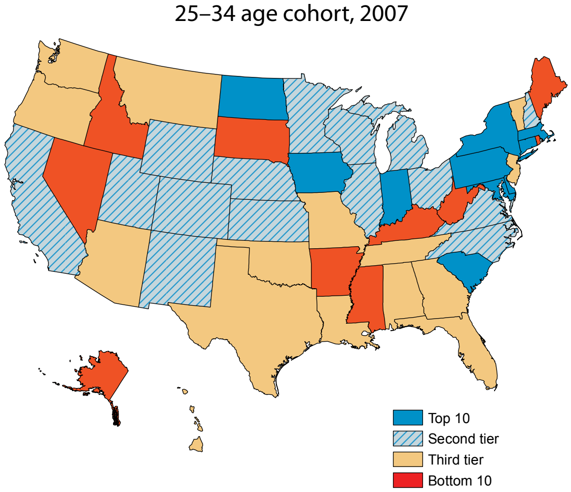
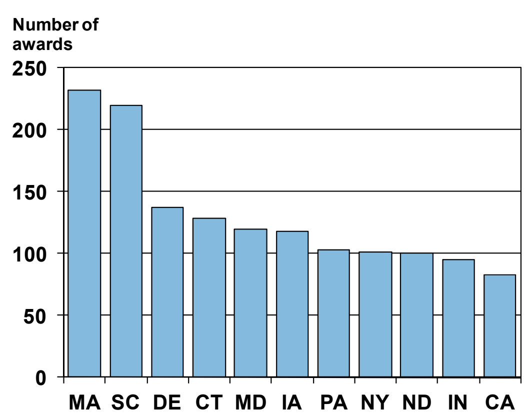


Figure 106. Science, engineering, and health Ph.D.s awarded
Top 10 states and California, 2007



*California ranked 16th.

Sources: National Science Foundation, U.S. Census Bureau.

Science, Engineering, and Health Postdoctorates Awarded

Definition

The indicator for science and engineering postdoctorates awarded measures the number of positions granted in a state for advanced academic or professional work immediately following a student's completion of doctoral degree studies. The indicator is calculated by taking the number of Ph.D. degree-holders age 25 to 34 conducting postdoctoral work and normalizing it per 100,000 state residents in that demographic. Postdoctoral programs allow participants to further specialize in their fields of interest after completing a Ph.D. Science, engineering and health (SEH) postdoctoral awards data is provided by the Division of Science Resources Studies of the National Science Foundation. Population figures come from the U.S. Census Bureau.

Why Is It Important?

This indicator relates to a state's ability to attract and produce highly trained knowledge workers. Postdoctoral work is important to Ph.D. holders and institutions alike because such programs allow newly minted Ph.D.s to further their knowledge in their field. Postdoctoral opportunities are predominantly awarded by universities, so participants often teach in addition to performing postdoctoral research.

Data on postdoctoral awards include all graduate degree candidates and recipients in SEH fields. There were some 49,000 SEH postdoctorates awarded in the United States to people ages 25 to 34 in 2006, for a national average of 108 SEH postdoctorates awarded per 100,000 members of this age group. Seventeen states exceed the national average.

Postdoctorates and California

California awarded 146.23 postdoctoral positions in science, engineering, and health programs for every 100,000 people age 25 to 34 for a ranking of 12th. The top five states were Massachusetts (813.06), Connecticut (303.44), Maryland (236.99), Pennsylvania (175.12), and Rhode Island (174.50). Massachusetts is a clear leader in this measure, with 5.5 times more postdoctoral positions per 100,000 young people than California.

Figure 107. Science, engineering, and health postdoctorates awarded per 100,000 people
25–34 age cohort, 2006

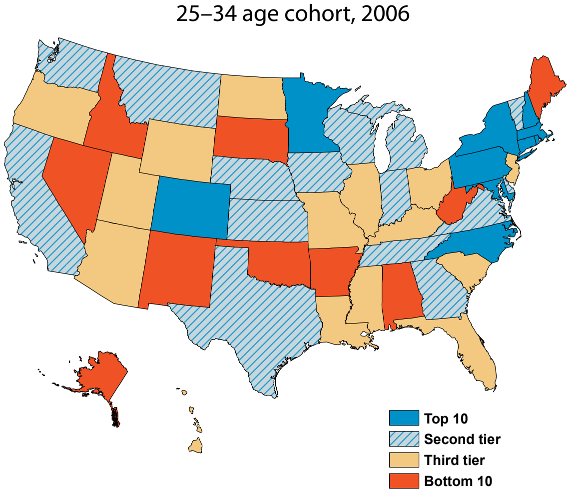
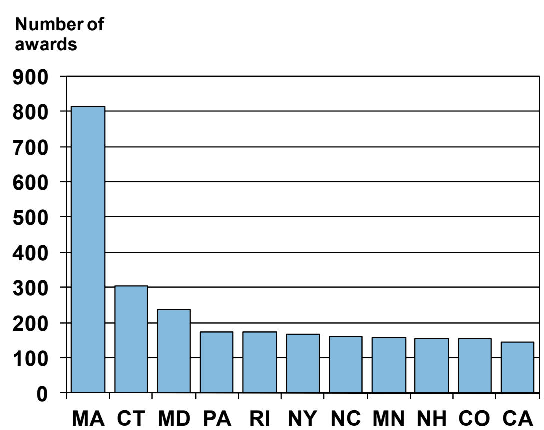


Figure 108. Science, engineering, and health postdoctorates awarded per 100,000 people
Top 10 states and California, 2006



*California ranked 12th.

Sources: National Science Foundation, U.S. Census Bureau.

Percentage of Bachelor's Degrees in Science and Engineering

Definition

The indicator for the percentage of bachelor's degrees granted in science and engineering measures the prevalence of science and engineering majors among a state's total pool of bachelor's degree recipients. The indicator is calculated by taking the number of bachelor degrees granted in a state for science- or engineering-related fields and dividing it by the total number of bachelor degrees granted in all disciplines. The indicator includes degrees conferred by Title IV-eligible, degree-granting institutions. Data is provided by the National Center for Education Statistics, a division of the U.S. Department of Education.

Why Is It Important?

This indicator reflects the popularity of science and engineering majors among a state's college students. A large share of degrees granted in science or engineering suggests correspondingly high interest in science- and engineering-related professions, but it does not automatically correlate with a flourishing high-tech economy.

Many high-scoring states such as Wyoming and Montana likely attract a much higher percentage of science and engineering majors than recognizably high-tech states like California and Massachusetts because the university curricula of the former are comparatively more limited. Nevertheless, a large percentage of science and engineering graduates can undeniably help feed a high-tech labor pool. The national average for science and engineering bachelor's degrees was 16.1 percent in 2007. Twenty-three states met or exceeded the average; North Dakota and Washington most closely matched the national average with 16.2 percent.

Science and Engineering Bachelor's Degrees and California

About 17.98 percent of university graduates in California received bachelor degrees in science and engineering programs, exceeding the national average. As a result, California ranked ninth in this measure. A strong focus on science and technology disciplines suggests a strong focus on high-tech human capital development and high-tech jobs in the state. In this measure, the top five performers were Wyoming (23.53 percent), Montana (21.72 percent), Maryland (21.07 percent), South Dakota (20.69 percent), and Colorado (19.65 percent).

Figure 109. Percentage of bachelor's degrees granted in science and engineering
2007

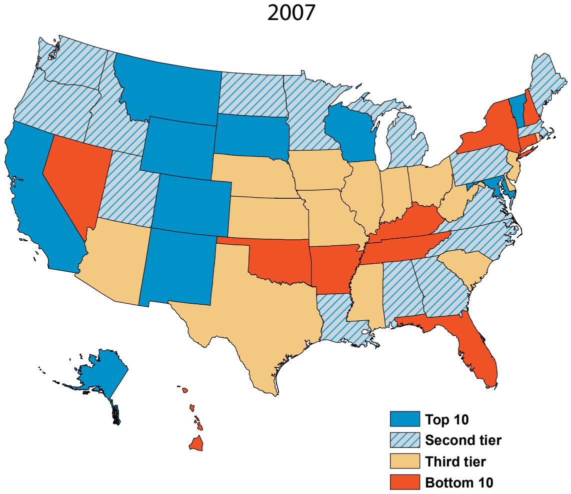
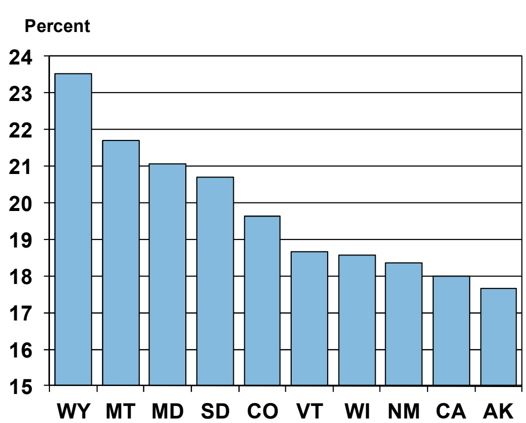


Figure 110. Percentage of bachelor's degrees granted in science and engineering
Top 10 states, 2007



Source: National Center for Education Statistics.

Recent Degrees in Science and Engineering

Definition

The indicator for recent degrees in science and engineering measures the proportion of people in a state's workforce who recently graduated from a higher-education program in science or engineering. The indicator is derived by totaling the number of workers who earned bachelor's, master's, or Ph.D. degrees in science or engineering in each state and then normalizing it per 1,000 of each state's respective civilian workers. Data on degrees earned came from the Science Resources Studies Division of the National Science Foundation. Civilian labor force figures were collected by the Bureau of Labor Statistics, a division of the U.S. Department of Labor.

Why Is It Important?

Counting recent science and engineering graduates in a state's workforce offers a proxy for the extent to which a state's labor pool is being infused with new talent that could directly contribute to high-tech industries. As a group, recent graduates in science and engineering fields tend to gravitate to those states that offer the most promising job opportunities. States that combine a high-tech industrial base with a large proportion of new S&E degree-holders in their workforce are well-positioned to benefit disproportionately from a cohort that is characterized by intellectual curiosity and eagerness to develop a high-tech career.

During 2007, more than 689,000 U.S. workers had recently obtained various degrees in science or engineering disciplines. Twenty-four states met or exceeded the national average of 3.6 recent science and engineering graduates per 1,000 civilian workers; Maine closely matches the average.

Recent Degrees and California

With 2.75 graduates per 1,000 civilian workers having recently received a degree in science and engineering, the state ranks 43rd among its peers. The top five states in this measure were North Dakota (6.10 graduates), Massachusetts (5.64), West Virginia (5.18), Arizona (5.17), and Pennsylvania (4.92).

Figure 111. Recent degrees in science and engineering
Per 1,000 civilian workers, 2007

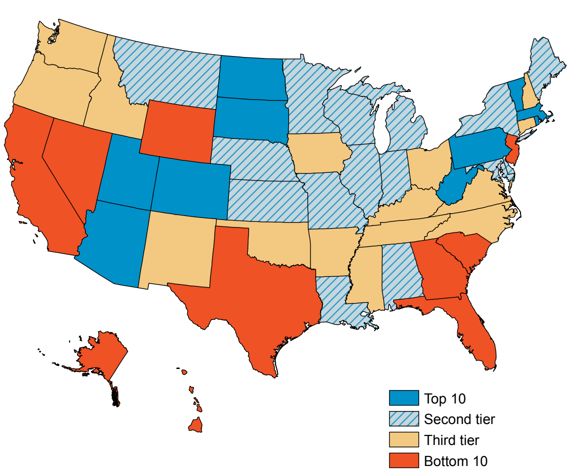
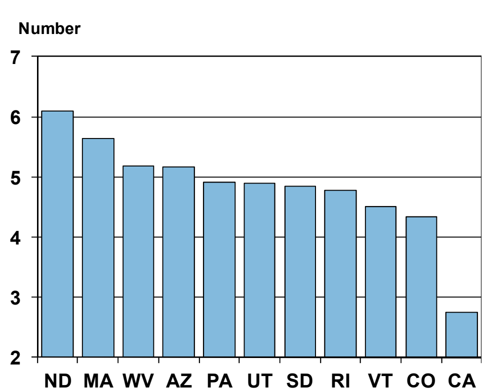


Figure 112. Recent degrees in science and engineering
Top 10 states and California, 2007



*California ranked 43rd.

Sources: National Science Foundation, Bureau of Labor Statistics.

Percentage of Households with Computers

Definition

This indicator measures each state's computer penetration rate. It is calculated by taking the number of households with computers and dividing by the number of households in each state. Traditionally, computer ownership is highest among the most educated and wealthiest segments of the population. However, with falling prices and bundling schemes, computer ownership among lower-income and less educated consumers has risen steadily over the past 10 years. The data was provided by the U.S. Department of Commerce, but new figures have not been collected since 2003.

Why Is It Important?

Having computers in the home helps children and adults alike become technically proficient and take advantage of knowledge and resources that would otherwise be difficult to attain. While the digital divide is narrowing, it still exists. Black and Hispanic communities remain the largest racial/ethnic populations with the lowest computer-ownership rates.

Computer ownership does not immediately correlate with high-tech industrialization. A more accurate assessment might be a statistic combining computer penetration within households with the number of computers per household, which would delve into the level of usage and proficiency. Nevertheless, a high degree of computer access and literacy among a population is an important component of any modern economy that aspires to equitable economic participation for the members of its society.

As of 2003, the latest year for which figures are available, 62.3 percent of all U.S. households were equipped with a computer.

Computer Households and California

This measure could not be updated because the Department of Commerce has not collected this data since 2003, the same figures used in the 2008 index. In that index, California ranked 12th, with 66.3 percent of households equipped with a computer. The top five states were Utah (74.1 percent), Alaska (72.7 percent), New Hampshire (71.5 percent), Washington (71.4 percent), and Colorado (70.0 percent).

Figure 113. Percentage of households with computers
2003

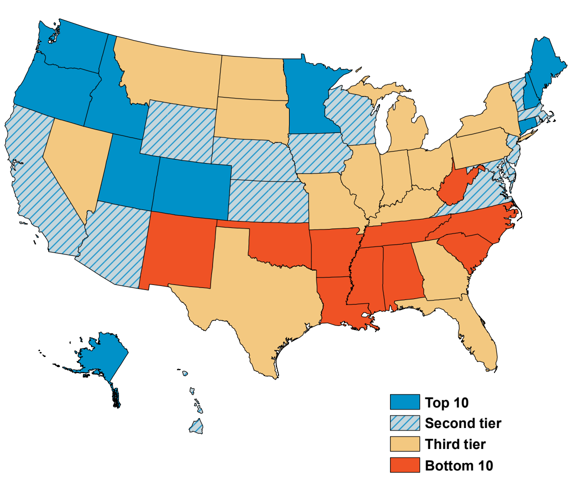
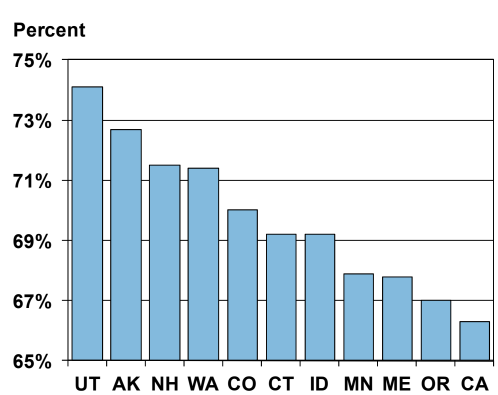


Figure 114. Percentage of households with computers
Top 10 states and California, 2003



*California ranked 12th.

Source: U.S. Department of Commerce.

Percentage of Households with Internet Access

Definition

This indicator measures each state's Internet penetration rate. The indicator is calculated by taking the number of households with Internet service and dividing that figure by the total number of households in each state. Since the predominant form of Internet access is via computer, this component is essentially a subset of the previous indicator on households with computers and is impacted by similar factors. The data is provided by the U.S. Department of Commerce.

Why Is It Important?

The Internet connects people with resources in a manner that is efficient, fast, and geographically unencumbered. It enables people to retrieve and share data, communicate, shop, study, be entertained, and perform other tasks.

As with computer ownership, Internet access does not automatically correlate with high-tech industrialization, but it is still a good gauge of the diffusion of modern information technologies among a state's population. High Internet penetration is harder to achieve than computer usage because of the added cost of Internet service provision and the need for telecommunications infrastructure.

This indicator may become less reliable in the future. Given the widespread use of (increasingly free) Wi-Fi hot spots in many public areas, tech-savvy consumers and employees with Internet-equipped mobile units may forgo paying for Internet access at home.

As of 2007, 71 percent of all U.S. households had Internet access at home, with 50.8 percent using broadband. Twenty-nine states exceeded this penetration rate, with Arizona closest to the national average at 71.7 percent penetration.

Internet Access and California

California ranked 17th in this measure, with 73.6 percent of households having Internet access. The top five states were Alaska (84.25 percent), Utah (82.00 percent), Washington (81.67 percent), New Hampshire (80.60 percent), and Vermont (79.42 percent).

Figure 115. Percentage of households with Internet access
2007

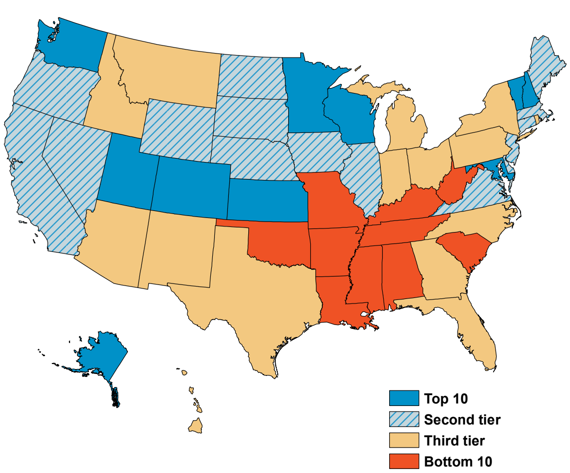
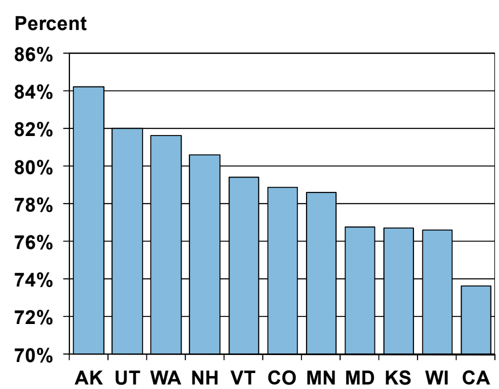


Figure 116. Percentage of households with Internet access
Top 10 states and California, 2007



*California ranked 17th.

Source: U.S. Department of Commerce.

Technology and Science Workforce Composite Index

Definition

The Technology and Science Workforce Composite Index encompasses three primary occupational areas: computer and information science experts, life and physical scientists, and engineers. Each category is made up of six components that measure employment intensity in various fields of science and technology. The composite index is then calculated by averaging the intensity scores of the three occupational areas so that 18 individual components feed into the overall score. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. Technology and science occupational data is collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

Why Is It Important?

The intensity of the technology and science workforce reveals the sophistication and technological competency of a state's labor pool. It reflects a state's capacity for technological innovation and its attractiveness to high-tech employers that need to locate near large talent pools. States that excel in only a limited number of the 18 scientific or technical specialties comprising the index will not do well. Conversely, strength across all three primary occupational areas will bolster a state's performance in the index. A high score bodes well because it is a proxy of a state's human capital potential. Combining that potential with stimulative factors such as adequate R&D funding and risk and human capital investments is key to catalyzing a state's high-tech development capacity.

Tech Workers and California

At seventh, California remains a leader in science and technology workforce, with 74.67 points. But its performance continued to slide, from sixth in 2008 (with a score of 75.00 points), third in 2004 and second in 2002. The state's strengths were second-place rankings in medical scientists and computer hardware engineers, though these individual performances were not sufficient to halt its descent. The top 10 states in this composite component were Massachusetts (89.41), Maryland (84.94), Delaware (84.40), Washington (81.78), Colorado (80.12), Virginia (79.06), California (74.67), Utah (73.41), New Jersey (72.56), and Texas (71.56).

Figure 117. Technology and Science Workforce Composite Index
2010

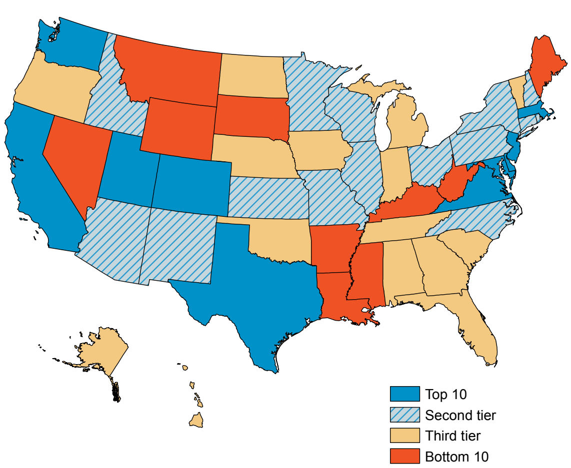
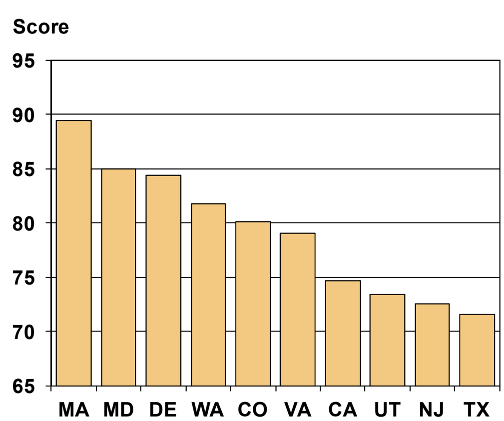


Figure 118. Technology and Science Workforce Composite Index
Top 10 states, 2010



Source: Bureau of Labor Statistics.

Intensity of Computer and Information Science Experts

Definition

The intensity of computer and information science (IS) experts is calculated by averaging the intensity scores of six different types of computer and information science-related occupations: computer and information scientists, computer programmers, software engineers, computer support specialists, systems analysts, and database and network administrators. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine total employment in the above fields and divide by increments of 100,000 state workers. These figures are then ranked, and the state rankings are converted into scores. Computer and IS occupational data and state employment data is collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

Why Is It Important?

Computer and IS professions are important to a state's economic vitality for a several reasons. They represent high value-added occupations, and there is a further strategic value in having skilled knowledge workers in these fields because so much in high technology and other advanced sectors of a modern economy functions on an information-technology platform. Some 2.2 million computer and IS experts reside in the United States. That translates to a national average of about 1,700 computer and IS experts per 100,000 U.S. workers.

Computer and Information Science Experts and California

With a score of 67.00 computer and IS experts per 100,000 workers, California ranked 15th in this measure, dropping one position from the 2008 index. The state's last top 10 performance was eighth in 2004. Although information technology services are increasingly being outsourced to cheaper states and countries, computer and IS experts are still important to California, and despite its declining performance in this measure, these experts continue to constitute a substantial part of the state's workforce. The top five states were Virginia (96.00), Maryland, Massachusetts (tied with 89.00), Washington (86.00), and New Jersey (84.00).

Figure 119. Intensity of computer and IS experts
2008

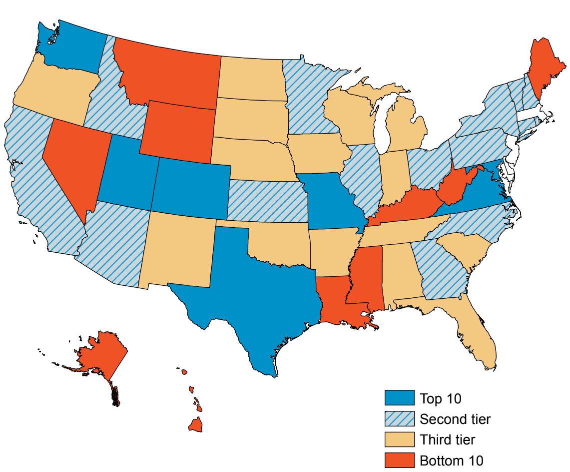
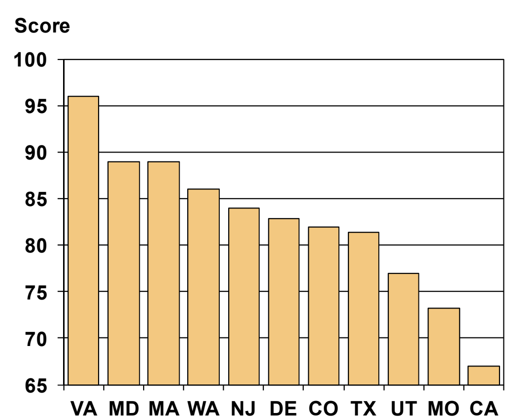


Figure 120. Intensity of computer and IS experts
Top 10 states and California, 2008



*California ranked 15th.

Sources: Milken Institute, Bureau of Labor Statistics.

Intensity of Life and Physical Scientists

Definition

The intensity of life and physical scientists is calculated by averaging the intensity scores of six different types of related occupations: agricultural and food scientists, biochemists and biophysicists, microbiologists, medical scientists, physicists, and miscellaneous life and physical scientists. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine employment in the above fields and divide it by increments of 100,000 state workers. These figures are then ranked, and state rankings are converted into scores. Life and physical science occupational data is collected by the Bureau of Labor Statistics (BLS) and compiled by the Milken Institute. However, many states do not report employment statistics to the BLS in these particular occupations.

Why Is It Important?

Life and physical scientists are leading developments in some of the most promising and fast-growing high-tech sectors. These sectors include biotech and medical devices and related fields that require in-depth knowledge of biochemistry, biophysics, microbiology, and medical science. Because these industries are growing and have a propensity toward innovation, these knowledge workers can disproportionately contribute to a region's techno-entrepreneurial dynamism. A strong concentration of life and physical scientists also helps promote a region to potential investors and corporations, and in turn stimulates an additional inflow of such scientists. There were a reported 173,670 life and physical scientists in the United States in 2008, or an average of 129 life and physical scientists per 100,000 workers nationwide.

Life and Physical Scientists and California

California tied with Hawaii for seventh in this measure, with scores of 79.00. In the 2008 index, California ranked 11th with a score of 77.33. The improvement could be attributed in part to a slight increase in R&D expenditures per capita in life and biomedical sciences. The top five in this measure were Delaware (93.33), Alaska (91.00), Massachusetts (88.33), Maryland (86.33), and Vermont (84.00).

Figure 121. Intensity of life and physical scientists
2008

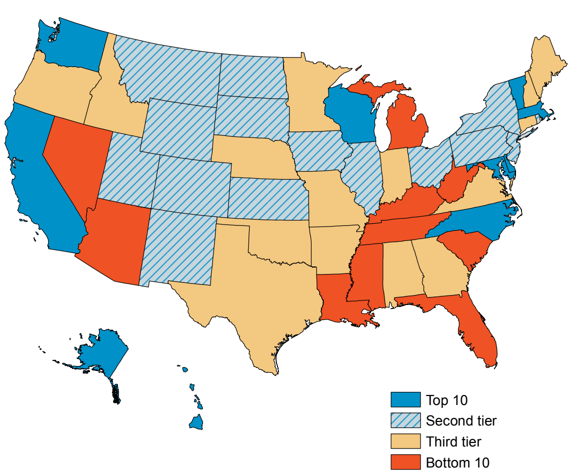
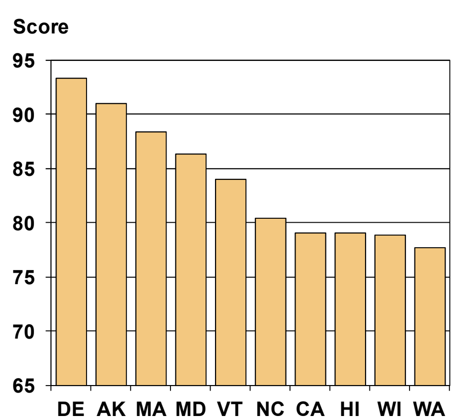


Figure 122. Intensity of life and physical scientists
Top 10 states and California, 2008



Sources: Bureau of Labor Statistics.

Intensity of Engineers

Definition

This indicator is calculated by averaging the intensity scores of six categories of engineering-related occupations: electronics engineers, electrical engineers, computer hardware engineers, biomedical engineers, agricultural engineers, and various other types of engineers. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine total employment in the above fields and divide it by increments of 100,000 state workers. These figures are then ranked, and state rankings are converted into scores. Occupational data is collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

Why Is It Important?

Engineering, broadly defined, is arguably the most fundamental building block of a technology-based economy. This applied discipline draws on a range of scientific knowledge in its endeavor to turn theories and concepts into reality. Engineering is especially important in such high-tech sectors as electronics, computers, and medical devices. Apart from their contributions to technology sectors, engineers also serve as all-around innovators and problem-solvers in areas from workplace productivity to building construction.

As of 2008, the United States had nearly 686,280 engineers, or an average of 510 engineers for every 100,000 workers nationwide, based on the reported data available. Since engineering functions can be either very basic or highly specialized, the presence of engineers in a state's economy is a reasonable indicator of both the breadth and depth of its high-tech economic capacity.

Engineers and California

Though it remains in the top 10, California has lost ground in this measure, with a score of 78.00 and a ranking of seventh. In the 2008 index, California tied with Virginia for fourth with a score of 79.33. The top five states in this measure were Massachusetts (91.20), Colorado (85.60), Virginia (84.00), Washington (81.67), and New Mexico (78.80).

Figure 123. Intensity of engineers
2008

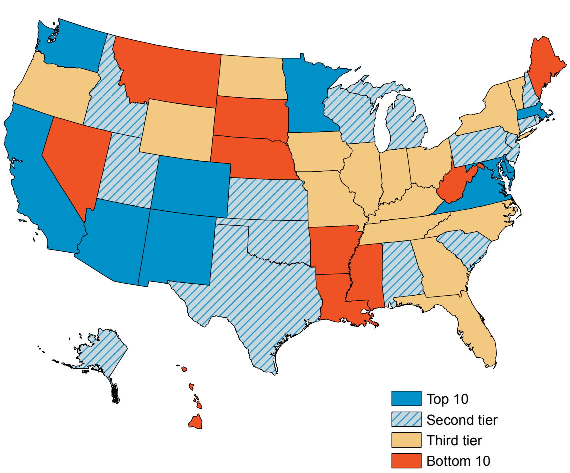
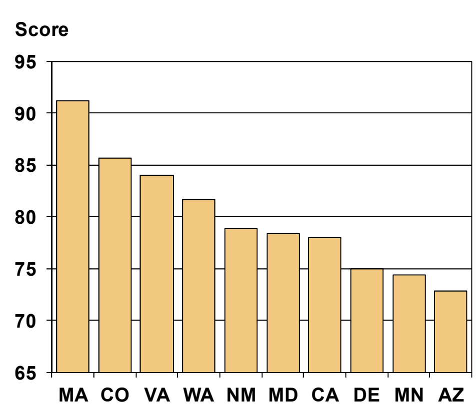


Figure 124. Intensity of engineers
Top 10 states, 2008



Sources: Milken institute, Bureau of Labor Statistics.

Technology Concentration and Dynamism Composite Index

Definition

The fifth set of indicators determining each state's position in technology and science is the Technology Concentration and Dynamism Composite Index, which measures the degree to which each state's economy is fueled by the technology sector. As such, it is a measurement of technology outcomes. The indicators that make up this composite focus on entrepreneurial dynamism and growth in high-tech industries. The following indicators explore such factors as high-technology employment, business formation, industry growth, and industry concentration. The data used in these indicators were collected from various sources, and compiled, modeled, and interpreted by the Milken Institute.

Why Is It Important?

The concentration and dynamism of a high-technology industry is presented last in this study because it is bolstered by the performances of the previous four areas of research and development, risk capital, human capital, and science and technology workforce. This index measures the degree of success in not just aggregating similar professions, but also creating regional hubs of high-technology industries that benefit from aggregation and economies of scale.

Technology Concentration and California

Thanks to Silicon Valley, California ranked fifth in technology concentration and dynamism with an overall score of 79.40 points. In 2008's rankings, California occupied seventh with a score of 72.60 points. California performed particularly well in number of high-tech industries with location quotients above 1.0. It topped the states with 18 industries, while Massachusetts took second with 15. California's weakest performance was 36th in high-tech industries average yearly growth. These findings suggest that California's growth in the high-tech area may be approaching saturation.

The top 10 were Utah (86.80 points), Colorado (82.00 points), Washington (80.60 points), Virginia (80.40 points), California, Maryland (tied with 79.40 points), Massachusetts (75.60 points), New Hampshire (74.80 points), Texas (70.80 points), and Arizona (69.40 points).

Figure 125. Technology Concentration and Dynamism Composite Index
2010

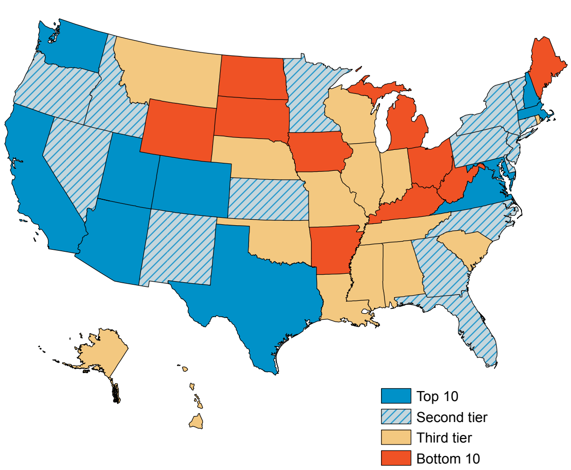
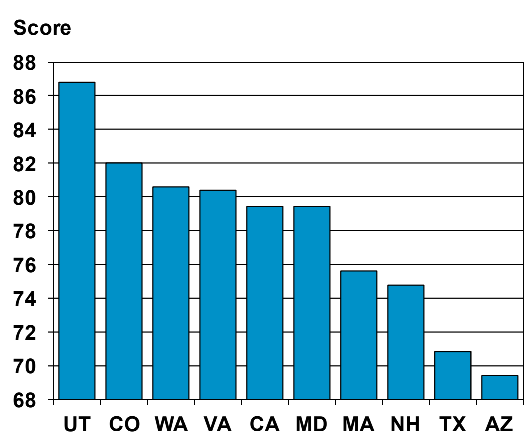


Figure 126. Technology Concentration and Dynamism Composite Index
Top 10 states, 2010



Source: Milken Institute.

Percent of Business Establishments in High-Tech NAICS Codes

Definition

The indicator for percentage of businesses in the high-technology North American Industry Classification System (NAICS) codes is determined by totaling the number of business establishments in 25 technology-intensive NAICS code industries. These particular NAICS codes represent industries that spend an above-average amount of revenue on R&D and employ an above-industry-average number of technology-using occupations. The Milken Institute's definition of high technology is coupled with business data from the Bureau of Labor Statistics. This figure is then divided by the total number of state business establishments as collected by the U.S. Census Bureau.

Why Is It Important?

This indicator measures the high-tech business intensity of a state. Given that its determining factors are R&D expenditures and technology-oriented occupations at businesses, the indicator sheds light on a state's high-tech business population as well as the high-tech orientation of the population. Scoring well in this category is one indication of a state possessing both an advanced industrial base as well as a skilled and technologically proficient workforce.

Roughly 484,800 U.S. establishments qualify as high-tech, according to the Milken Institute's high-technology classification standards. When measured as a portion of all U.S. business establishments, the national average for percentage of businesses with high-tech NAICS codes was 6.27 percent. Florida, ranked 22nd, most closely matches the national average with 6.38 percent.

High-Tech Business Establishments and California

About 6.98 percent of California's business establishments fall within the high-tech industry for a ranking of 16th overall. In 2008's computation, 7.19 percent of California's businesses were high-tech, positioning the state in ninth place. The top five states were Colorado (10.12 percent), Virginia (9.69 percent), Maryland (9.15 percent), Utah (8.91 percent), and New Hampshire (8.86 percent).

Figure 127. Percent of businesses in high-tech NAICS codes
2009

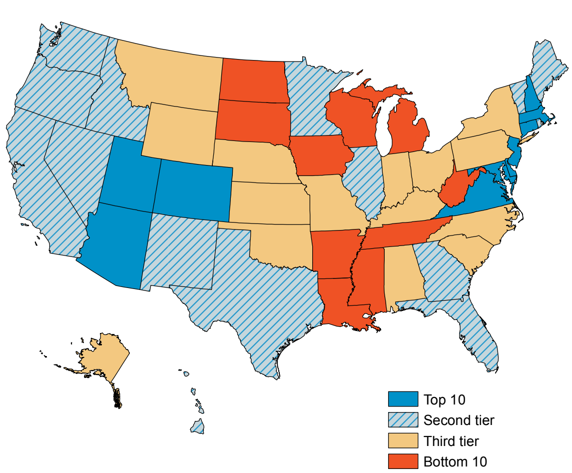
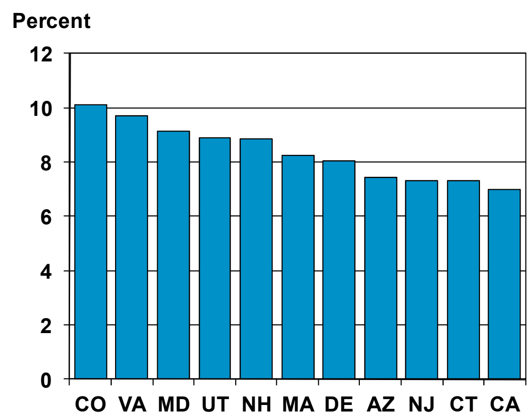


Figure 128. Percent of business establishments in high-tech NAICS codes
Top 10 states and California, 2009



*California ranked 16th.

Sources: U.S. Census Bureau, Bureau of Labor Statistics, Milken Institute.

Percent of Employment in High-Tech NAICS Codes

Definition

The indicator for percent share of employment in high-technology North American Industry Classification System (NAICS) codes is calculated by dividing the total number of employees within 25 high-tech industries (defined by the Milken Institute) by the total employment base in the respective state. This is a change in methodology from previous editions, incorporating sectors that we deem to be representative of industries that spend an above-average amount of revenue on R&D and that employ an above-industry-average number of technology-heavy occupations. It defines high technology more narrowly than the Bureau of Labor Statistics' definition, which leans toward heavy manufacturing. Employment data used in this indicator were collected by the U.S. Census Bureau.

Why Is It Important?

From an industrial perspective, states benefit from having a significant percentage of employment in technology-related fields because such workers tend to contribute disproportionately to the overall economy. States benefit from their above-average salaries and pay packages. A concentration of high-tech employment attracts out-of-state high-tech firms and encourages existing firms to stay.

As of 2009, 5.8 percent of U.S. workers were employed in a high-tech industry, though this percentage has been declining since its peak in 2001. For a state to score well in this category requires not only sources of high-tech employment but also sources of training, such as universities.

High-Tech Employment and California

With 10.43 percent of California's workers in the high-tech industry, the state placed fourth in this measure. Despite gaining ground from 8.92 percent in the 2008 index, California slid one spot in the rankings. The top five states were Massachusetts (10.78 percent), Colorado (10.61 percent), Washington (10.49 percent), California (10.43 percent), and Kansas (9.08 percent).

Figure 129. Percent of employment in high-tech NAICS codes
2009

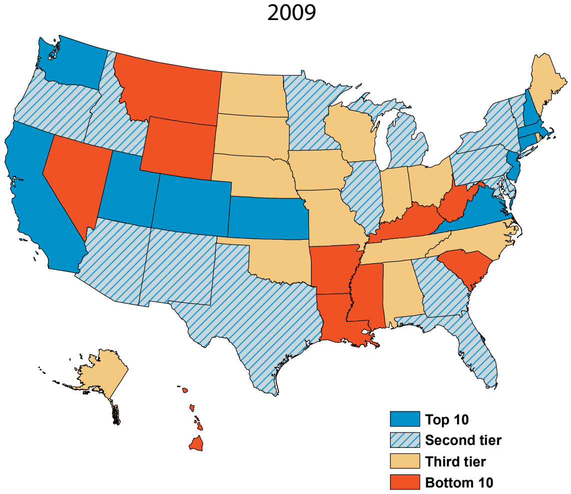
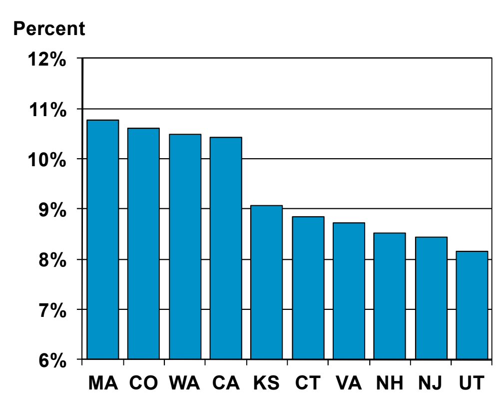


Figure 130. Percent of employment in high-tech NAICS codes
Top 10 states, 2009



Sources: U.S. Census Bureau, Bureau of Labor Statistics, Milken Institute

Percent of Payroll in High-Tech NAICS Codes

Definition

The indicator for percentage of total payroll paid out to workers in high-technology North American Industry Classification System (NAICS) code industries is calculated by dividing the dollar amount paid out to high-tech workers by the total amount of wages and salary disbursements paid out to all workers in each state respectively. High-tech industries are narrowly defined by the Milken Institute. High-technology employment data is collected by the U.S. Census Bureau under contract with Taratec Corporation.

Why Is It Important?

As noted, states benefit from having a significant percentage of employment in technology-related fields for several reasons: The industries have long-term growth potential and tend to contribute disproportionately to an economy, and high-technology employees tend to have above-average salaries and pay packages. This indicator augments and expands on the previous indicator—percentage share of high-tech employment—by showing how much of total payroll income is generated by high-tech employment.

The data clearly indicate that high-tech jobs pay disproportionately high salaries. The total value of annual payroll income from high-tech employment in the United States amounts to almost $650 billion, which represents 8.72 percent of all payroll dollars in the nation.

High-Tech Payroll and California

With 15.73 percent of California's payroll coming from its high-tech jobs, the state ranked third in this indicator compared with 16 percent and a ranking of second in the 2008 index. This suggests the state has a relatively high proportion of high-tech in its industry mix. The top five states were Washington (17.76 percent), Massachusetts (16.40 percent), California (15.73 percent), Virginia (15.65 percent), and Colorado (14.90 percent).

Figure 131. Percent of payroll in high-tech NAICS codes
2009

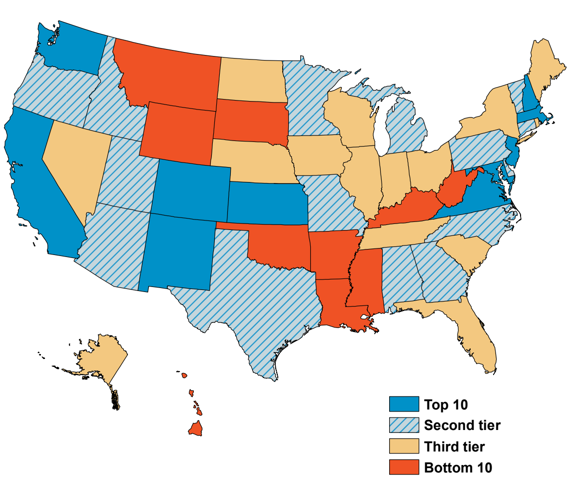
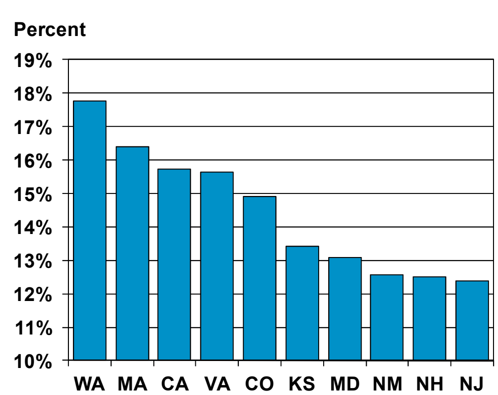


Figure 132. Percent of payroll in high-tech NAICS codes
Top 10 states, 2009



Sources: U.S. Census Bureau, Milken Institute.

Percent of Business Births in the High-Tech Sector

Definition

The indicator for percent of business births in the high-technology sector is calculated by dividing the number of new high-tech business establishments born in the year for which the most recent data is available and dividing that by the total number of new business establishments created during the same year. A business establishment, as defined by the U.S. Census Bureau, is a "single physical location at which business is conducted." The distinction is worth noting because an establishment is not interchangeable with a company. A company can have more than one establishment, so business establishment data include branches. Nevertheless, the data is an accurate measure of high-tech business presence. Data on new high-tech firms and total business establishments are compiled by the U.S. Census Bureau under the Statistics of U.S. Businesses (SUSB) program.

Why Is It Important?

Business births are important to a state because growth is a sign of economic dynamism, prosperity, and optimism. Business births in the high-technology sector are particularly important because of such additional benefits as the sector's high wages, knowledge intensity, and long-term growth prospects.

The latest data available (for 2006) indicates that an average of 9.11 percent of all new business establishments formed in the United States were in the 25 industries categorized as high-tech by the Milken Institute definition. Washington, ranked 22nd with 9.12 percent, most closely matched the national average.

High-Tech Business Births and California

Based on the latest available data, 11.46 percent of California's new business establishments fell into the high-tech sector for a ranking of seventh. Coupled with the state's strong performance in high-tech industry payroll, this finding confirms the high-tech sector constitutes an important part of California's industry mix. The top five states were Virginia (14.86 percent), Delaware (14.26 percent), Colorado (13.15 percent), Maryland (12.72 percent), and Massachusetts (12.46 percent).

Figure 133. Business births in high-tech NAICS codes
Percent of all establishment births, 2006

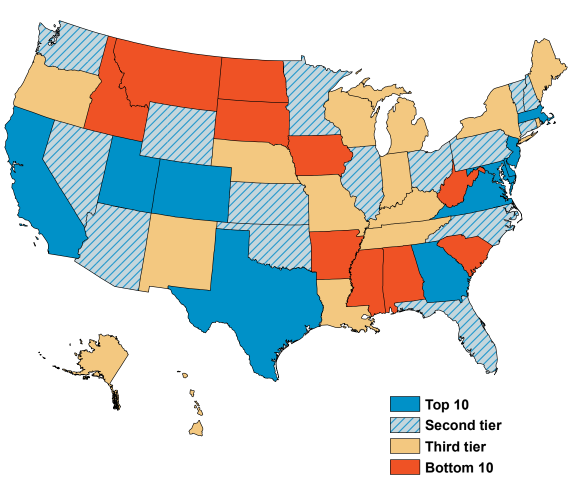
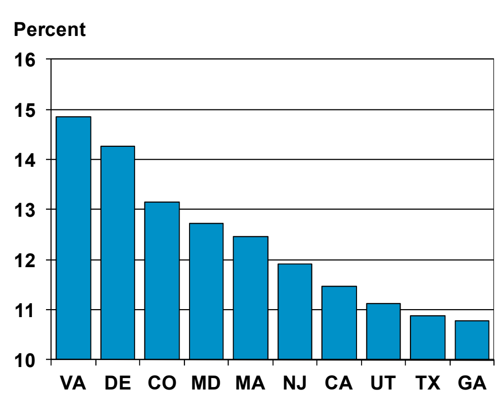


Figure 134. Establishment births in high-tech NAICS codes
Top 10 states, 2006



Source: Census Bureau.

Net Formation of High-Tech Establishments

Definition

This indicator measures the number of high-tech establishment births minus the number of high-tech business establishment deaths during a one-year period. This figure is then divided by increments of 10,000 business establishments in each state. A business establishment is considered in this indicator only if it has an employer identification number (EIN) issued by the U.S. Census Bureau. High-technology and total establishments' birth data is compiled by the U.S. Census Bureau under contract with Taratec Corporation.

Why Is It Important?

The previous indicator is a comparative absolute measure of business births: It looks at the total number of new high-tech firm formations as a percentage of all business births. This indicator for net formation is more specific in ascertaining the "balance sheet" of high-tech firm births versus deaths. By basing the indicator statistic on the population of all businesses (in units of 10,000 establishments), we get a clearer picture of how this high-tech industrial life cycle plays out. Net high-tech firm formation reveals high-tech entrepreneurial dynamism.

For the year measured (2006), the net total of new high-technology business establishments across all 50 states was 14,000. This simply means more businesses were created than have ceased operations. This represents a net formation of 17 high-tech companies per 10,000 business establishments. Only two states showed negative growth (Delaware and West Virginia), compared with 19 states in 2002 and one state in 1999, representing a renewed commitment and better environment for innovation and competitiveness for American businesses.

Net High-Tech Formation and California

California occupies the 11th position in this measure, with a net formation of 30 high-tech companies per 10,000 business establishments. This is a marked improvement from a net loss of six companies and a rank of 42nd in the 2008 computation, which was based on 2002 data reflecting the dot-com crash. The top five states were Utah (56), Virginia (50), Wyoming (42), Nevada (34), and Alaska (33).

Figure 135. Net formation of high-tech establishments per 10,000 establishments
2006

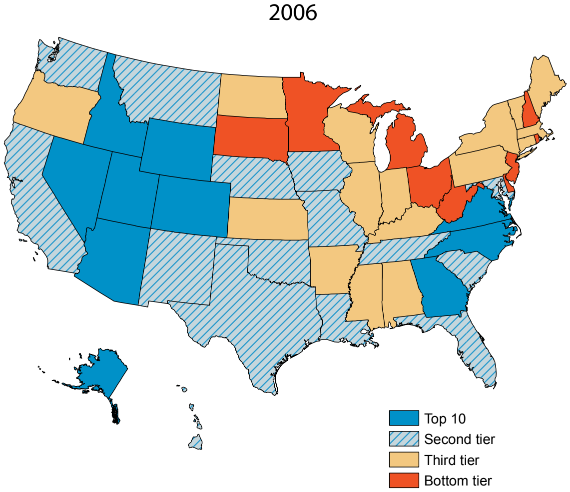
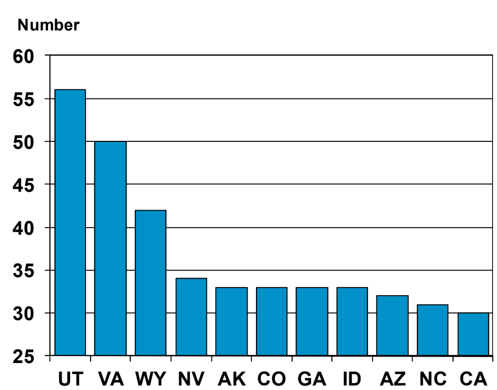


Figure 136. Net formation of high-tech establishments
Top 10 states and California, 2006



Source: Census Bureau.

*California ranked 11th.

Number of Technology Fast 500 Companies

Definition

This indicator measures a state's relative performance in generating fast-growing high-tech enterprises. The list of Technology Fast 500 companies is compiled annually by Deloitte & Touche, which ranks the fastest-growing technology companies in the United States and Canada over the most recent five-year period. In our indicator, the relevant Technology Fast 500 figures are averaged out by increments of 10,000 business establishments in each state. Deloitte & Touche considers a company to be high-tech if it produces technology or technology-related products, uses extensive technology, or allocates a large percentage of revenue to R&D efforts. Business establishment data is collected by the U.S. Census Bureau.

Why Is It Important?

The Deloitte & Touche list of North America's fastest-growing 500 high-technology firms relies on a combination of quantitative and qualitative data to identify innovative, rapidly expanding firms that demonstrate strong promise for long-term technological and economic impact.

The combination of factors used as evaluation criteria means the list of Technology Fast 500 companies is unavoidably subjective. Nevertheless, it is helpful for identifying new technology companies that demonstrate high growth and future potential. Our measure provides an indication of how rapidly a state's high-tech base is expanding by accounting for the state's business population. A total of 450 companies made the Technology Fast 500 list in the United States. Averaged out per 10,000 businesses nationwide, this leads to a ratio of 0.4. Only 29 states are home to Technology Fast 500 companies, an indication of the relatively exclusive nature of the list.

Tech Fast 500 Companies and California

With 1.5 Tech Fast 500 companies per 10,000 business establishments, California ranked third. This represents a slight improvement from fourth in the 2008 index, with the same number of Tech Fast 500 Companies. California has a more diversified high-tech sector, which makes the state's high-tech concentration more sustainable. The other top states in this measure were Massachusetts (2.5 companies), Connecticut (1.6 companies), Maryland (1.4 companies), and New Jersey and Virginia (tied with 1.3 companies).

Figure 137. Number of Technology Fast 500 companies per 10,000 establishments
2009

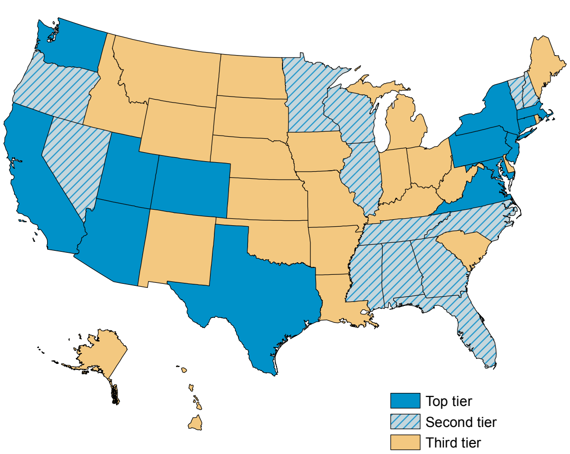
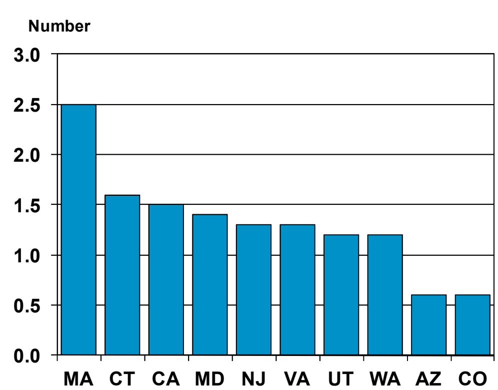


Figure 138. Number of Technology Fast 500 companies
Top tier states, 2009



Sources: Deloitte & Touche, U.S. Census Bureau.

Average Yearly Growth of High-Tech Industries

Definition

The indicator for average yearly growth of high-technology industries measures expansion in high-tech employment. It is calculated using the average yearly growth in high-tech sectors for a state during the most recent five-year period on record. The Milken Institute's definition of high technology is utilized for this indicator. Data for this indicator were provided by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

Examining where technology is prevalent does not necessarily correlate to where technology is growing. This indicator aims to capture where technology has grown at the fastest rate during the past five years regardless of industry base. Identifying places where technology has grown allows stakeholders to identify and determine where new technology opportunities are arising throughout the United States.

This also allows stakeholders to assess the health of their current investment and enables states to estimate the ramifications of their policies. Stringent laws governing taxes and businesses practices, coupled with skyrocketing electricity prices from deregulation, for example, could force firms to relocate to other states, or worse, to another country.

Average yearly growth of high-tech industries in the United States as a whole during the five years measured (2004-2008) was 1.88 percent. High-tech industries as a whole expanded in this period, with the largest increase in the computer systems design sector. Because states with a small technology industry base will register disproportionately strong growth rates with even a small industrial expansion, this indicator is easily dominated by states with relatively limited high-tech industrialization.

High-Tech Growth and California

California saw a 0.19 percent decline in high-tech employment, for a ranking of 36th in this measure. The state's performance however, is a marked improvement from the 2008 index, where California experienced a 3.2 percent decline for a ranking of 41st. The following two measures provide a more detailed picture of California's high-tech industry growth. The top five states were Alaska (18.44 percent), Idaho (12.87 percent), South Dakota (6.89 percent), New Hampshire (6.41 percent), and Montana (5.95 percent).

Figure 139. Average yearly growth of high-tech industries
Employment, 2004–2008

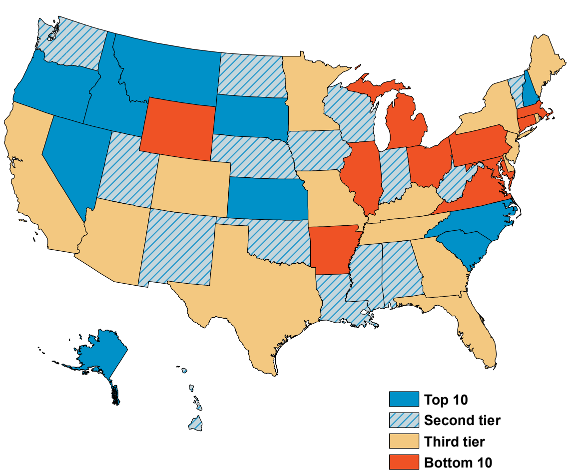
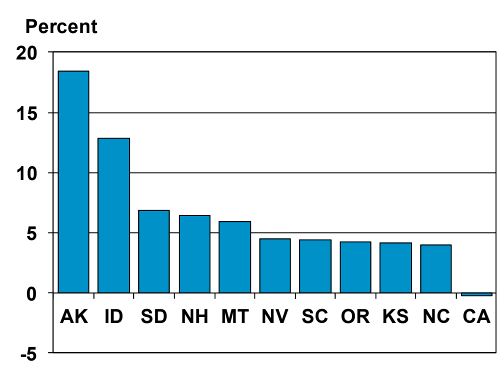


Figure 140. Average yearly growth of high-tech industries
Top 10 states and California, 2004–2008



Sources: Moody's Analytics, Milken Institute. *California ranked 36th.

High-Tech Industries Growing Faster Than U.S. Average

Definition

This indicator measures the number of high-technology industries whose employment is growing faster than the national average for the overall economy. Growth rates are based on the most recent five-year period. The Milken Institute definition of high-tech is utilized for this indicator. These particular high-tech NAICS codes represent industries that spend an above-average amount of revenue on R&D and employ an above-industry-average number of technology-dependent occupations. The data used in calculating this indicator were furnished by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

High-tech industries tend to be fast-growing, although growth rates can be influenced by many factors and, depending on the constituents in a state's high-tech sector, can expand or decline at various periods. In this indicator, successful performance comes from how close a state's score is to 25, the maximum number of high-tech industries that could register growth above the U.S. average.

The years measured, 2004-2008, were characterized by a period of consolidation for many high-technology industries, especially those related to information technology. During this period, no state had the maximum number of industries outperforming U.S. employment growth. The closest was North Carolina with 18 high-tech industries.

High-Tech Growth and California

With 10 high-tech industries growing faster than the U.S. average, California tied for 26th with Arizona, Indiana, Kentucky, New Hampshire, New York, and Tennessee. California's weak performance in this measure suggests a possible saturation of its high-tech sector. Incidentally, California is not the only state subject to this possible saturation; Massachusetts and Pennsylvania rank 33rd and 42nd, respectively. The top states in this measure were North Carolina (18 industries), Alaska (17), South Carolina (16), Mississippi, Montana, and Oregon (tied with 15).

Figure 141. Number of high-tech industries growing faster than U.S. average
Employment, 2004–2008

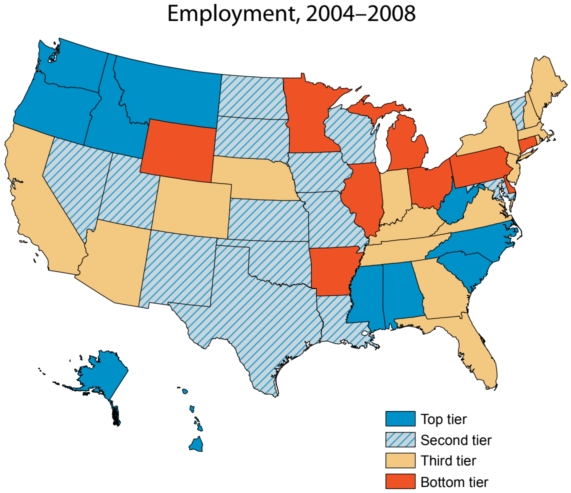
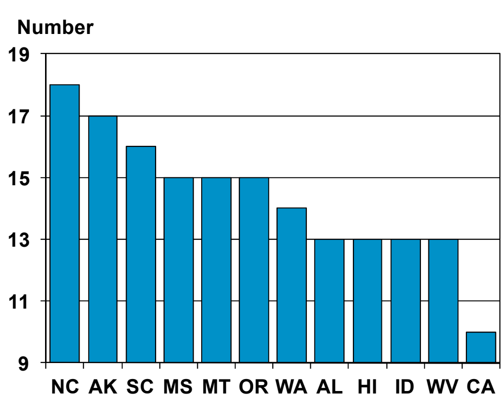


Figure 142. Number of high-tech industries growing faster than U.S. average
Top tier states and California, 2004–2008



*California ranked 26th.

Sources: Moody's Analytics, Milken Institute.

High-Tech Industries with LQ Higher Than 1.0

Definition

The indicator for the number of high-technology industries with location quotient (LQ) higher than 1.0 measures how many high-tech industries are densely concentrated in a state. It is calculated by counting the number of high-tech industries (out of 14) that have an above-average location quotient in employment. An industry's location quotient measures a location's (in this case, a state's) level of employment concentration relative to the industry average across the United States. A high-tech industry in a state with an employment LQ higher than 1.0 is more densely concentrated in that state than in the nation on average. Industry output numbers used in this indicator were provided by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

This indicator reveals whether each state has attracted an above-average mass of high-tech industries. States that exceed the national average in high-tech industry LQs have an edge in attracting and retaining high-tech firms due to their dense employment bases and other positive agglomeration factors.

Compared to above-average growth in employment (shown in the previous indicator), which measures industry momentum, this indicator on high-tech location quotients measures a more static but also critical dynamic: density. Taken together, the two indicators give a perspective on how well a spectrum of industries from the high-tech sector are both anchored to and growing within a state. As with the previous indicator, no state has the maximum number of 25 industries outperforming the national average.

High-Tech Concentration and California

California tops the list with 18 industries whose employment concentrations are higher than the U.S. average. Thanks to its reigning high-tech cluster in San Jose, California has repeatedly been the leader in this measure. The remaining top five states were Massachusetts (15 industries), Utah (14), Colorado (11), and Connecticut (10).

Figure 143. Number of high-tech industries with LQ higher than 1.0
2008

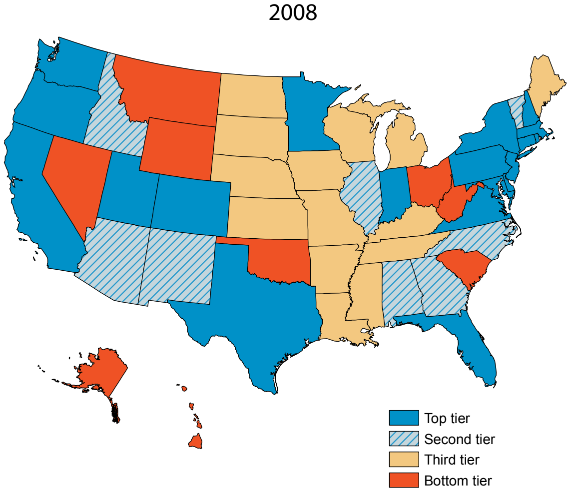
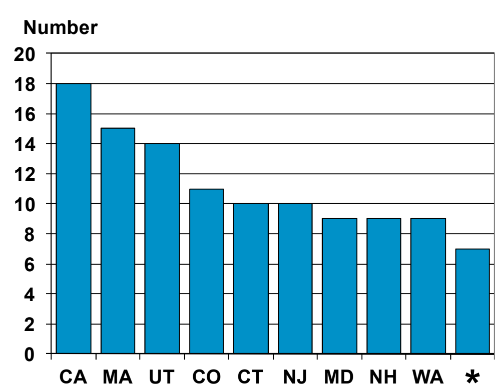


Figure 144. Number of high-tech industries with LQ higher than 1.0
Top tier states, 2008



*Tied for 10th were FL, IN, MN, NY, OR, PA, RI, TX, and VA.

Sources: Moody's Analytics, Milken Institute.

Number of Inc. 500 Companies

Definition

The indicator for the number of Inc. 500 companies per 10,000 business establishments measures how many companies on *Inc*. magazine's top 500 list are located in each state. *Inc.*'s list ranks firms that apply to be on the list and can demonstrate that total net revenue (or, for financial companies, total net income) has more than tripled in the most recent five years. Our indicator is calculated by totaling the number of Inc. 500 companies in a state and normalizing the figures by increments of 10,000 business establishments in that state. Business establishment data is provided by the U.S. Census Bureau.

Why Is It Important?

The Inc. 500 has a nearly three-decade history and is recognized as a chief barometer of entrepreneurial venture growth in the United States. Although it is not specific to technologically or otherwise knowledge-intensive enterprise, it offers a window into the national landscape for fast-growing, entrepreneurially dynamic firms. When its rankings are assessed on a normalized state-by-state basis and considered in the context of other indicators, it provides a useful comparative measure of economic vibrancy and dynamism throughout the United States.

Forty-one states are home to at least one company on the Inc. 500 list. This reflects the broader nature of this indicator (as opposed the Technology Fast 500 rankings, in which just 29 states have companies that qualify). The U.S. average for Inc. 500 companies per 10,000 businesses is 0.5. Florida, Ohio, and West Virginia match the national average.

Inc. 500 Companies and California

With 0.9 Inc. 500 companies in every 10,000 business establishments, California tied for sixth in this measure with Colorado, Massachusetts, Minnesota, and Texas. In the 2008 computation, the state also ranked sixth, but with 1.1 Inc. 500 companies per 10,000 business establishments. The top five states in this measure were Utah (2.0 companies), New Hampshire, Virginia (both 1.8), Maryland (1.4), and Washington (1.0).

Figure 145. Number of Inc. 500 companies per 10,000 establishments
2009

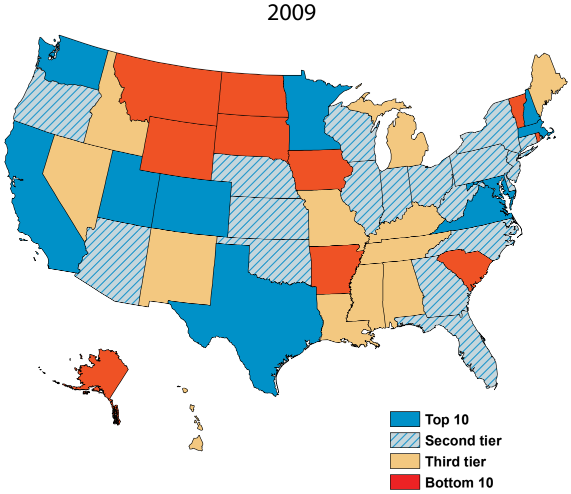
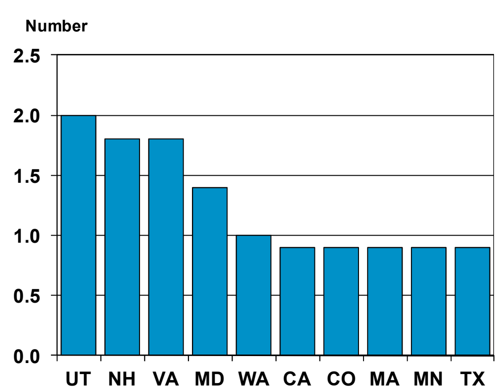


Figure 146. Number of Inc. 500 companies
Top 10 states, 2009



Sources: Inc. magazine, U.S. Census Bureau.

Appendix: Data Sources

Research and Development Inputs	
Federal R&D Dollars per Capita	National Science Foundation (NSF)
Industry R&D Dollars per Capita	NSF
Academic R&D Dollars per Capita	NSF, Academic R&D Expenditure
National Science Foundation Funding	NSF, Experimental Program to Stimulate Competitive Research
National Science Foundation Research Funding	NSF, Experimental Program to Stimulate Competitive Research
R&D Expenditures on Engineering	NSF, Academic R&D Expenditure
R&D Expenditures on Physical Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Environmental Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Math and Computer Science	NSF, Academic R&D Expenditure
R&D Expenditures on Life Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Agricultural Sciences	NSF, WebCASPAR
R&D Expenditures on Biomedical Sciences	NSF, WebCASPAR
STTR Awards per 10,000 Businesses	Small Business Administration, U.S. Census Bureau
STTR Award Dollars	Small Business Administration
SBIR Awards per 100,000 People	Small Business Administration
SBIR Awards per 10,000 Businesses (Phase I)	NSF, Experimental Program to Stimulate Competitive Research (EPSCoR)
SBIR Awards per 10,000 Businesses (Phase II)	NSF, EPSCoR
Competitive NSF Proposal Funding Rate	NSF, EPSCoR
Risk Capital and Entrepreneurial Infrastructure	
Total Venture Capital Investment Growth	PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report, Thomson Financial
Number of Companies Receiving VC per 10,000 Firms	PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report, Thomson Financial
Growth in Number of Companies Receiving VC	PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report, Thomson Financial
Venture Capital Investment as Percent of GSP	PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report, Thomson Financial
SBIC Funds Disbursed per $1,000 of GSP	Small Business Administration
Business Incubators per 10,000 Establishments	National Business Incubation Association, U.S. Census Bureau
Patents Issued per 100,000 People	U.S. Patent and Trademark Office
Business Starts per 100,000 People	U.S. Census Bureau
IPO Proceeds as Percent of GSP	Securities Data Corporation, Thomson Financial
VC Investment in Nanotechnology as Percent of GSP	Thomson Financial
VC Investment in Clean Technology as Percent of GSP	Thomson Financial
Sum of Equity Invested in Green Tech per $100,000 GSP	Thomson Financial
Human Capital Investment	
Percentage of Population with Bachelor's Degrees or Higher	U.S. Department of Education
Percentage of Population with Advanced Degrees	U.S. Department of Education
Percentage of Population with PhDs	U.S. Department of Education
Graduate Students in Science and Engineering	NSF, EPSCoR
Per Capita State Spending on Student Aid	NSF, EPSCoR
Average Verbal SAT Scores	NSF, EPSCoR
Average Math SAT Scores	NSF, EPSCoR
Average ACT Scores	NSF, EPSCoR
State Appropriations for Higher Education (per capita)	NSF, EPSCoR

** All population statistics are from the U.S. Census Bureau. All Gross State Product figures are from the U.S. Department of Commerce.*

Human Capital Investment *con't.*	
Percent Change in State Appropriations for Higher Education	NSF, EPSCoR
Doctoral Scientists per 100,000 People	NSF, Division of Science Resources Studies
Doctoral Engineers per 100,000 People	NSF, Division of Science Resources Studies
Science, Engineering, and Health PhDs Awarded	NSF, Division of Science Resources Studies
Science, Engineering, and Health Postdoctorates Awarded	NSF, Division of Science Resources Studies
Percentage of Bachelor's Degrees in Science and Engineering	National Center for Education Statistics, U.S. Department of Education
Recent Bachelor's Degree in Science and Engineering	NSF, Division of Science Resources Studies
Recent Master's Degree in Science and Engineering	NSF, Division of Science Resources Studies
Recent PhD Degree in Science and Engineering	NSF, Division of Science Resources Studies
Recent Degrees in Science and Engineering	NSF, Division of Science Resources Studies
Percentage of Households With Computers	U.S. Department of Commerce
Percentage of Households With Internet Access	U.S. Department of Commerce
Technology and Science Workforce	
Intensity of Computer and Information Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Programmers	Bureau of Labor Statistics, Milken Institute
Intensity of Software Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Support Specialists	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Systems Analysts	Bureau of Labor Statistics, Milken Institute
Intensity of Database and Network Administrators	Bureau of Labor Statistics, Milken Institute
Intensity of Agricultural and Food Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Biochemists and Biophysicists	Bureau of Labor Statistics, Milken Institute
Intensity of Microbiologists	Bureau of Labor Statistics, Milken Institute
Intensity of Medical Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Physicists	Bureau of Labor Statistics, Milken Institute
Intensity of Other Life and Physical Science Occupations	Bureau of Labor Statistics, Milken Institute
Intensity of Electronics Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Electrical Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Hardware Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Biomedical Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Agricultural Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Other Engineers	Bureau of Labor Statistics, Milken Institute
Technology Concentration and Dynamism	
Percent of Businesses in High-Tech NAICS Codes	Bureau of Labor Statistics, Milken Institute, U.S. Census Bureau
Percent of Employment in High-Tech NAICS Codes	Bureau of Labor Statistics, Milken Institute, U.S. Census Bureau
Percent of Payroll in High-Tech NAICS Codes	Milken Institute, U.S. Census Bureau
Percent of Business Births in the High-Tech Sector	U.S. Census Bureau
Net Formation of High-Tech Establishments	U.S. Census Bureau
Number of Technology Fast 500 Companies	Deloitte & Touche; U.S. Census Bureau
Average Yearly Growth of High-Tech Industries	Moody's Economy.com; Milken Institute
High-Tech Industries Growing Faster Than U.S. Average	Moody's Economy.com; Milken Institute
High-Tech Industries With LQs Higher Than 1.0	Moody's Economy.com; Milken Institute
Number of Inc. 500 Companies	Inc. Magazine, U.S. Census Bureau

** All population statistics are from the U.S. Census Bureau. All Gross State Product figures are from the U.S. Department of Commerce.*

About the Authors

Kevin Klowden is a managing economist at the Milken Institute, where he serves as director of the California Center. He specializes in the study of demographic and spatial factors (the distribution of resources, business locations, and labor), how these are influenced by public policy, and how they in turn affect regional economies. Klowden has addressed the role of technology-based development in publications such as "North America's High-Tech Economy," and location-specific studies on Arkansas and Arizona. In addition, he oversaw the yearlong Los Angeles Economy project, which examined key workforce and economic development issues in Los Angeles. Klowden was the lead author of "Film Flight: Lost Production and Its Economic Impact in California" and "The Writers' Strike of 2007–2008: The Economic Impact of Digital Distribution," both of which analyze the changing dynamics of the entertainment industry. He has also written on the role of transportation infrastructure in economic growth and job creation in reports such as "California's Highway Infrastructure: Traffic's Looming Cost" and "Jobs for America: Investments and Policies for Economic Growth and Competitiveness," as well as in several publications including The Wall Street Journal. Klowden earned an M.A. in economic geography from the University of Chicago and an M.S. in politics of the world economy from the London School of Economics.

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