



THE JAMES A. BAKER III INSTITUTE FOR PUBLIC POLICY
RICE UNIVERSITY

HOT TOPIC:
INNOVATION AND ECONOMIC COMPETITIVENESS
THROUGH SCIENCE AND TECHNOLOGY

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Innovation and Economic Competitiveness through Science and Technology

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Innovation and Economic Competitiveness through Science and Technology

The United States is losing its competitive edge in a rapidly changing world economy. By taking advantage of advances in computing, telecommunication and other technological innovations, countries such as China and India have been able to outcompete the United States, not just in labor cost but in productivity and quality as well. Indeed, outsourcing business is so good that some Indian companies have been re-outsourcing work to other parts of the world, including parts of the United States! It is worth remembering that the computer and Internet revolutions came out of inventions made in the United States. Clearly, a nation does not have to discover and invent everything to be a leader; but that is how this country established its global dominance in high-tech business and commerce. Can we really be comfortable with the thought that most of the future discoveries and inventions are not likely to be made in the United States?

This frightening prospect derives from the fact that China and India have put science, engineering and technology very high on their list of national priorities, rapidly increasing their governments' support of scientific research and science, math and engineering education, while we in the United States seem satisfied with the status quo. Together, China and India graduate, *each year*, nearly eight times the number of bachelor's degree candidates in engineering as the United States; and the number of China's production engineering Ph.D. graduates surpassed the U.S. total in 2003. The National Science Board (NSB) noted in its report, "Science and Engineering Indicators 2004," that the United States dropped to 17th place in the world for the number of science degrees earned by 17- to 24-year-olds from third place three decades ago. True, American universities continue to be the envy of the world. But the rest of the world is rapidly catching up. In addition, the NSB pointed out that "the number of jobs that require science and engineering training will grow; the number of U.S. citizens prepared for those jobs will, at best, be level." Will these findings impact the quality of life of most Americans in the coming decades? How should the nation react? We believe that the answer to these questions is to ramp up the priority for federal spending on path-breaking basic research in the nation's universities and national laboratories, where large experimental facilities can be built and operated in a cost-effective manner for all the nation's researchers.

According to the American Association for the Advancement of Science (AAAS), the U.S. federal investment in nondefense research and development (R&D), as a fraction of gross

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domestic product (GDP), has been sliding downward for several decades to a predicted 0.4 percent GDP in 2008 from 0.7 percent GDP in 1970. The U.S. federal government spends \$150 billion or 2 percent of its total annual budget on R&D. Most of this is funding to the Department of Defense for large weapons development and testing. Only \$56 billion is invested in research carried out in universities, medical schools and national laboratories. Why do we believe this number should grow significantly?

First, history has shown that new products for market, powerful medical treatments and innovative technologies that lead to new jobs all come out of discoveries and inventions based on science and engineering research, much of it in universities.

Second, the nation's research community has the capacity to do much more research than it currently has funding to do. The fraction of research proposals submitted to federal agencies that are actually funded is below 30 percent and, for some programs, as low as 10 percent. These low numbers mean that many high-risk, high-reward ideas and early-career researchers are losing out to more conservative projects proposed by more senior scientists. Not only does this hinder innovation, but it also has created a situation in which young researchers are stuck in a holding pattern of post-doctoral assistantships for 15 years or longer before they can obtain their first grant. At the National Institutes of Health (NIH), the federal agency that funds most biomedical research, the average age for a first grant increased to 43 today, up from 34 in 1970. True innovation and scientific discovery come from independent exploratory research and fresh ideas, often from the young. Making scientists wait until they are 43 years old to be truly independent is wasteful of talent; and our nation is the loser.

Third, one of the most important products of university research is the pool of talented young men and women who graduate with degrees in science, mathematics and engineering. In the coming decades, as the baby boomer generation of scientists and engineers retires, we will need more, not fewer, young talented researchers. At the present time, far more biomedical researchers are working in temporary positions than the total of number of permanent jobs existing in their fields in academia. The federal agencies should create new bridge programs, in partnership with universities, to smooth the transition of post-doctoral research assistants to

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tenure-track positions in universities in anticipation of coming retirements. By thoughtfully managing this unusual time period, we will lessen the risk of having unmet demands down the road, after we have isolated a generation of the nation's best and brightest in a postdoctoral holding pattern.

For these reasons, we believe the United States is in desperate need of a national strategy that will place science and technology at the top of the list of priorities. The recently passed American COMPETES Act of 2007 addresses some of these issues, including keeping the National Science Foundation (NSF) on a path to double its budget over 10 years; increasing NSF programs to enhance undergraduate education for science and engineering; and expanding early-career grant programs to support young investigators at NSF. But the act only authorizes the funding; it does not guarantee that money will be appropriated each year. Furthermore, it does not address research covered at NIH, which has experienced flat or declining budgets for the past five years. We believe that the NIH budget should be placed on a similar growth curve. Steady growth proves to be far superior to rapid doubling followed by flat funding.

As we approach the presidential election in 2008, we believe that all candidates should be asked the question, "What are your plans to increase funding for research and education in science, mathematics and engineering at all levels?" If this matter is as important as we have suggested, then our next president needs to have thought about this question and have a very good answer.

On October 13, 2007, the Baker Institute Science and Technology Policy Program co-sponsored a symposium with The Academy of Medicine, Engineering and Science of Texas (TAMEST) to address the need for improving science and math education. The event, "Improving Science and Math Education: Texas Confronts the Gathering Storm," was part of a larger TAMEST project, which will review K-12 education in Texas and make recommendations for improvements. The aim is to highlight the success and failures in Texas and find ways to improve science and math education, thereby improving the economic success of the state.

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The Science and Technology Policy Program at the Baker Institute will continue to focus on policy matters that are critical to the future leadership of the United States in all aspects of science, engineering and technology. We invite your interest and participation.