Testimony for the Record
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"Driving Innovation Through Federal Investments"

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Chairwoman Mikulski and Vice Chairman Shelby, thank you for the opportunity to submit testimony on this timely and vitally important subject.

I commend you for your efforts to restore "regular order" to the appropriations process. I know you have set an ambitious schedule to complete the FY 2015 appropriations bills. Please know how very much we appreciate your efforts to make the federal government work for all Americans.

The future of innovation in the United States is of course a complex question, with many dimensions. This testimony will focus on four dimensions in particular that touch the work of our universities: federal research funding, young scientists, translational activities and collaboration.

Johns Hopkins University was the nation's first research university, marrying education and research in a model that has been emulated around the world. We created modern medical education, with its synthesis of research, education and patient care, and we are the home of the first research-based school of public health. We have forged world class interdisciplinary programs in biomedical engineering, the brain sciences and cell engineering, to name only a few. And due to hard work of our faculty and staff, we are privileged to be the leading U.S. academic institution in competitive federal research and development spending, undertaking research from a wide range of federal agencies including the National Institutes of Health, the National Science Foundation, and the Department of Defense, to name only a few. These investments have led directly to groundbreaking discoveries in areas as far ranging as satellite navigation, cancer diagnosis and detection and genetic engineering.

For these reasons and more, we have a keen interest in the state of innovation in the United States, and we welcome the invitation to comment on this critical issue.

Investing in Research

Starting in the mid-20th century, the United States embarked on an ingenious experiment, one since credited with fueling the rise of our country as the world leader in science innovation. Vannevar Bush's book *Science: The Endless Frontier* had argued in 1945 for the essential role of federal support for basic research through the use of competitive grants to universities, as an investment in the commercial and military future of the nation. Over the next several decades, a host of federal agencies would harness the research talent at universities to drive the discoveries and innovations that supported decades of long-term economic growth. Universities and colleges are now the main performers of basic research in the United States, accounting for 55 percent of such research.

Even so, this relationship between the federal government and U.S. research universities has started to unravel. Sequestration slashed over five percent from domestic agencies such as NIH and NSF. Even

with the slight increases provided for FY 2014, the NIH has lost more than twenty percent of its purchasing power since 2003, leading to the elimination of about two thousand research projects each year. This has had a direct impact on Johns Hopkins and the work we do, in the form of shelved research, terminated jobs, and lost opportunities for educating and training the next generation of innovators. We estimated last year that the sequester would reduce our non-defense research efforts by more than $70 million dollars.

And of course, this impact is not confined to Johns Hopkins. According to two recent surveys, 81 percent of universities said sequestration had affected their research activities,[1] and 47 percent of scientists abandoned an area of planned investigation that they considered central to their laboratories' mission in response to the recent financial pressures.[2] The stakes of this divestment could not be higher. One study found that the federal investment in health research in 2010 alone produced $69.2 billion in new economy activity across the country.[3] Another analysis concluded that the Human Genome Project delivered $178 to the U.S. economy for every public dollar spent on the sequencing effort.[4] A study of 21 of the important drugs introduced from 1965 to 1992 showed that 16 were developed with input from the public sector[5]; a separate study showed that every dollar of increase in federal life sciences funding at universities leads to a 33 cent increase in private funding for such research.[6]

Simply put, the evidence shows that an investment in federal research funding provides an incomparable return for economy, our health and our global competitiveness.

Investing in the Next Generation

The United States' approach to research funding in recent years has placed unique pressures on young scientists in particular. For example: In 1980, 5.6 percent of all NIH research funding went to scientists 35 and younger. That number dropped to 1.3 percent in 2012. The average age at which a young scientist receives an R01, the signature NIH award and an important platform for independent research, has inched upwards from 38 in 1980 to 41 in 2011. The percent of principal investigators for R01s who were 36 years of age or younger has declined from 18 percent in 1983 to 3 percent in 2010. The number of awards that have gone to these investigators has slipped from 1,984 in 1980 to 1,135 today.

The potential impact on our young scientists is grave – without the funding to launch their own research in the United States, our young scientists are discouraged. They are turning elsewhere, pursuing positions outside of academic research, outside of the country, even outside of science entirely. According to one report, 80 percent of scientists see an increase in recent years in the number of graduate students and fellows seeking positions outside the academy, and 35 percent see an increase in young researchers seeking positions outside the United States. The ones who leave take with them the next generation of innovation – scholars observe that it is often the entering scientists that are most likely to shatter paradigms and divine a

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[1] Association of American Universities et al., Survey on Sequestration: Selected Results from Private and Public Research Universities (2013).
[2] Paul Basken and Paul Voosen, Strapped Scientists Abandon Research and Students, The Chronicle of Higher Education, Feb. 24, 2014.
[3] United for Medical Research, An Economic Engine: NIH Research, Employment, and the Future of the Medical Innovation Sector (2011)
[4] Batelle Technology Partnership Practice, The Impact of Genomics on the U.S. Economy (2013).
[5] Cockburn & Henderson, *Public-Private Interaction and the Productivity of Pharmaceutical Research*, National Bureau of Economic Research Working Paper 6018 (1997).
[6] Blume-Kohout et al., *Federal Life Sciences Funding and University R&D*, National Bureau of Economic Research Working Paper 15146 (2009).

new trailblazing approach that revolutionizes a field. And the ones who stay report that they are chilled into offering more conservative proposals in an effort to attract an ever shrinking pool of funding.

The reasons for these trends are complicated, but there can be no doubt that the lack of federal investment is one central variable. The NIH has launched new initiatives to provide mechanisms tailored to entering scientists. But even as outside reports continue to call for significant increases in these awards, NIH to date has only been able to fund many of these programs in an amount that numbers in the dozens each year. Congress should explore additional investments in these targeted programs, as well as other mechanisms to support our next generation of scientists. For example, Canada provides funding for more than 900 faculty chairs for exceptional young and emerging researchers who are believed to have the potential to be leaders in their field. Unless we act, we are placing at risk an entire generation of scientists – and indeed an entire generation of science.

Investing in Translation

There is a rising tide of concern about a national deficit in support of the translation of discoveries into marketable technologies. One recent report from the National Research Council underscored that "[m]arket inefficiencies and a long term shift away from seed stage investments have created a substantial gap between the demand by entrepreneurs for seed and early-stage funding and the supply in the risk capital market."[7] Another report highlighted the widening financing gap between basic research and clinical development of therapeutics, observing that "[t]raditional investors in translational research . . . are becoming increasingly risk adverse."[8] These reports and others have underscored the ways in which the federal government and universities can partner in filling this innovation void.[9]

Our nation's research universities have mobilized to this cause. Johns Hopkins, for example, has launched a technology accelerator called FastForward to catalyze the advancement and commercialization of Johns Hopkins innovations, invested in a university social innovation laboratory, and partnered with a number of stakeholders to bring DreamIt Ventures, a health care information technologies accelerator to Baltimore. A 2013 report of the U.S. Chamber of Commerce highlighted how more than ever, universities across the country are investing in faculty and student innovation and entrepreneurship, bolstering university technology transfer operations, facilitating university-industry collaboration, and engaging with regional and local development efforts.[10] These efforts are paying dividends: Each year, universities are yielding more start ups, issued patents and invention disclosures that embody the innovation of tomorrow.

The federal government has a central role to play in driving innovation in this area as well. A letter signed by myself and more than 140 other university presidents set out a range of potential reforms, including the creation of new research award programs that focus on commercialization, the introduction of tax credits to encourage stakeholders to leverage university technologies, and the promotion of DARPA-hybrid models of collaboration between small firms and universities.[11] There is an opportunity for the federal government

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[7] National Research Council, Rising to the Challenge: U.S. Innovation Policy for the Global Economy (2012).
[8] Milken Institute, Fixes in Financing: Financial Innovations for Translational Research (2012).
[9] *See also, e.g.,* National Research Council, Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security (2012).
[10] U.S. Department of Commerce, The Innovative and Entrepreneurial University: Higher Education, Innovation & Entrepreneurship in Focus (2013).
[11] National Advisory Council on Innovation and Entrepreneurship, Letter to Secretary Locke: Recommendations to Facilitate University-Based Technology Commercialization (2011).

to partner in earnest with research universities and private industry in sparking a blaze of innovation through knowledge transfer. Several decades ago, the U.S. Congress enacted the Bayh-Dole Act to clarify the ownership of intellectual property in federally sponsored research. The law was a master stroke – the Economist called the legislation "[p]ossibly the most inspired piece of legislation to be enacted in America over the past half-century", one that unleashed a "flowering of innovation unlike anything seen before."[12] The time has come for a similar master stroke of congressional commitment, one that builds on that Act by investing in the efforts of universities to serve as an engine for translation and entrepreneurship.

Investing in Collaboration

The future of innovation will lie at the crossroads of ideas, with the creative collaborations that occur at the intersections of areas of expertise. At Johns Hopkins, we have committed ourselves to investing in collaboration. We have placed at the centerpiece of our current fundraising campaign an ambitious set of cross-disciplinary initiatives to address the major problems of tomorrow that cannot be solved in one field alone – in areas ranging from individualized health to the science of learning to the future of our cities. And we have launched the Bloomberg Distinguished Professors, a cohort of fifty multi-disciplinary professors who will serve as bridges across the university, straddling more than one discipline or field of study, even as they still teach undergraduates.

As we anticipate the innovations of tomorrow, it falls to all stakeholders to be attentive to how we can promote collaboration across traditional boundaries. The U.S. government has made important strides in this area in recent years, including through the National Network for Manufacturing Innovation, the creation and investments in the Common Fund at the NIH, and the recent $230 million Accelerating Medicines Partnership among the NIH, ten biopharmaceutical companies and a number of non-profit organizations. The U.S. Congress can play a critical role in funding and incentivizing new forms of collaborative initiatives in the coming years, within federal agencies, across such agencies, and among the U.S. government and non-profit and private stakeholders. The permeability of silos will be the key to the future of innovation, a future where discovery moves more nimbly across disciplines, agencies, and sectors.

Conclusion

Now is the time for the federal government to recommit to innovation by robustly funding science today, tomorrow and always. Renewed investment along each of the dimensions identified above, as well as predictable, sustainable funding paths, will give all our scientists the confidence they need to pose bold questions and seek the answers we all need.

[12] *Innovation's Golden Goose*, The Economist, Dec. 12, 2002.