

Winning the Race for the Future

A National Science Board Policy Companion to the *Indicators Report Discovery: R&D Activity and Research Publications*

U.S. competitiveness and security hinge on:

- Funding bold, curiosity-driven basic research - the next, *next* big things - keeps America ahead in critical technologies.
- Growing domestic science, technology, engineering, and math (STEM) talent through direct support for the next generation of scientists, engineers, and technicians.



WHY IT MATTERS

- Basic research pays off.** Federal basic research dollars return 140-210%¹ to the economy, spark game-changing discoveries, and create a STEM ready workforce.
- China is closing in fast.** Without recent private sector research & development (R&D) growth, the People's Republic of China (PRC) would already outspend the U.S. in R&D.
- Industry can't do it alone.** Companies fund near-term R&D, but the most transformative breakthroughs need longer investments that fall outside their payback window.

The synergistic federal funding of fundamental research (Figure 1) and STEM talent seeds the discovery that unleashes innovation and capitalization in the U.S. business sector. The U.S. has long benefitted from this innovation engine and seen a dramatic rise in industry buy-in (Figure 2), and economic returns, as a result. In contrast, loss of federal funding for basic research limits discoveries, is linked with declines in productivity, and risks technological surprise and ceding new industries to competitor nations.

Economic risks to the U.S. grow with rising global competition in science and engineering (S&E). The PRC is growing its R&D investments faster than the U.S. is and is likely to outpace us in the near future (Figure 3).

PRC investments are bearing fruit. The PRC's share of the world's first open reports of promising discoveries is growing, as measured by an increased ability to perform highly cited research (Figure 4). Although these publications are not sufficient for economic benefit,

they indicate significant research accomplishment and are frequently accompanied by the ability to translate discoveries into economic benefit. Those closest to generation of new knowledge have an advantage in translating it into benefits, and as U.S. science and technology leadership slips, our nation risks ceding the economic growth and national security it brings. Early stage research matters – but how much it matters depends on how well it is funded, integrated, and applied. A future *Indicators* report, *Translation to Impact*, will highlight indicators of outputs and outcomes from R&D.

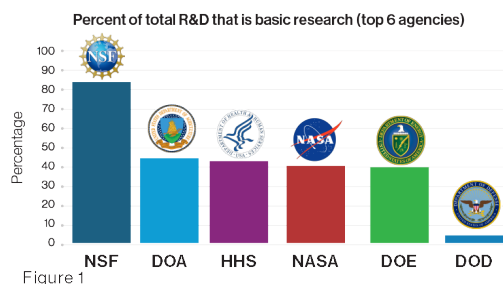


Figure 1

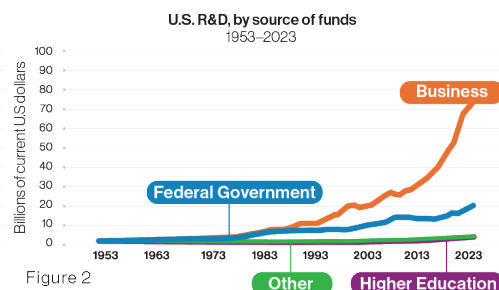


Figure 2

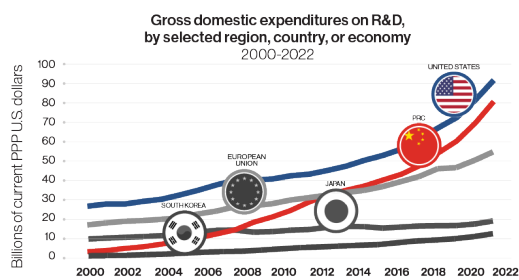


Figure 3

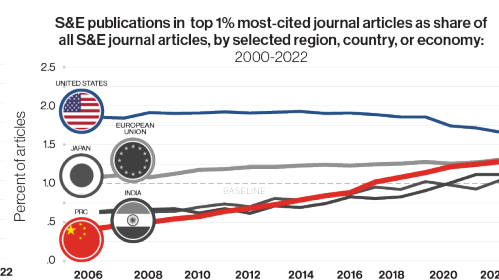


Figure 4

¹ The Returns to Government R&D: Evidence from U.S. Appropriations Shocks No. 2305 (Revised November 2024) Andrew J. Fieldhouse and Karel Mertens

National Security: Critical Technologies

FUNDAMENTAL RESEARCH

U.S. leadership in critical technologies - such as artificial intelligence (AI), quantum, and biotechnology - is a national priority. Because the most important discoveries often arise from unexpected avenues or in areas of low

interest to the private sector, strong and sustained federal funding of early stage research across all fields is necessary to achieve this goal. Federal investments in basic R&D underlying critical technologies are spread across agencies (Figure 5). The National Science Foundation (NSF) uniquely spans all S&E disciplines.

STEM WORKFORCE TRAINING

The U.S. would be unable to undertake world-leading discovery research without the human capital to advance scientific frontiers. Federal funding develops STEM talent across at all levels, from skilled technical workers to PhDs, and NSF plays an outsize role (Figure 6). Investments are particularly urgent in fields underlying critical technologies, both for U.S. leadership and because the U.S. is currently highly dependent upon foreign-born talent in these fields. A future *Indicators* report on *STEM Talent* will cover this topic.

Federal investments also train the workforce for AI and quantum-related industries – people who will make future discoveries and staff startups and industries as they deliver and field technologies. For graduate students supported by Federal funds, NSF, DoD, NIH, and DOE are leading funders.

S&T
is the new global
currency of power



Today, industry plays a large and growing role in funding and performing research. This shift has the potential to pay dividends for the U.S. as businesses unlock new discoveries and capitalize on federally funded discoveries, developing products, services, and applications in a variety of settings, including defense. Now is the moment for reforms that make it easier for federal agencies and national laboratories to partner with industry to meet urgent national needs, speed the translation of research to benefit all Americans, build a robust domestic STEM workforce, and secure our national defense.

At the same time, industry R&D is concentrated in certain areas, often with a relatively short-term return on investment. The most revolutionary discoveries often lie outside the window of private sector investment. Federal funding of fundamental research is a uniquely valuable way to generate new knowledge in areas of highest priority:

- **Aligning with national priorities:** the Federal government invests for the nation and its people and is the only entity primarily focused on national goals. Industry must focus on its economic viability so is focused on profit and often driven to protect discoveries that are not or cannot be openly shared. Both motivations are essential and complementary to drive a healthy innovation ecosystem.
- **Leveraging the power of the science and engineering apprenticeship model at all degree levels:** federal funding enables the efficient synergy of fundamental research activities and STEM training/workforce development. People form the networks for discovery.
- **Discoveries on multiple time horizons:** federal investment can sustain the long-term exploration and innovation necessary for discoveries we cannot yet imagine and supports the discovery and translation of near-term breakthroughs that spin off into economic and security gains. It gives researchers the freedom to explore ideas that are too far in the future for industry investment.

By investing in discovery science and engineering, we sow the seeds of our country's future and develop STEM talent. U.S. economic competitiveness and national security depend on robust, wide-ranging fundamental research and the means to translate those discoveries into technologies and knowledge that has societal benefit.

America needs to rapidly accelerate its investment in critical and advanced technologies such as AI, quantum computing, and biotechnology. The U.S. must *also* stay at the cutting edge of discovery to lead the development and deployment of future technologies that we cannot imagine today.

Top Agencies for Basic R&D Funding Crucial for AI & QIS
Basic Research Funding by Field and Agency

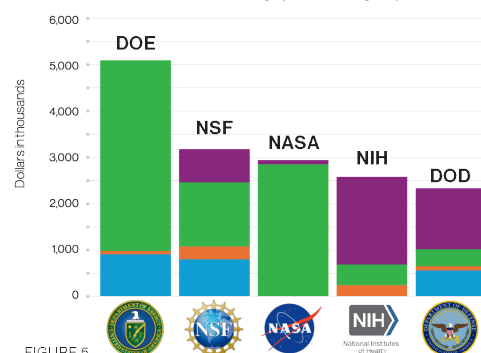


FIGURE 5

Computer and Information Sciences Mathematics and Statistics Physical Sciences Engineering

Top Agencies for Training AI & QIS Talent

Primary source of federal support for full-time graduate students

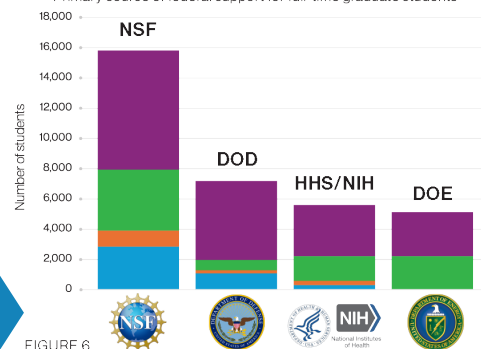


FIGURE 6

Computer and Information Sciences Mathematics and Statistics Physical Sciences Engineering