POLICYBRIEF

STRENGTHENING AMERICA: INVENTING THE FUTURE

Kent Hughes

SUMMARY

The U.S. innovation system has enormous strengths, including public and private support for research and development, the world's best university system, and an entrepreneurial risk-taking culture. But those elements of the system now face several domestic and international challenges. In the United States, cuts in federal spending could reduce support for university research. The kindergarten through 12th grade (K–12) education system struggles to keep pace with the rising demands of the 21st-century workplace. Internationally, the United States now faces competition to attract or keep advanced manufacturing firms, research facilities, and top scientific talent. The United States will need to maintain support for research and development (R&D), improve its education system, and learn from best practices around the world.

CURRENT STRENGTHS

The U.S. innovation system is still the envy of the world. U.S. scientists are at the forefront in a host of fields, including the newer fields of nanotechnology and synthetic biology. Not only do U.S. scientists generally lead in most fields in terms of scientific papers, but those papers are generally the ones most cited by other scientists. Moreover, the nation is ahead in terms of the sheer number of patents developed by U.S. inventors.

American universities continue to attract outstanding students and scholars from around the world. In physics, chemistry, computer science, and the other physical sciences, international students often account for 50 percent of the graduates in doctoral programs.

The United States continues to invest heavily in R&D, with investments amounting to $436 billion, about 32 percent of the world total, in 2011. Private sector spending accounts for roughly two-thirds of total investment in R&D, with the federal government providing the rest.

DOMESTIC CHALLENGES

The U.S. K–12 system continues to lag the performance of other advanced industrial countries. According to the Programme of International Student Assessment, U.S. 15-year-

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olds rank 17th in science and 25th in mathematics. One-fourth of high school students fail to graduate, and many of those who do graduate are not well prepared. As a result, community colleges are struggling with large numbers of students requiring remedial education.

Furthermore, the fiscal challenge facing the country is expected to force a reduction in domestic spending, perhaps at the expense of scientific and technological research.

INTERNATIONAL COMPETITION

International competitors have seen the success of the U.S. innovation system and are working to match it. The advanced industrial countries are putting more of their investment dollars into scientific research. They have seen American success in attracting international talent and are now competing with America for top students and researchers. Individual countries have been successful in helping to speed up the process of moving inventions from the laboratory into the marketplace.

The same is true of tax codes. The United States was the first country to introduce tax credits for research and experimentation, but it now lags more than 20 countries in terms of the actual support it provides. Worse, rather than being a permanent feature of the tax code, which would make it the kind of incentive that would support longer-term research, the U.S. credit is renewed annually, often after periods during which it has lapsed altogether.

Venture capital remains a largely American innovation. But other countries are trying to attract U.S. venture firms and to develop institutions that would substitute for the risk taking that has characterized venture capital funds in the past. As investment bankers have become a larger force in the venture capital world, venture funds have reduced their taste for risk and shortened the time they are willing to wait for a financial return.

Other industrial countries are also moving ahead of the United States in terms of educational performance. European and East Asian countries have the best performance among 15-year-olds. A number of countries are now moving ahead of the United States in terms of degrees from four-year colleges.

Emerging-market countries are also working to become major competitors in the scientific world. For example, China now ranks second in individual country spending on R&D and is steadily increasing the share of its gross domestic product devoted to scientific research.

STRENGTHENING U.S. INNOVATION

Government Investment in Science

Even in a period of deficit reduction, there is still a broad consensus that investments in infrastructure, science, technology, education, and training can contribute to more rapid productivity growth. If growth plus fiscal balance are the goals, then lawmakers will have to carefully weigh any proposed cuts in funding for science and technology.

Presidents George W. Bush and Barack Obama have favored a doubling of funding for the National Science Foundation, the National Institute of Standards and Technology, and the Department of Energy's Office of Science.

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However, fiscal restraint has already extended the period over which that funding will take place. Steady increases in funding are needed to foster a predictable expansion of research, researchers, and research facilities.

In particular, funding for younger researchers has been limited, with scientists often not receiving grants until they are well into their 30s. Redirecting some funding to younger researchers will help keep them in the laboratory, and in some fields, very good work is done in a researcher's early years.

Government Leadership

The U.S. innovation system depends on many parts working together, including laboratories that do basic and applied research; manufacturing facilities; a strong education system; advanced services (design, supply-chain management, and marketing); appropriate regulations; and adequate financing. A periodic presidential address on the state of the U.S. innovation system in a global context would focus public and private attention on its strengths and weaknesses.

Research depends on both private and public funding. The entrepreneurial startups that contribute so much to future growth look for funding from savings, home equity loans, credit cards, and family and friends. The role of venture capital is important but was never the sole or main source of support. Advocates for innovation point to possible roles for government grants, changes in the tax code, and regulatory reform.

The federal government already provides some support for startups through the Small Business Innovation Research Program (SBIR) and the Small Business Administration. The SBIR requires agencies to set aside a percentage of their research budget to fund startups that are working on innovations that will serve the agencies' mission.

Establishment of an innovation foundation modeled on the National Science Foundation has supporters and skeptics. One school of thought says the independent institution would focus on fostering technology, including by supporting entrepreneurial startups. In part, the new foundation would provide steadier funding for startups and would act as a balance wheel when venture capital and other funds focus on one field at the expense of others. Skeptics question whether such a foundation could match the agility needed by the entrepreneurial economy. The other school of thought instead emphasizes a series of regulatory reforms and tax incentives that will support prospective entrepreneurs. The point the groups share is the belief that state and federal governments need to adopt policies that foster startups with an eye to future innovation.

Government's Role in Filling the Gaps

In the decades immediately following World War II, major U.S. companies had in-house laboratories that did basic as well as applied research. AT&T's Bell Labs was the archetype. Since the mid-1970s, growing domestic and international competition has led many companies to shift their funding to development and away from research.

That shift has, in turn, created what many call a *valley of death* between innovations in the laboratory and the companies that can turn them into wealth and job-generating commercial products. One response has been analysis that suggests that federal funding should support research through the pilot project stage, in which the research demonstrates the viability of an innovation or proof of concept.

Growing recognition of the links between laboratory innovations and manufacturing has identified a second valley of death in which small and medium manufacturers need research answers. Germany's Fraunhofer-Gesellschaft, the largest organization for applied research in Europe, has developed the Fraunhofer Institutes, which link manufacturers to applied research and university research. The Obama administration has proposed a National Network for Manufacturing Innovation to play a similar role.

As the U.S. innovation system has evolved during the nearly seven decades since World War II, it has set a standard that more countries are working to emulate. The government has also begun to focus on overseas successes as possible ways to strengthen the U.S. system. In the 1980s, spurred by the Japanese pace of moving from research to the commercial market, the U.S. government enacted a series of laws designed to bring private industry closer to the research in university and national laboratories. Recently, it has begun to focus on the success other systems have had in terms of education and training. In a fast-moving world, the government needs to set benchmarks for institutions and policies that are based on the best practices around the world.

Kent H. Hughes is director of the Program on America and the Global Economy. He can be reached at Kent.Hughes@wilsoncenter.org.

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www.wilsoncenter.org

Woodrow Wilson International Center for Scholars
One Woodrow Wilson Plaza
1300 Pennsylvania Avenue NW
Washington, DC 20004-3027

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