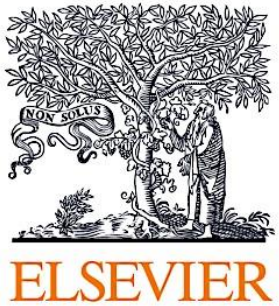

THE COUNCIL OF STATE GOVERNMENTS

AMERICA'S KNOWLEDGE ECONOMY | A STATE-BY-STATE REVIEW

April 2015

Overview of Report Findings

2015-04-10

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http://www.csg.org/programs/knowledgeeconomy/background.aspx

Key Motivating Ideas

- Research is a key drive of economic prosperity – both short-term economic activity and long-term growth.

- This report focuses on long-term growth – it's not about easy fixes, but sustainable success.

David Adkins
Executive Director / CEO

Council of State Governments

(CSG.org)

Founded in 1933, the nation's only organization serving all three branches of state government.

CSG champions excellence in state governments to advance the common good.

CSG is a region-based forum that fosters the exchange of insights and ideas to help state officials shape public policy.

CSG offers unparalleled regional, national and international opportunities to network, develop leaders, collaborate and create problem-solving partnerships.

CSG is a national community with six offices across the U.S. The headquarters office is in Lexington, Ky., and the federal affairs office located in Washington, D.C. Regional offices are located in Atlanta, Chicago, New York City and Sacramento.

It's structure invites focused participation at the regional and national levels provides a national to exchange information and ideas.

Elsevier

(Elsevier.com)

Largest information technology company that you do not know.

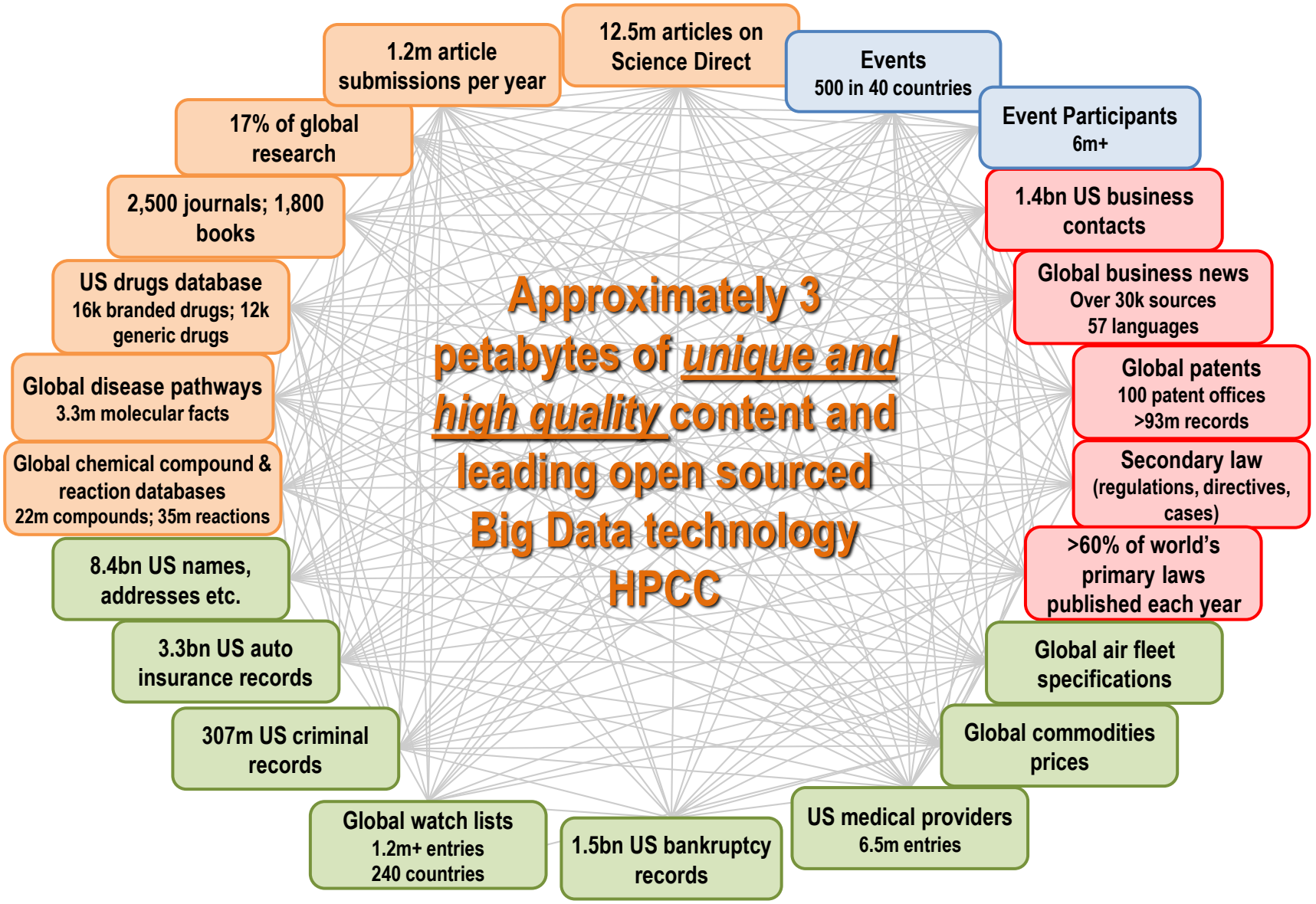
Each year

- 1 million article manuscripts received by ~2,000 journals (all with Open Access options)
- 350,000 new articles published, in addition to 11M existing articles
- 2,000 new books published
- ScienceDirect: 750M digital article downloads

- Scopus: 56M records, 22,000 titles, 5,000 publishers, 700M citations, 170K Books

- SciVal: 75 trillion metrics values
- Grants:7,000 sponsors, 20,000+ active opportunities, ~5M awarded grants
- Patents: >93m records, 100 patent offices
- Compounds: 22M compounds, 35M reactions; 3.3M molecular facts
- Drug information: 16k branded drugs; 12k generic drugs

Content and data assets that are Deep and Broad



What content does Scopus include?

55.5M records from **22,283** serial titles and **170,000** books
21.3M pre 1996 records | 34.1M post 1995 records

- Content from > 5,000 publishers
- “Articles in Press” from > 3,750 titles
- Titles from 105 different countries in all geographical regions
- 40 “local” languages covered
- More than 2,800 Open Access journals indexed

Physical Sciences 6,600
- Chemistry
- Physics
- Engineering
- etc.,

Health Sciences 6,300
- (100% Medline)
- Nursing
- Dentistry
- etc.,

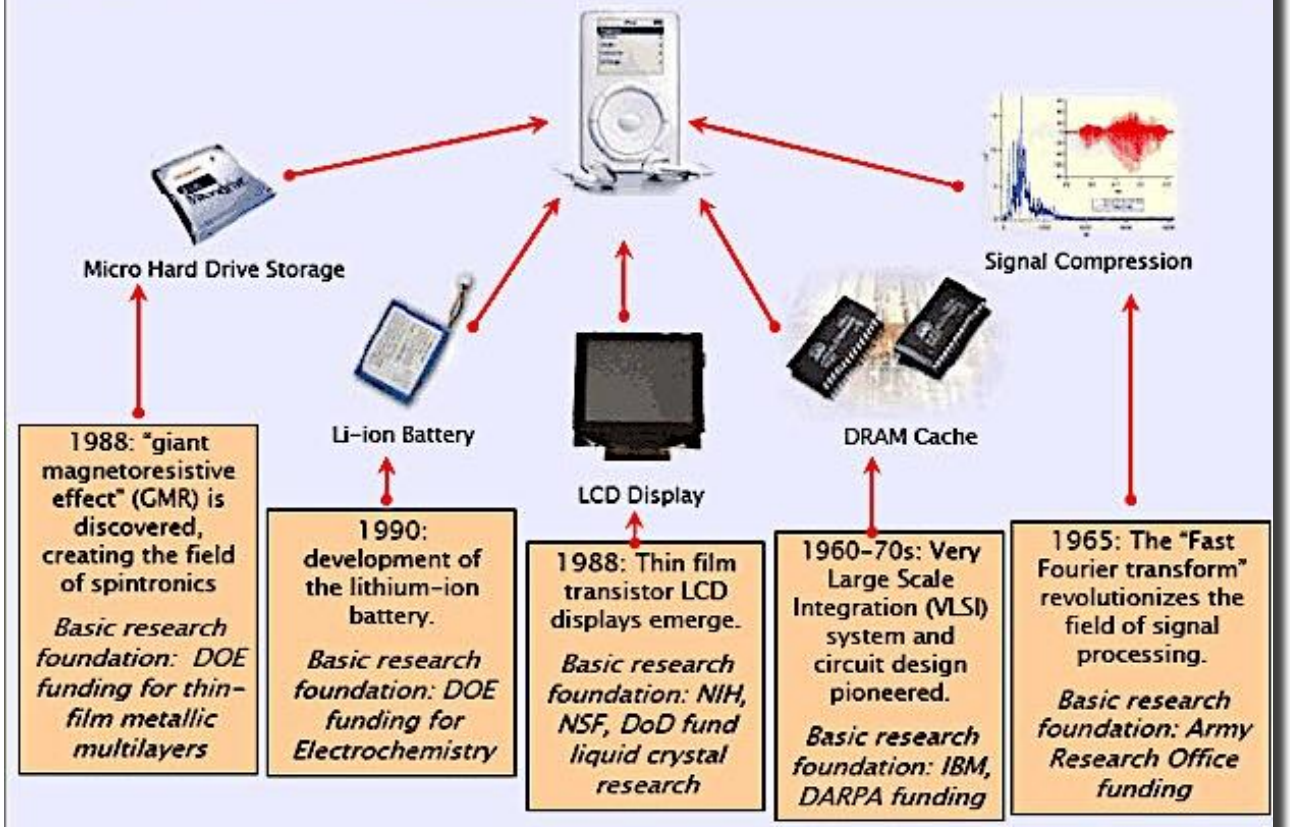
Social Sciences 6,350
- Psychology
- Economics
- Business
- A&H
- etc.,

Life Sciences 4,050
- Neuroscience
- Pharmacology
- Biology
- etc.,

More than 20,400 titles in Scopus, titles can be in more than one subject area

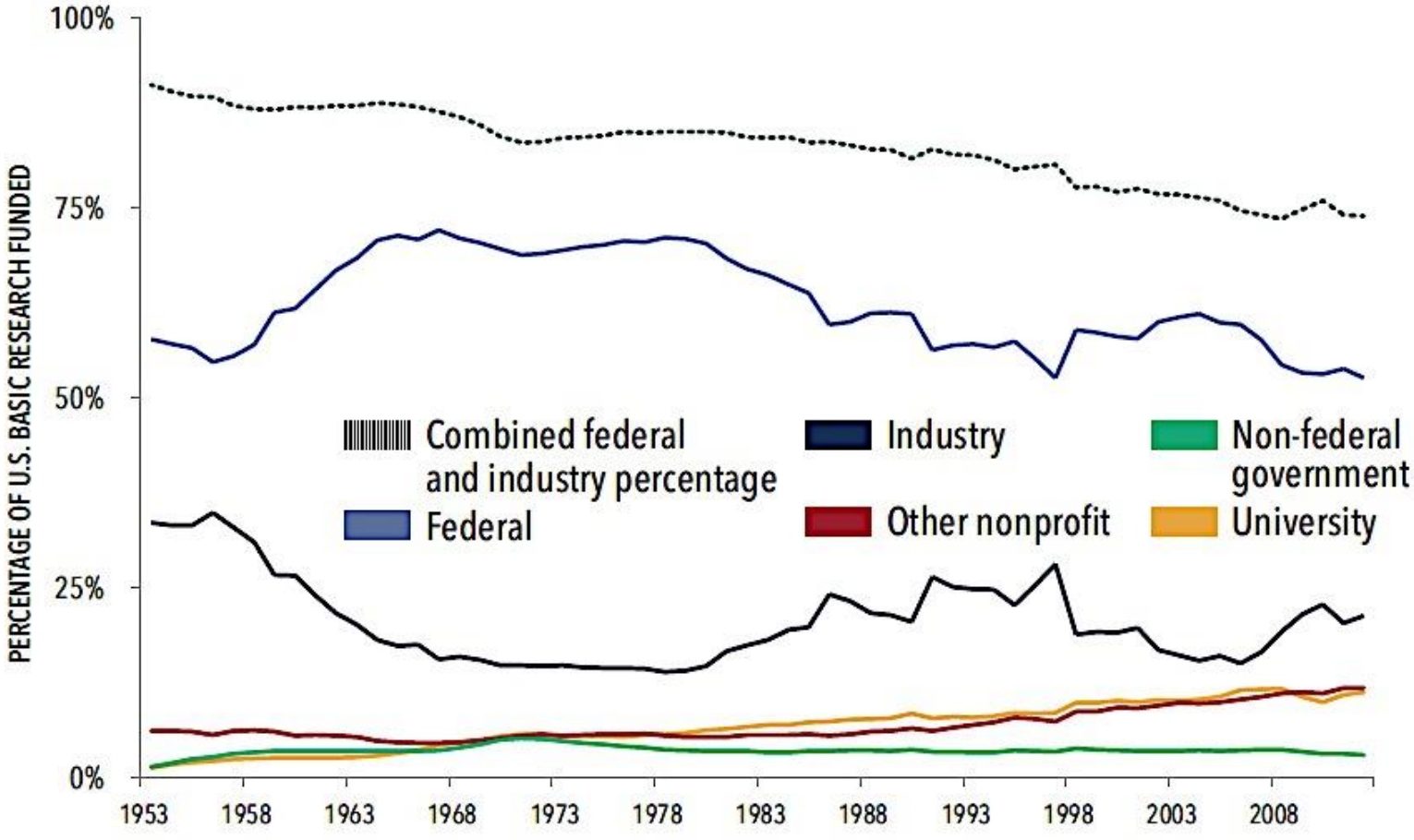
Data sources to identify a state's unique strengths

Impact of Basic Research on Innovation

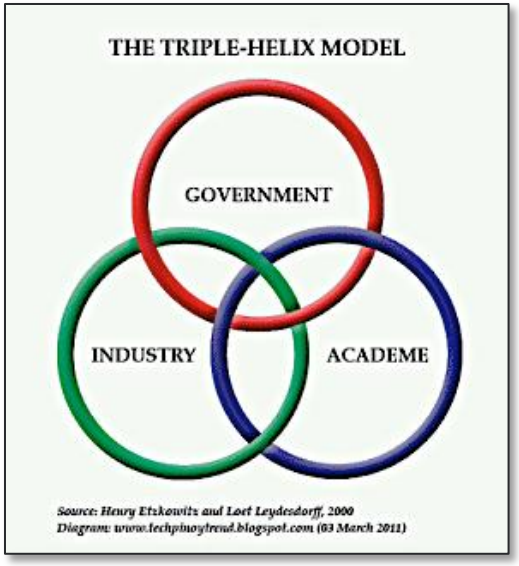


The development of MP3 technologies illustrates the unexpected benefits of basic research. In 1965, a hand-sized storage and playback device that would hold 15,000 recorded songs was the stuff of science fiction. Even simple hand-held calculators were rare and expensive at that time. Research funded by the Department of Defense, the National Science Foundation, the National Institutes of Health, the Department of Energy, and the National Institute of Standards and Technology contributed to the breakthrough technologies of magnetic storage drives, lithium-ion batteries, and the liquid crystal display, which came together in the development of MP3 devices. The device itself is innovative, but it built upon a broad platform of component technologies, each derived from fundamental studies in physical science, mathematics, and engineering.

Who Funds Basic Research ?

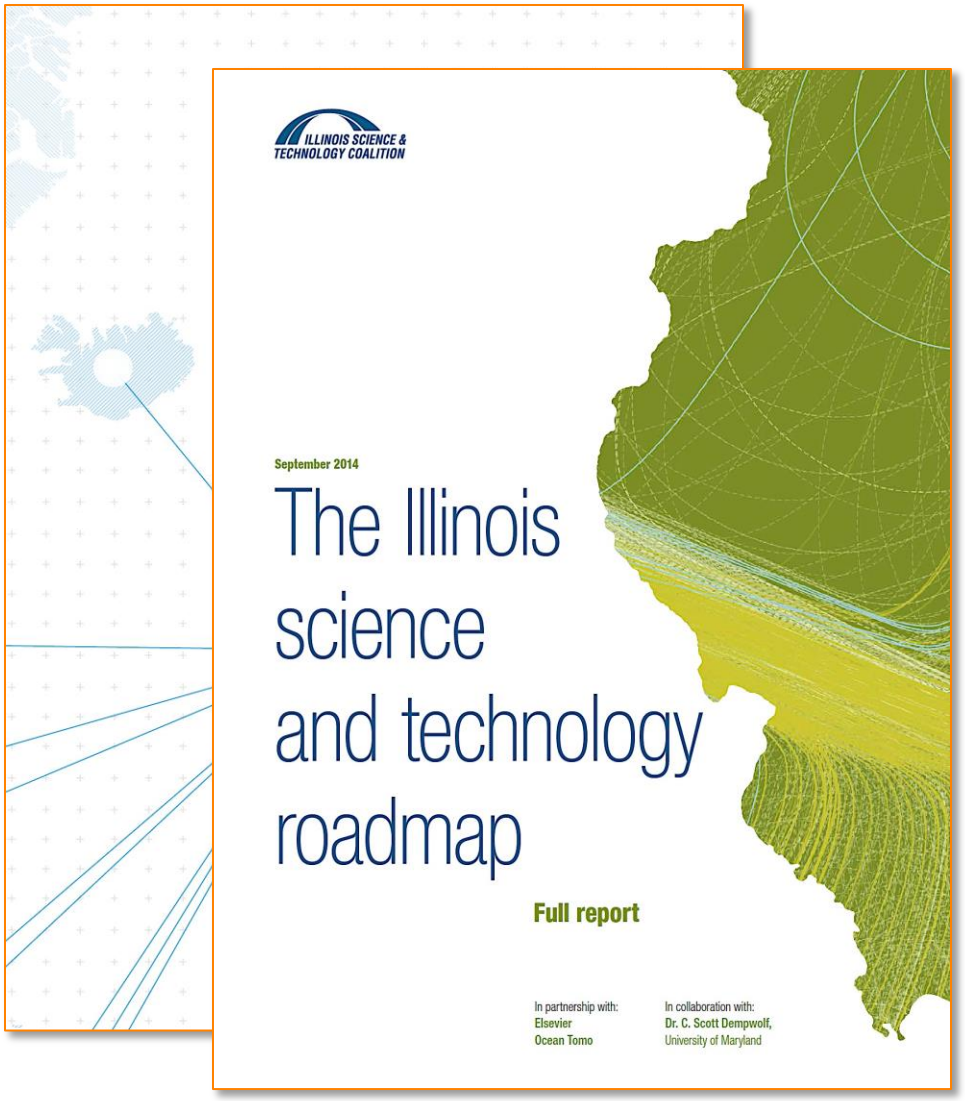


Source: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update.



Starts with new knowledge discovery and follows with Dissemination and Use to drive Innovations.


International **Comparative Performance** of the **UK** Research Base – **2013**
A report prepared by Elsevier for the UK's Department of Business, Innovation and Skills (BIS)
SciVal
ELSEVIER


ILLINOIS SCIENCE & TECHNOLOGY COALITION
September 2014
The Illinois science and technology roadmap
Full report
In partnership with:
Elsevier
Ocean Tomo
In collaboration with:
Dr. C. Scott Dempwolf,
University of Maryland


ILLINOIS SCIENCE & TECHNOLOGY COALITION
September 2014
Mapping Research and Innovation
Understanding Amsterdam's Competitive Advantage
CITY COMPETITIVENESS RESEARCH STRENGTHS RESEARCH TO COMMERCIALIZATION MUNICIPAL TO GLOBAL
11× Comparator Cities
AMSTERDAM BARCELONA BERLIN BRUSSELS COPENHAGEN DUBLIN
HAMBURG MADRID MANCHESTER STOCKHOLM VIENNA
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urban innovation network
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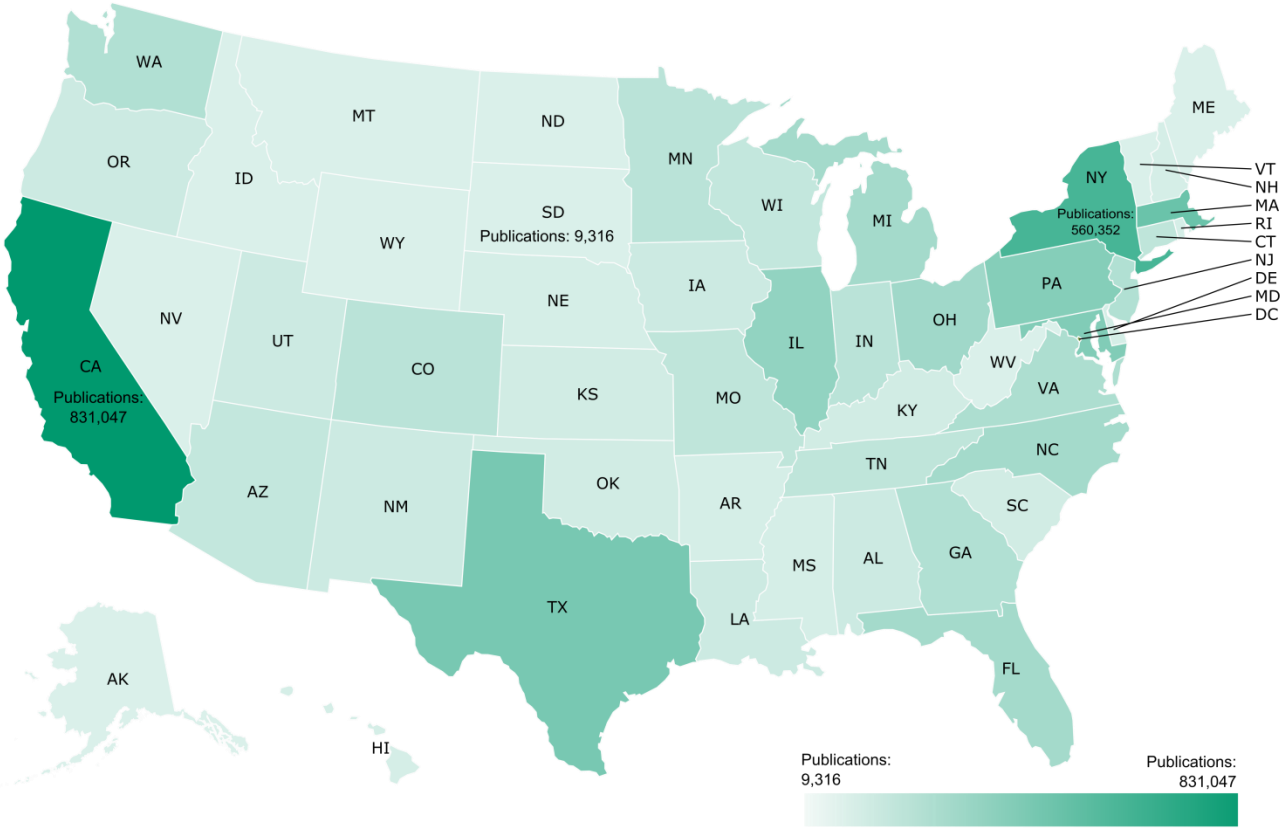
ILLINOIS SCIENCE & TECHNOLOGY COALITION
September 2014
AMERICA'S KNOWLEDGE ECONOMY | A STATE BY STATE REVIEW
April 2015
ELSEVIER

Key Motivating Ideas

- Research is a key drive of economic prosperity – both short-term economic activity and long-term growth.
- This report focuses on long-term growth – it's not about easy fixes, but sustainable success.
- States with strong research ecosystems are able to attract, grow, and retain innovative companies and high-wage jobs.
- This report outlines a process that states can take to identify and showcase their research strengths:
  - Research output and impact
  - Research focus
  - Inputs and research efficiency
  - Knowledge transfer and collaboration

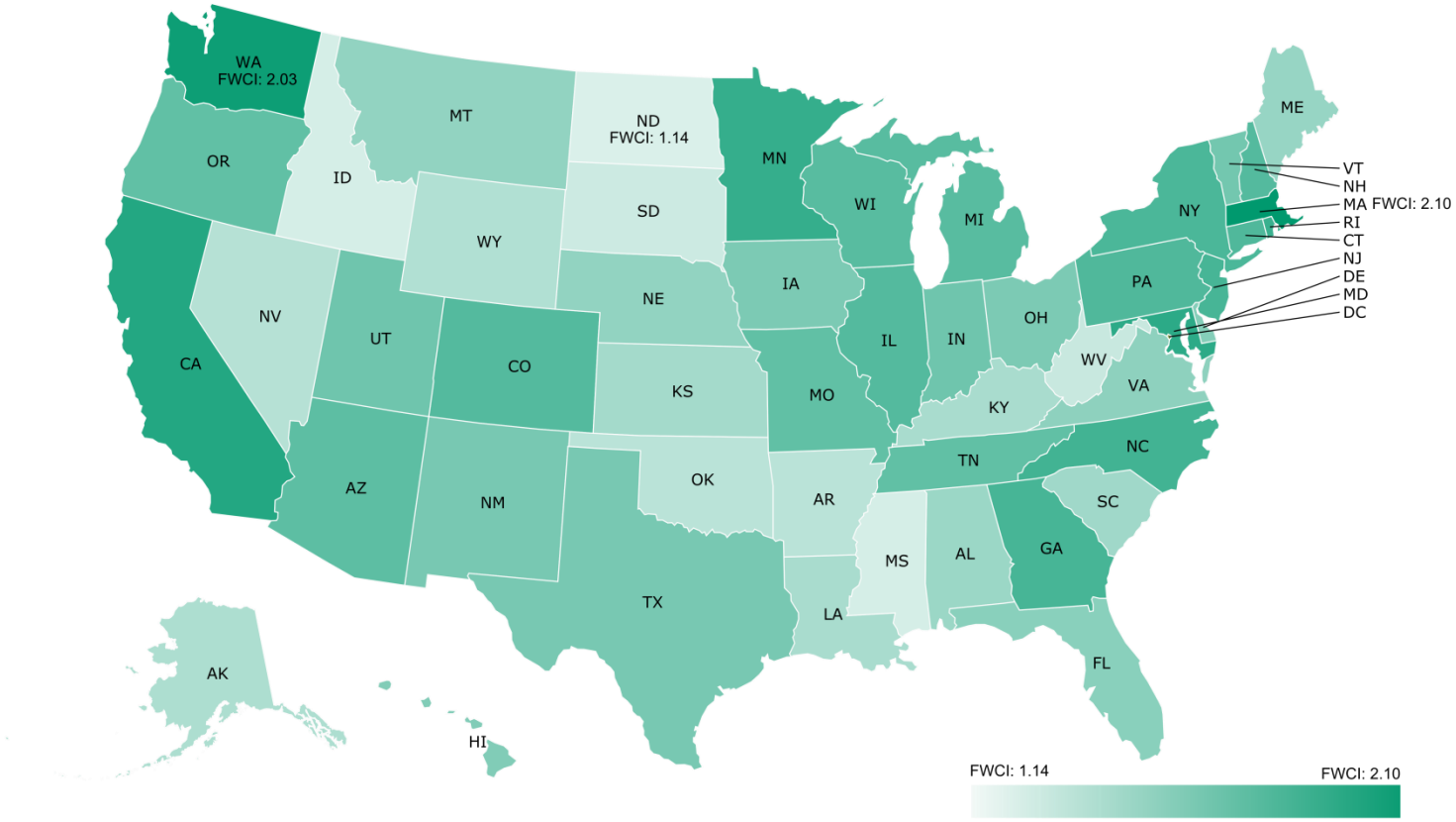
Production of research is not balanced in the US

- The combined absolute number of research publications of the top five states (California, New York, Massachusetts, Texas and Maryland) comprised more than 50% of the total U.S. output.



Many states produce highly cited research

- As a whole, the US produces highly impactful research, cited 49% more than the world average.



KEY FINDINGS

NATIONAL
1.7 PUBLICATIONS
PER 1,000 RESIDENTS

NATIONAL
6.5 PUBLICATIONS
Per million $USD R&D expenditures

TOP STATE
MASSACHUSETTS
7.5 publications produced per 1,000 residents, the highest of any state.

TOP STATES
MINNESOTA
10.5 publications produced per million $USD of R&D expenditures, the third rate among all states after Massachusetts and Delaware.

TOP RESEARCH FIELDS (NUMBER OF PUBLICATIONS)
1. MEDICINE
2. ENGINEERING

COLLABORATION PARTNERS
NEW YORK & MASSACHUSETTS
From 2004–2013, researchers from these states collaborated on 37,972 publications, of which 43% were in medicine.

TOP RESEARCH AREA (RELATIVE CITATION IMPACT)
COMPUTER SCIENCES
U.S. research in computer science achieves a field-weighted citation impact of 1.74, or 74% above the world average.

TENNESSEE | GROWTH IN RESEARCH IMPACT
The field-weighted citation impact of Tennessee's research grew from 1.54 in 2004 to 1.76 in 2013, or 1.5% per year over the past decade. This was the top growth rate among states that already achieved an impact above the U.S. average (1.49).

NORTH CAROLINA | RESEARCH STRENGTH IN MEDICINE
ranked in the top five among all states in both the relative volume of its research in medicine and the relative citation impact of its research in medicine.

America's Knowledge Economy:
A State-by-State Review

TEXAS

OVERVIEW: Research and development is a critical contributor to innovation and long-term economic growth, and the United States has a long history of being a global leader. According to a new collaborative report from The Council of State Governments and Elsevier—"America's Knowledge Economy: A State-by-State Review"—the United States published more than 536,000 publications in 2013. Predictably, states with larger populations also tended to publish more. For example, California and New York were the top two producers from 2004 to 2013. From 2004 to 2013, a big chunk of United States publications—more than one-quarter—focused on the field of medicine. Over the same period, Massachusetts and California produced the most impactful research—also called field-weighted citation impact—among all states. This brief offers a state-specific snapshot of data pulled from the report. To read the full report, visit *www.csg.org/knowledgeeconomy.*

1.69 PUBLICATIONS

PER 1,000 RESIDENTS, 2013

U.S. Average: 1.70 publications per 1,000 residents

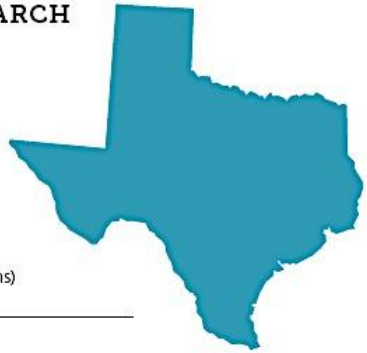
FIELD-WEIGHTED CITATION IMPACT, 2004–2013

1.58 Cited 58% more than global average

COMPARATIVE ADVANTAGE IN RESEARCH

MATERIALS SCIENCE

Ranked 7th among all states in terms of research impact and cited **9% more** than the U.S. average.



CALIFORNIA

TOP COLLABORATING STATE, 2004–2013

36,577 collaborations from 2004–2013 (9.5% of all of Texas's publications)

RESEARCH AND DEVELOPMENT FUNDING, 2004–2013

3RD AMONG ALL STATES | $43.1 BILLION

CRITICAL MASS OF RESEARCH AND INNOVATION, 2004–2013

Texas researchers and inventors account for 7.8% of all U.S. research publications (4th among all states) and 7.1% of all U.S. patents granted (2nd among all states).

America's Knowledge Economy:
A State-by-State Review

VIRGINIA

OVERVIEW: Research and development is a critical contributor to innovation and long-term economic growth, and the United States has a long history of being a global leader. According to a new collaborative report from The Council of State Governments and Elsevier—"America's Knowledge Economy: A State-by-State Review"—the United States published more than 536,000 publications in 2013. Predictably, states with larger populations also tended to publish more. For example, California and New York were the top two producers from 2004 to 2013. From 2004 to 2013, a big chunk of United States publications—more than one-quarter—focused on the field of medicine. Over the same period, Massachusetts and California produced the most impactful research—also called field-weighted citation impact—among all states. This brief offers a state-specific snapshot of data pulled from the report. To read the full report, visit *www.csg.org/knowledgeeconomy.*

2.34 PUBLICATIONS

PER 1,000 RESIDENTS, 2013

U.S. Average: 1.70 publications per 1,000 residents

FIELD-WEIGHTED CITATION IMPACT, 2004–2013

1.48 Cited 48% more than global average

COMPARATIVE ADVANTAGE IN RESEARCH

MEDICINE

Cited **11% more** than the U.S. average.

MARYLAND

TOP COLLABORATING STATE, 2004–2013

15,244 collaborations from 2004–2013 (8.7% of all of Virginia's publications)

RESEARCH FROM MEDICAL SECTOR, 2004–2013

16.7% of Virginia's total research output is from its government sector, the 5th highest rate among all states.

RESEARCH FROM CORPORATE SECTOR, 2004–2013

6.3% of Virginia's total research output is from its corporate sector, the 10th highest rate among all states.

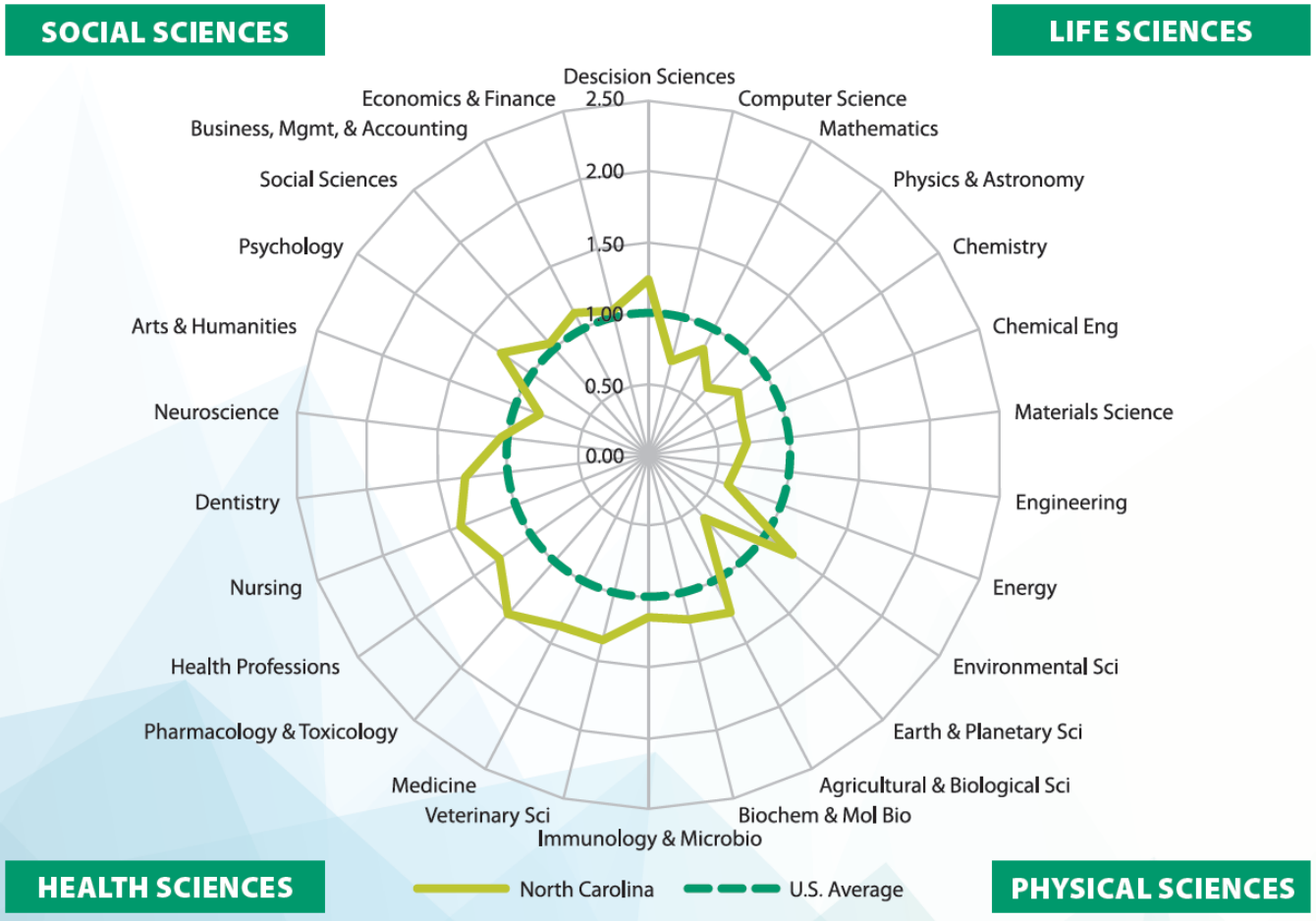
ELSEVIER | CSG THE COUNCIL OF STATE GOVERNMENTS www.csg.org/knowledgeeconomy

A few examples ---

- ✓ California has a national patent share more than three times that of the next closest state, which is Texas. New York, Massachusetts and Washington round out the top five.
- ✓ Minnesota, Rhode Island and North Carolina are the top three states for medical research intensity.
- ✓ New Mexico, Idaho and Virginia are the top three states in engineering.
- ✓ Maryland, North Carolina and Nebraska lead in biochemistry, genetics and molecular biology.
- ✓ Alabama's agricultural and biological sciences output is 18 percent higher than the national average.
- ✓ Arkansas' relative output in business, management and accounting is second among all states, trailing only Oklahoma.

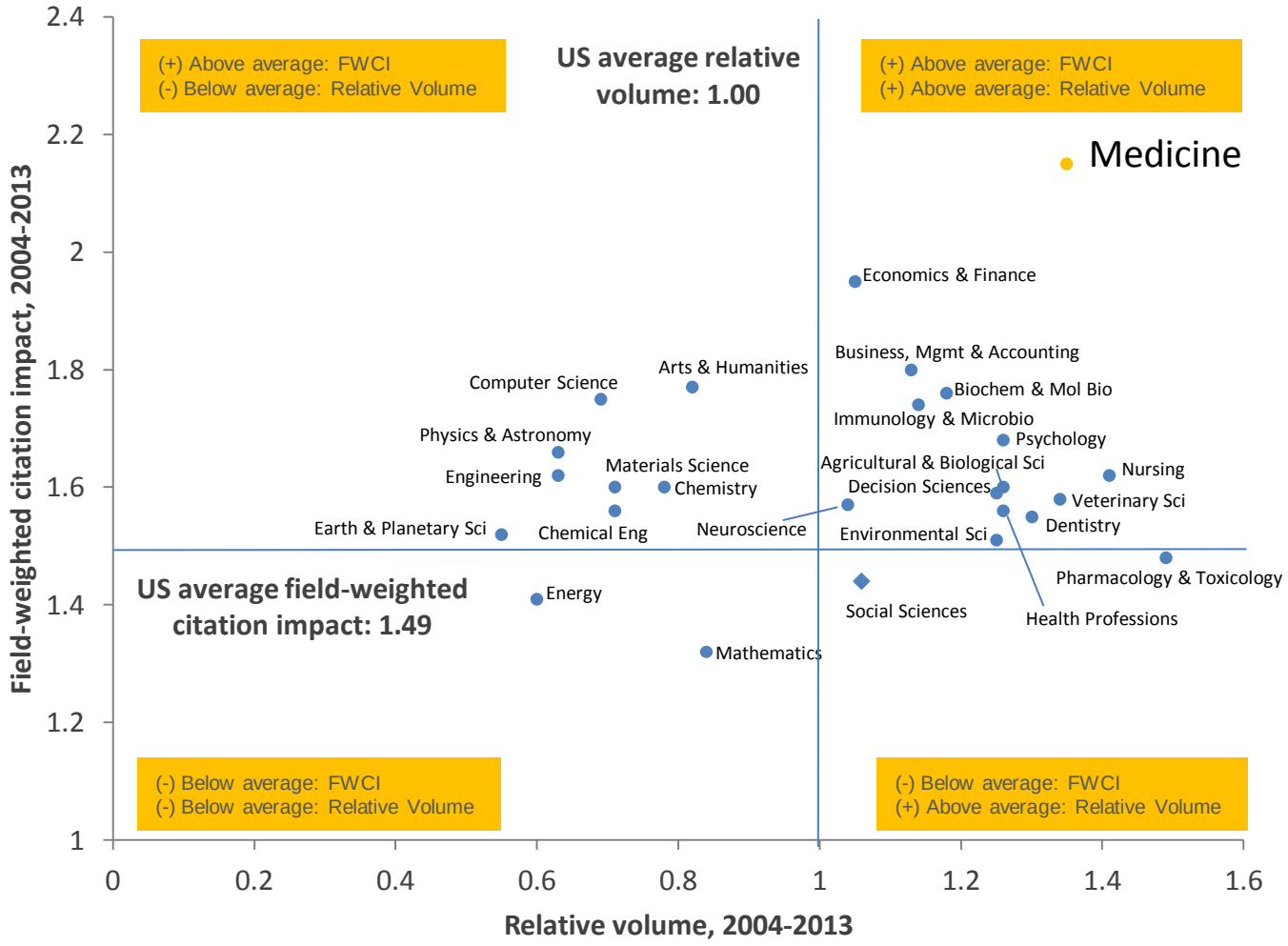
Relative volume: North Carolina specializes in the health sciences

- 28.7% of all US output was in the field of medicine, but an even higher percentage (38.6%) of North Carolina's output was.



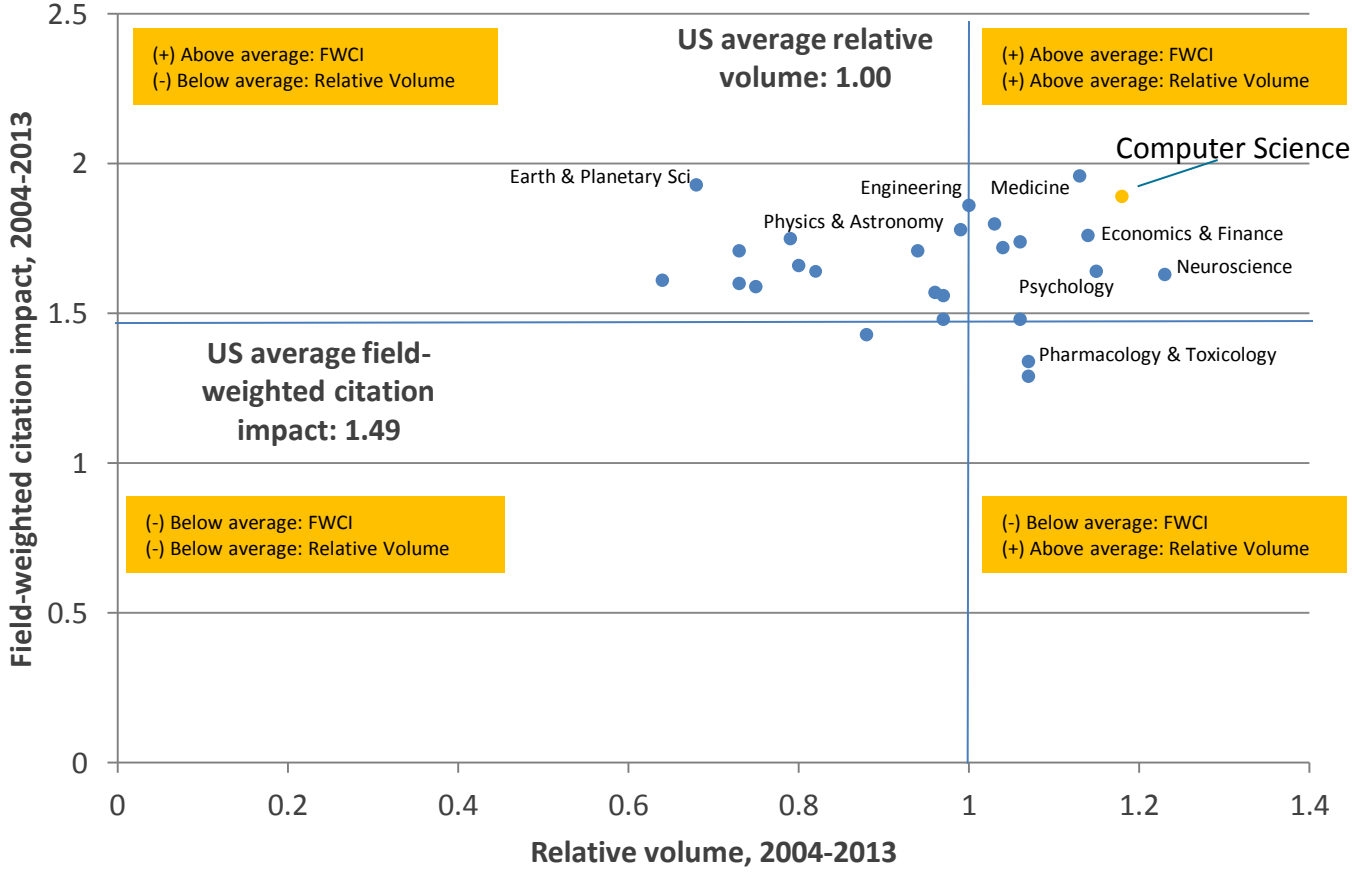
Relative volume and impact: North Carolina has a comparative advantage in medicine

- 3rd among all states in relative volume, 4th in relative impact



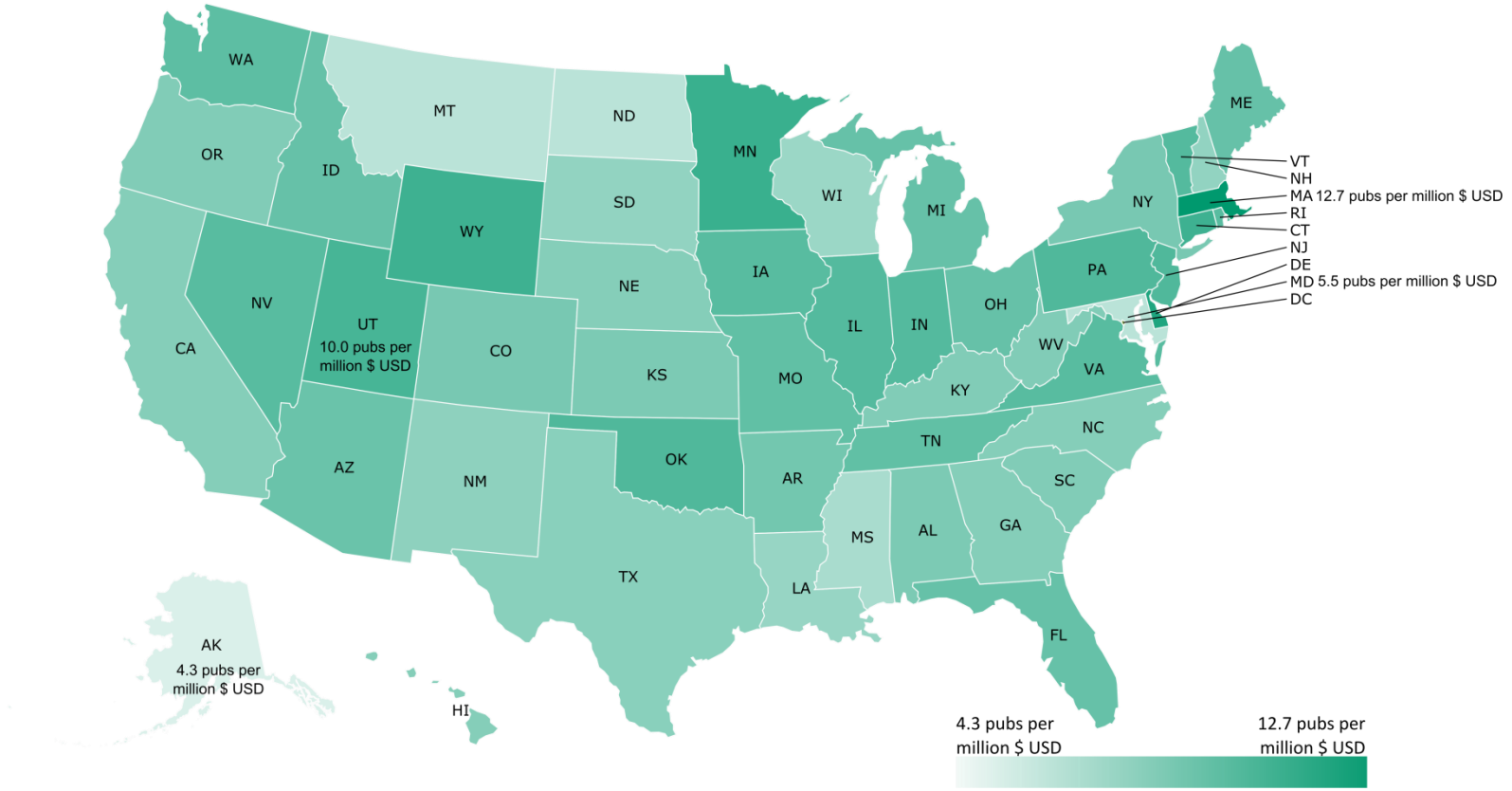
Relative volume and impact: New York has a growing advantage in computer science

- 4th among all states in relative volume, 10th among all states in relative impact



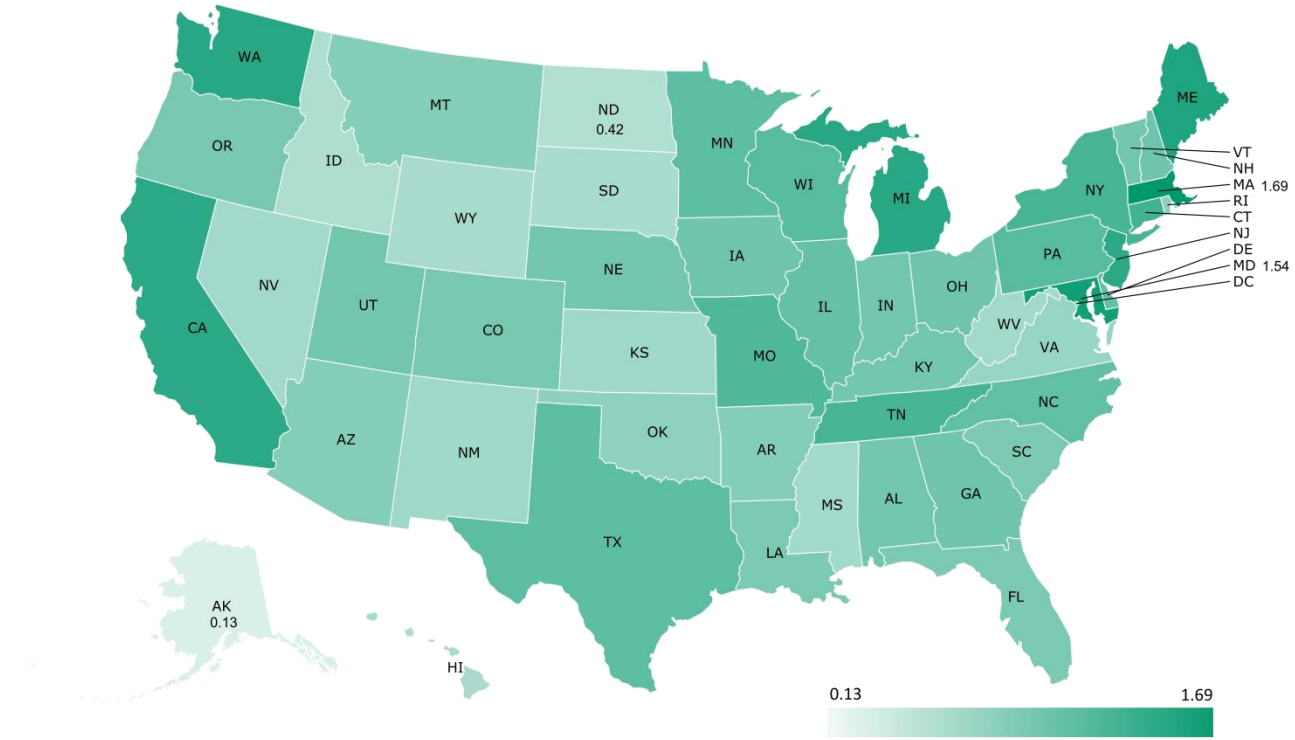
Research requires substantial investment

- US universities produced 12.7 publications per million $ USD of research and development expenditures.
- Map below shows range of states' academic research outputs per million $ USD



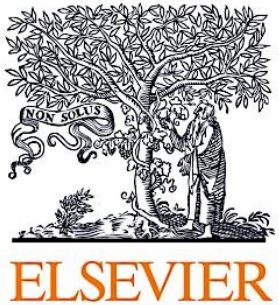
But, the payoffs – driving innovation – are worth it

- Knowledge and basic research produced help drive innovation
- One proxy is how much academic research is cited in industry patents. For example, New York's research in computer science from 2004-2012 has been cited in 1,026 patents so far.
- States with highest relative patent citation-to-publication shares shown below



Main Takeaways

- US produces a large amount of highly impactful research.
- Although the level of output and funding varies, quality research is distributed across the entire country.
- Through a variety of metrics, each state can identify its relative comparative research strengths.
- Research requires substantial focused investment, but the payoffs – driving innovation and future economic growth at the state level – are worth it.



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In the current economy, R&D jobs are multiplied 3.2X

Projected U.S. R&D spending of $465 billion will directly employ over 2.7 million U.S. residents in the private and public sectors. In turn, an additional 6 million U.S. jobs will be supported.[2]

Source: Battelle, *R&D Magazine*

R&D spending is amplified 2.9X

As R&D spending ripples through the U.S. economy, it will generate an additional $860 billion in indirect economic impact.

Long-term economic growth is linked to research intensity

The most important example of long-term R&D impact is U.S. economic growth in the second half of the 20th century. Large research initiatives like the Human Genome Project or the War on Cancer also have high rates of social and economic return over the long term.[3]