



Is the United States Losing Its Edge in Science and Technology?

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Is the United States in danger of losing its competitive edge in science and technology? This concern has surfaced repeatedly since the end of the Cold War. In the mid-2000s, numerous public and private sector reports argued that the United States is falling behind, and Capitol Hill responded with a wave of policy initiatives. Yet despite some foreboding rhetoric and the urgent call to action, in fact the news is not bad. This is the central finding of *U.S. Competitiveness in Science and Technology*, a new RAND report by Titus Galama and James Hosek. Taking an objective, comprehensive look at the evidence behind the claims, the authors find that the United States continues to lead the world in science and technology and appears to be in no imminent danger of losing its edge.

Reasons to Worry That the United States Is Falling Behind

Two developments drive much of the concern that U.S. leadership in science and technology is slipping. First, globalization and the rapid growth in science and technology of other nations, such as China and India, may make it increasingly difficult for the United States to retain its comparative economic advantage. Second, some fear that the building blocks of science and technology within the United States—science and engineering (S&E) infrastructure, education, and workforce—are not being sustained. Presumed deficiencies include inadequate expenditures on research and development (R&D), particularly on basic research; problems with education in S&E; a shortage of S&E workers; an increasing reliance on foreigners in the workforce; and the decreasing attractiveness of S&E careers to U.S. citizens.

U.S. Performance in Science and Technology Remains Strong

To investigate the claim that the United States is

Abstract

The United States continues to lead the world in science and technology. It generally benefits from the influx of foreign science and engineering students and workers, and it will likely continue to benefit from the development of new technologies by other nations, as long as it maintains the capability to acquire and implement such technologies. However, U.S. leadership in science and technology must not be taken for granted.

losing its edge over other nations, Galama and Hosek examined key measures of science and technology capability, including R&D expenditures, triadic patents, and world publications and citations. Comparing the United States with other nations, they found no evidence that the United States is failing to keep pace.

R&D spending. The United States accounts for 40 percent of global expenditures on R&D, more than any other nation. U.S. R&D spending has grown faster than that of the European Union (EU-15) and Japan. Total U.S. expenditures on R&D (federal and nonfederal, in current dollars at purchasing power parity) grew at an average rate of 5.8 percent per year from 1993 to 2003. This is in line with the world's average of 6.3 percent per year. China and South Korea show rapid growth but still account for a small share of global expenditures.

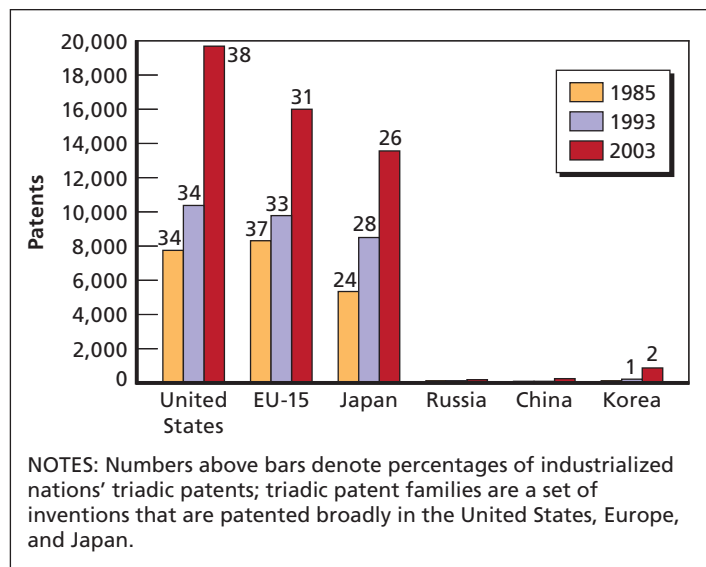
Triadic patents. In 2003, 38 percent of industrialized nations' triadic patents went to the United States versus 31 percent to the EU-15 and 26 percent to Japan (Figure 1). The U.S. lead has expanded since 1985, when the United States came in slightly behind the EU-15, with 34 percent to the EU-15's 37. China and India currently hold only a very small share of patents.

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Figure 1
Triadic Patents in 1985, 1993, and 2003, by Nation/Region



Publications. The U.S. share of total scientific publications, 35 percent, is on par with its closest competitor, the EU-15, at 37 percent. The United States leads on measures of the influence of its publications, with 49 percent of the total number of citations and 63 percent of the world's most highly cited publications. Still, Europe, Japan, China, and South Korea gained world share on all three indicators.

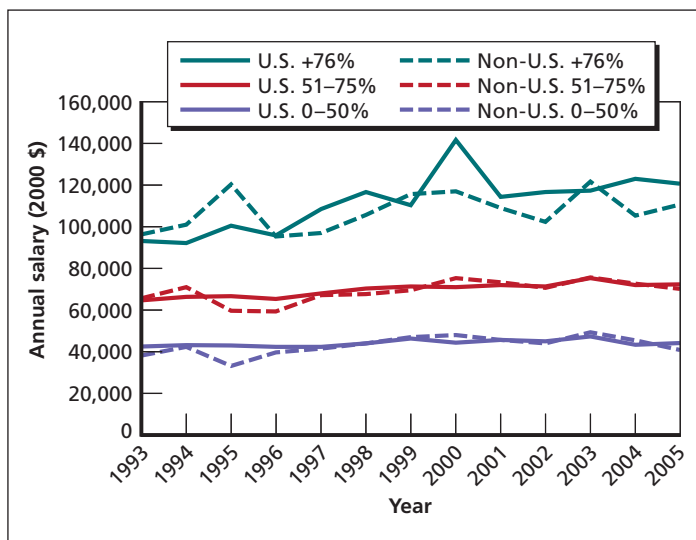
Investment in science and math education. U.S. investments per student in elementary and secondary education are on par with those of other industrialized nations. For post-secondary education, the United States spends considerably more—nearly double the amount per student—than the average of other industrialized countries.

Science and engineering workforce. U.S. employment in S&E has grown rapidly and steadily, at 4.2 percent per year since 1980. Foreign-born workers have helped enable this growth: Their share of the workforce has doubled from 6 percent in 1994 to 12 percent in 2006. The salaries of native and foreign-born S&E workers are similar at low, middle, and high portions of the salary distribution (Figure 2), suggesting that the market perceives these workers to be of equal quality.

Continued Vigilance Is Needed

Although the pillars of the nation's science and technology are being adequately maintained, there are potential weaknesses. Federal research funding is focused on the life sciences, and other fields are perhaps being underfunded. In science and math, younger K–12 students compare well with their peers in other industrialized countries, but students in the upper grades perform worse than most of their peers abroad. Further, the consequences of the increasing reli-

Figure 2
Average Salaries of U.S. and Non-U.S. S&E Workers, by Percentiles (Bachelor's Degree or Higher)



ance on foreign-born scientists and engineers are not yet fully understood.

Globalization May Prove Economically Beneficial

Counterintuitively, globalization and the rise of science and technology capability in other nations may prove to be economically beneficial to the United States overall. A future with more technologies invented abroad can benefit the United States, since domestic use of new technology, whether invented in the United States or elsewhere, can result in greater efficiency, economic growth, and higher living standards.

The impact of globalization on U.S. innovative activity is less clear. The rise of populous low-income countries may threaten U.S. comparative advantage in certain areas as such countries develop the capacity and institutions necessary to apply new technologies, including a well-educated, low-wage S&E workforce. In this dynamic competition, the United States needs to maintain its capability not only to innovate but also to acquire and apply technologies invented abroad. Interestingly, innovation elsewhere may increase the foreign and domestic demand for U.S. research and innovation—provided that the United States keeps its comparative advantage in R&D.

The United States Can Bolster Its Competitive Edge

The United States should not take its leadership in science and technology for granted. Certain policy steps may help to strengthen its footing:

- **Establish a centrally coordinated, independent body to monitor and evaluate U.S. performance in science**

and technology over the long term. Comprehensive, objective assessments of U.S. performance in science and technology, performed periodically, are vital to ensuring its health. They can help to inform public debates, identify problems, and guide the development of new legislation. At the same time, they may quell exaggerated claims of the demise or success of U.S. science and technology.

- **Facilitate high-skilled immigration to allow the United States to continue to benefit from employing foreign S&E workers.** Currently, offshoring of science and engineering is driven not only by a need to reduce costs but also by an increasing need to gain access to highly skilled labor. If firms cannot fill their S&E positions in the United States, they may decide to offshore or outsource R&D to take advantage of foreign S&E

labor pools. High-skilled immigrants have been a major factor in the fast growth of the S&E workforce—which has been much faster than U.S. S&E degree production. Foreigners thus help to ensure that the benefits of innovation accrue in the United States by allowing innovative activity to remain and expand in the United States.

- **Increase U.S. capacity to interact with science centers abroad and capitalize on the scientific and technological advances being made elsewhere.** Economic strength and global leadership depend on a nation's ability both to absorb and use new technologies and create them. As emerging nations become stronger in R&D, it will become more critical for U.S. researchers to pursue joint ventures, collaborative research, and residences in foreign universities and laboratories to learn about new technology invented elsewhere. ■



This research brief describes work done for the RAND National Defense Research Institute documented in *U.S. Competitiveness in Science and Technology*, by Titus Galama and James Hosek, MG-674-OSD, 2008, 188 pp., \$32.00, ISBN: 978-0-8330-4424-2 (available at <http://www.rand.org/pubs/monographs/MG674/>). The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. **RAND**® is a registered trademark.

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