

SPECIAL REPORT

SWOLLEN WITH SUCCESS

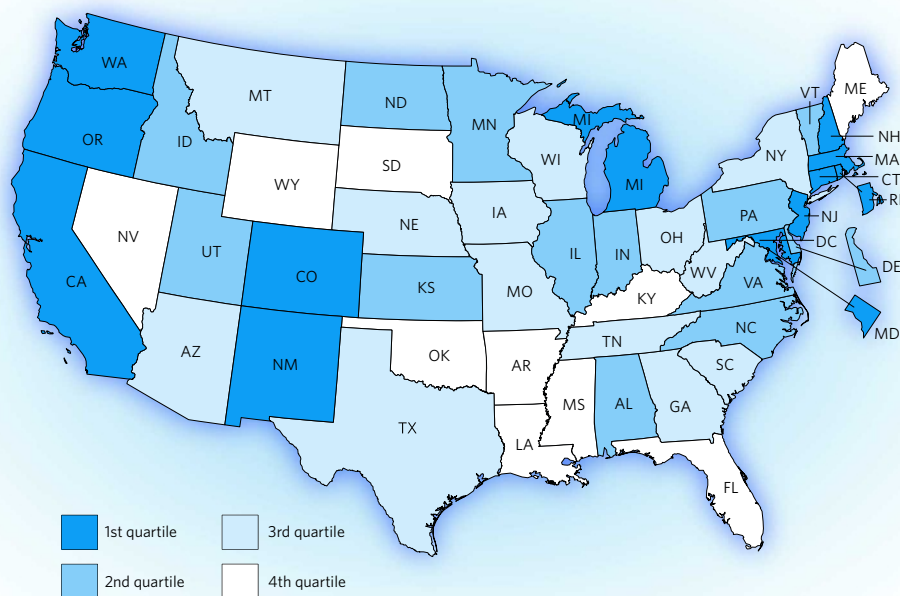
For a different perspective on the 2008 indicators from the US National Science Foundation, take a look at *Nature's* cartograms. Words and maps by Declan Butler.

Science indicators make for compulsive reading in the research community, where scientists pore over them like fans analysing the latest football results. Conventional mapping of indicators can make interpretation tricky, so *Nature* has generated a series of cartograms that reveal the United States distorted in proportion to a variable other than area — such as state spending on R&D. The maps here were made using data from the State Indicators chapter of the 2008 edition of the US National Science Foundation's (NSF's) Science and Technology Indicators (www.nsf.gov/statistics/seind08). For simplicity, the cartograms use a base map of the 48 contiguous mainland states and the District of Columbia.

Perhaps the best-known use of cartograms is the 2004 analysis of US presidential election results by Mark Newman of the University of Michigan in Ann Arbor, and Michael Gastner, at the Santa Fe Institute in New Mexico, who are experts in social and information networks. Whereas standard maps showed the United States awash in red Republican votes, cartograms that adjusted state and county areas on the basis of their population gave a more accurate picture, with roughly equal areas of red and blue (T. M. Gastner and M. E. J. Newman *Proc. Natl Acad. Sci. USA* 101, 7499–7540; 2004).

That paper introduced an improved algorithm

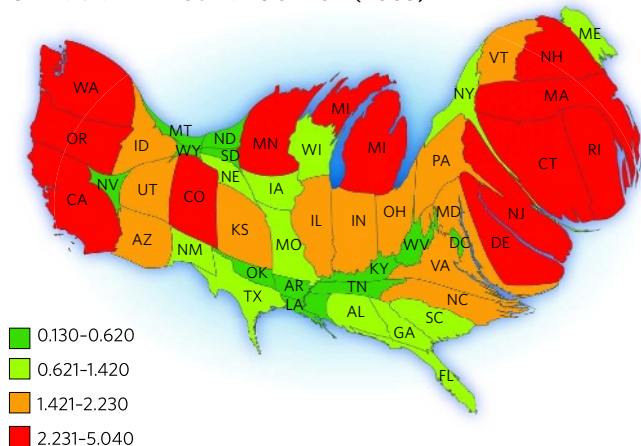
R&D AS SHARE OF GROSS DOMESTIC PRODUCT (2004)



Source: NSF Science & Engineering Indicators, 2008

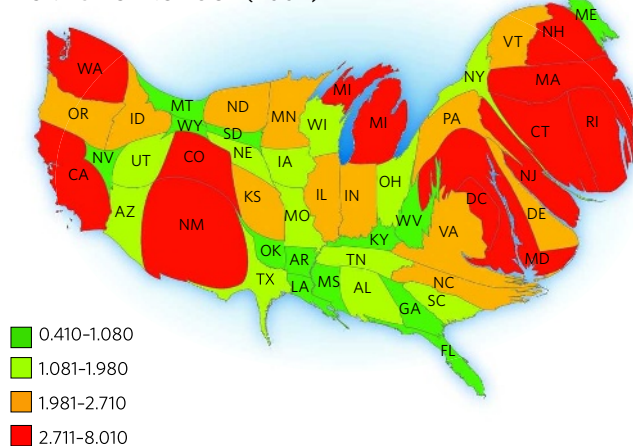
The standard map above of R&D as a share of each state's gross domestic product can be compared directly with the cartogram immediately below. This NSF indicator shows the importance of R&D to a state's economy, a measure of its potential for future growth.

INDUSTRY-PERFORMED R&D AS SHARE OF PRIVATE-INDUSTRY OUTPUT (2005)



States with high values for this indicator were mostly located on the west coast or the northern half of the east coast.

R&D AS SHARE OF GROSS DOMESTIC PRODUCT (2004)

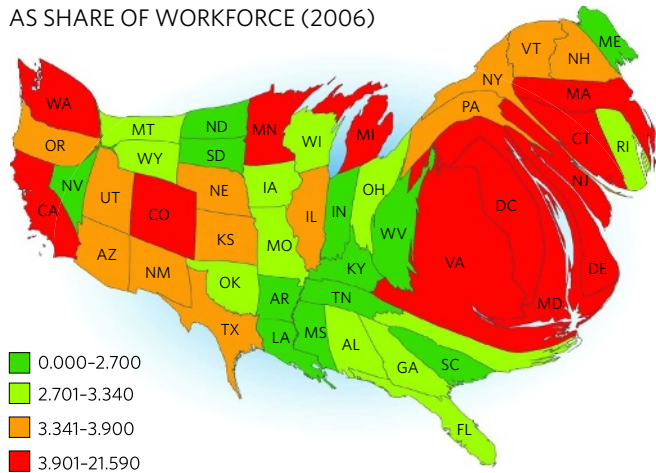


New Mexico and Colorado are prominent because of the presence of national labs in these states with an otherwise small GDP.

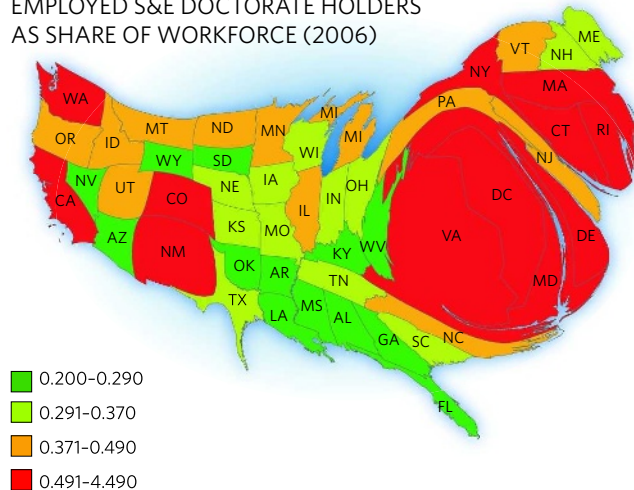


BIRDS CONFUND CLIMATE MODELS
 Could more than 60% of 'climate envelope' studies be wrong?
www.nature.com/news

INDIVIDUALS IN S&E OCCUPATIONS AS SHARE OF WORKFORCE (2006)



EMPLOYED S&E DOCTORATE HOLDERS AS SHARE OF WORKFORCE (2006)



Science and engineering jobs have the biggest share of the workforce in the District of Columbia and the adjacent states of Maryland and Virginia.

This indicator shows a state's ability to attract and retain highly trained scientists and engineers.

for generating cartograms, which was the one used here. The software implementation is the open-source ScapeToad, released in May by the Chôros Laboratory at the Swiss Federal Institute of Technology (EPFL) in Lausanne, which researches the concept of space in society, from urban planning to territorial development.

Cartograms have rarely been used for science indicators, although the NSF generated two for its 2006 science and engineering indicators. "The resulting feedback was mixed," says John Gawalt of the NSF's statistics division, "they can be difficult for readers to interpret."

But visualizing information in this way can be stimulating. "For such a familiar map as the United States, the combined distortions and

colour scales of these cartograms are highly meaningful; the maps become somehow shocking and subversive," says Rémi Barré, a researcher at the National Conservatory of Arts and Crafts (CNAM) in Paris and former head of the French science indicators agency, the Paris-based Science and Technology Observatory (OCT). "This double visualization is powerful and welcome."

"They're a really nice visualization of some things I hadn't really appreciated before," says Newman. "The one of R&D as share of gross domestic product is pretty close to a population cartogram, except for Colorado and New Mexico, where the big national labs are. It's interesting to see Michigan, with the auto industry, and

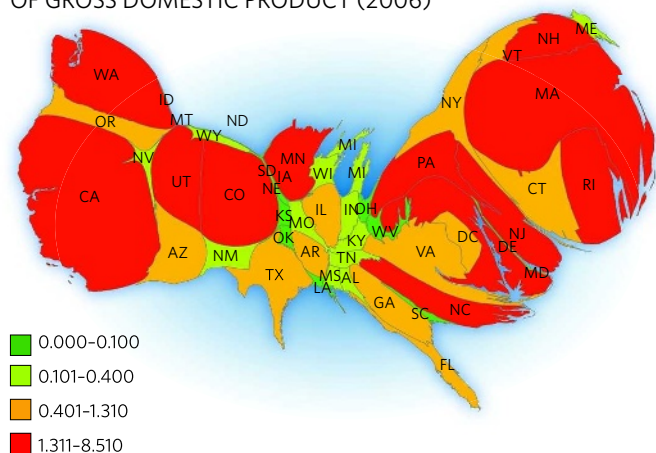
Washington state, home of Microsoft, looming large on the industry-funding cartogram. Why is Oregon so big? Is that Intel?"

Geographer Jacques Lévy, director of the Chôros lab, says the *Nature* maps are fascinating. "I'm struck by the efficient resistance of the east, including a part of the Rust Belt and the coastal south. Conversely, California and the west coast do not seem to do as well as we might imagine."

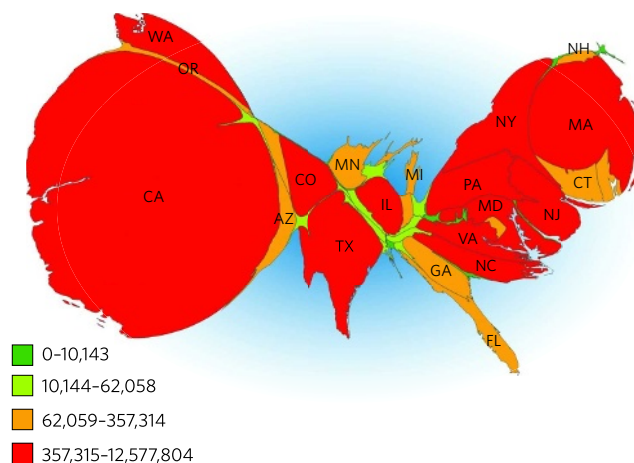
"The maps also show how in a supposed neo-liberal America, the role of a powerful, multi-tier state can challenge the spontaneous distribution of resources induced by socio-economic rationales," Lévy adds. ■

See Editorial, page 264.

VENTURE CAPITAL DISBURSED PER \$1,000 OF GROSS DOMESTIC PRODUCT (2006)



VENTURE CAPITAL DISBURSED (\$ THOUSANDS) (2006)



High values of venture capital normalized to the size of a state's economy show which states are successfully attracting venture capital to fuel growth.

Absolute values of venture capital disbursement show that it is concentrated in a handful of states, with California obtaining almost half.