Steven Brint, distinguished professor of sociology and public policy at the University of California, Riverside, examines the role of academic researchers in the top 50 inventions from 1955 to 2005.
Has academic research become a leading engine of economic growth in the United States? Many social scientists and policy analysts think so, and trace the change to legislative acts in the 1980s that incentivised technology transfer from universities to industry.

But the signals are mixed. In the United States, as in other advanced economies, the great majority of R&D - more than two-thirds - is done in private corporations. Some additional proportion - no less than 15% - is conducted in government facilities or non-profit organisations. That leaves but a small share for academic research and indeed academic research in the United States accounts for about 0.3% of GDP, out of a total for all R&D of some 2.7%.

Can our expectations for academic research as an engine of economic growth really be that high, given the relatively small amounts invested in it? It is easy enough

"University R&D looms large as a source of inventions that transformed human life in the late 20th century."

Academic research was the most important source in the invention of DNA fingerprinting
ACADEMIC RESEARCHERS PLAYED THE MOST IMPORTANT ROLE OR A VERY IMPORTANT ROLE, TOGETHER WITH ACTORS FROM OTHER SECTORS, IN 40% OF THE PROJECTS.”

EXAMINING THE TOP 50
Research I recently conducted takes a different approach. I took a list of the top 50 inventions from the period 1955-2005 and examined the locations in which the main actors were employed during the research and development that led to these inventions. I categorised the actors into one of five categories: academic, corporate, foundation, government, or other non-profit. I divided the invention cycle into four stages: early research, refining research, development, and production. I also examined the entities providing funding support for the R&D behind these top inventions.

To assign credit for inventions and to trace funding support, I read a minimum of three articles or books about each invention, and I examined only major research and development breakthroughs on the entire invention, rather than focusing on individual components. (Imagine the task of tracing innovations related to every component of the jet airliner, for example.)

The results showed that academic researchers played the most important role or a very important role, together with actors from other sectors, in 40% of the projects and that half of the top inventions received government funding.

Of course, this is a small sample of all inventions, but we can say that in terms of inventions that have transformed the way we live and work, academic research and government funding have had an outsized role given what we would expect simply based on their share of R&D effort and expenditures.
Academic researchers were the most important sources of the following eight inventions on the *Popular Mechanics* top 50 list: coronary bypass surgery, DNA fingerprinting, fuel cells, genetic engineering, genetic sequencing, *in vitro* fertilisation, magnetic resonance imaging (MRI), and the polio vaccination. As this list makes clear, academic R&D efforts are most prevalent in medical and biotechnology breakthroughs. Biomedicine is also, by far, the largest recipient of non-defence federal research spending in the United States.

By my accounting, academic researchers were very important sources of R&D breakthroughs, together with researchers from other institutional spheres, in the following 12 inventions: ARAPANET (the forerunner of the Internet), fibre optics, high-yield rice, the mark-up language HTML, industrial robots, the laser beam, the MP3 player, the pacemaker, the personal computer, video games (yes, invented at MIT), and the World Wide Web.

**ACADEMIC INVOLVEMENT**

A few of these are well-known stories, such as the breakthrough technology for gene splicing created by Herbert Boyer of the University of California, San Francisco and Stanley Cohen of Stanford University, or the role of Charles Townes of Columbia University in the invention of the laser beam. Others, such as the invention of DNA fingerprinting by the geneticist Alec Jeffreys of Leicester University, and the work of Yuan Longping of Southwestern University in China on high-yield rice varieties, are more obscure than they should be.

As expected, academics tended not to be involved at all in most of the consumer and leisure goods on the *Popular Mechanics* list, such as the television remote control, the smoke detector, Velcro, and the waffle-sole running shoe (which launched the jogging craze in the 1970s). In addition, a few spectacular technical achievements of the late 20th century, such as float glass (the glass used in skyscrapers) and the birth control pill, received little or no attention from academics.

There were some additional surprises: Academic contributions were not concentrated in the top 50 universities. Instead, in more than three quarters of the cases in which university researchers were major contributors, academic researchers were spread out beyond the top 50
Alec Jeffreys, inventor of DNA fingerprinting. Image: PLoS Genetics

Yuan Longping, developer of high-yield hybrid rice varieties

Charles Townes, inventor of the laser

Stanley Cohen and Herbert Boyer, inventors of recombinant DNA technology. Images: Chemical Heritage Foundation
universities. University researchers were also not concentrated in early stage (or upstream) research. Instead, they were as likely to be found in development as early stage research, and the most common patterns was to find academic researchers involved in every stage prior to production.

**SOURCES OF INVENTION**
The list of inventions was compiled by a panel of 25 experts convened by the magazine *Popular Mechanics*. This is the only list available based on the expert opinion and not intended for public relations purposes. The experts here were professors in science and technology programmes and directors and curators of museums of science and technology.

The editors of *Popular Mechanics* required the expert panel to choose inventions from among several categories, including consumer and leisure goods. This arguably leads to a bias in the choices, but it is one that would tend to make academic research less, rather than more, likely to appear; corporations (and private inventors) conduct the great majority of R&D on leisure goods and the government is rarely, if ever, involved in financing this work.

In sum, university R&D looms large as a source of inventions that transformed human life in the late 20th century - greatly exceeding what would be expected given the relatively small share of total R&D conducted by universities. And academic researchers could not have made these contributions without the continued faith of politicians in the value of government support of academic R&D. It should be a cause for concern that this support seems to be wavering now, at least in the United States.

---

**AUTHOR**

Steven Brint is distinguished professor of sociology and public policy at the University of California, Riverside. He is the author or editor of seven books and has published more than 70 articles. His work has been translated into Chinese, Dutch, Japanese, French, German, Italian, Portuguese, and Spanish. He is currently completing work on a new book, *The Ends of Knowledge: Organizational and Cultural Change in U.S. Universities, 1980-2015*.