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to

Senator Elizabeth Warren and Congressman Elijah Cummings

on

Building the Economy of the Future:  Why Federal Investments in Science and Innovation Matter

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Good afternoon. Thank you for the opportunity to be with you today to share my experience with federal investment in research and innovation. My name is Dr. Carol Espy-Wilson and I am a Professor of electrical engineering at the University of Maryland. I have been able to sustain a research program for almost 25 years now with support from the National Science Foundation and the National Institutes of Health. I am in the process of commercializing technology that originated from this research program and that effort too has been funded through Small Business Innovative Research grants from the National Science Foundation and a Small Business Technology Transfer Research grant from the National Institutes of Health.

I think it would be informative for this hearing to start by describing the typical academic career track for someone who has earned a PhD in science or engineering. After completion of the PhD, some graduates will opt to do a postdoc for a year or more while others will go right into an assistant professorship position. After 5 years as an assistant professor, if you are promoted and tenured, you become an associate professor. Finally, after typically another 5 years, you may apply to become a full professor.

If you are at a major research university, a significant part of your time as a professor is spent conducting research which typically includes the training of graduate students as independent researchers, possibly some training of undergraduates (which is important for building a pipeline of students who are excited about research and ready for graduate school, especially in STEM fields), and collaborations with colleagues inside and outside of your university to address problems that may span several disciplines. (Note that at many major research universities, there is often a parallel research track for people who only do research. They can typically get more research done in the same period of time as someone who is also teaching. However, they don’t have the same degree of interaction with undergraduates to foster the excitement and passion for research.)

The combination of research and teaching is very important. Professors who do research are able to share their research in the classroom to help students understand how the subject matter can be applied to do analysis or solve useful problems, and to potentially motivate undergraduate and graduate students to explore research opportunities. Conducting basic research helps us to build our understanding of all sorts of matters, helps us to solve significant problems, develop useful technologies that can be transformative and all the while helps us to train the next generation of scientists and engineers. The funding of basic research should be of highest priority.Basic research, which provides the foundation for advances that will benefit our children and grandchildren, is supported almost exclusively by the federal government. Both basic and applied research are valuable, but there are alternative sources of support for applied research.Without basic research, there is no applied research, and no innovation. Federal cutbacks in research funding is undermining the American economy:

* Excellent and innovative research is not being funded. For example, at NIH, the funding percentile for scored proposals in some institutes is as low as 9%, and I want to highlight that I am referring to scored proposals - Only about half of the proposals received at NIH are even scored. Back in 2001, the funding percentiles were around 29%. This reduction in the number of proposals that are funded has had a significant negative impact on the morale of investigators, on the training of students and the degree to which fundamental research gets done.
* Young scientists and engineers are making other career choices. These are the very people we should encourage the most to do research because they are the next generation of drivers of innovation.  For some, particularly computer scientists and engineers, they can find interesting industry jobs. However, many of our young scientists are headed into underemployment. This is especially true for young scientists who don’t have the option to go back to their country of origin if they don’t get funded, and to students who come from families that can’t afford to support them through a period of lean research funding.
* Program officers are cutting budgets significantly because they are trying to spread the wealth, but that causes considerable disruption in the research programs and training of students. One area investigators are forced to cut back first is funding for travel because getting the research done is the most important priority. However, students need to be funded to attend conferences if they are going to have good prospects for the job market.
* Cutbacks in funding also have the effect of making agencies more conservative in the research they will support. As a result, there are no incentives, encouragement and financial support for faculty, post-docs and students toward “out of the box” and “creative” ways of thinking. In real terms, while government-supported research is shrinking here in the US, it is growing in most of Europe and Asia.This trend begs the question of where will the big breakthroughs and discoveries made in the future?
* Finally, I am sure you are aware of the existing problem of too few US students going into STEM fields. I fear that federal cutbacks will only make this problem worse. I feel confident in saying that in most major research universities, it is already the case that our graduate student population, particularly at the PhD level, has far more foreign students than Americans. We need to look for ways to turn this deficit around.

Investments in research and education have a huge return, but only over a long time span.  These are investments we make not necessarily for ourselves in the short term, but for our children and grandchildren.  It’s sometimes not easy to think that far ahead, but it is imperative that we do so.

Now I would like to address the translation of research from the lab to a startup for commercialization. The research that is being translated at my company OmniSpeech was supported by multiple NSF and NIH grants as part of my research program at the University of Maryland. I did not conduct this research initially with an eye toward commercialization. After disclosing the invention of our algorithm to the office of Technology Commercialization at UMD for patenting purposes, I was invited to give a brief talk and demo at a Research Review Day organized by my department. Afterwards many faculty and people from industry encouraged me to do something with the technology. That began my foray into entrepreneurship. In addition to the fact that the University of Maryland at College Park has a very active entrepreneurship incubation program, it was of the utmost importance to me that the Small Business Innovation Research and Small Business Technology Transfer programs existed. For OmniSpeech, the NSF SBIR grant was the critical catalyst for beginning the effort to transform original research code into a commercially viable solution. It enabled me to hire our first DSP engineers and reach out to prospective partners for evaluation. Moreover, as a tiny startup it was critical for establishing credibility. Finally, the promise of additional matching funds was pivotal in securing third party angel investment that allowed us to further expand the team as we prepared for commercialization.

The government must continue to provide incentives to spur innovation and support the development of new technologies as these efforts in turn lead to expanded employment, the growth of the middle class and improvements to our quality of life. Professors who are also entrepreneurs can teach students about how research and startup companies fit into the business world. This training will make students more valuable contributors to the companies they join and to the economy in general. Research and SBIR grants to professors effectively multiply the workforce supply of trained scientists and engineers ready to preserve the US’s position as the world’s leading innovation economy.

Fortunately, the SBIR and STTR Programs are doing well. NSF has raised the funding amount for the Phase II award from $500,000 to $750,000. That is significant and will help startups considerably especially since commercializing technology can take a lot of effort, resources and time. In my case, given I did not have a company in mind when I started to conduct the research that led to the founding of OmniSpeech, we had to take code that was computationally very expensive and optimize it so that it runs many times faster than real time and can fit on a DSP chip. The other factor that can affect how quickly technology can be commercialized is understanding what the market requires. In my case, while the technology was being developed as part of my research program, we used simulated data. It wasn’t until I started OmniSpeech and started talking to potential strategic partners and customers that I learned the extent to which real-life scenarios could differ from our simulations. That discovery led to further performance optimizations in our code. Today, the technology we have developed, while still based on the original concepts, looks really different from where we started, and it took us considerably more time than we had imagined at the outset. So, again, the funding needs to be significant enough to allow entrepreneurs enough runway to develop their technology before they have to raise angel investment and/or VC funding.

I also want to add the NSF has developed the I-Corps program. The primary goal of this program is to foster entrepreneurship, i.e., preparing engineers and scientists to extend their focus beyond the laboratory in the commercialization of technology that has been supported previously by NSF-funded research. This program came on board too late for me to take advantage of it. However, several of my colleagues at the University of Maryland have or are currently participated in this program and felt it was very beneficial to them. They have all started companies. I don’t think the growth I am seeing in professors willing to take this step would be as large, and I know of several more who are contemplating this move. So, I think this program too is very successful and it shows great commitment from the federal government to foster entrepreneurship. We just have to keep in mind that without basic research, we would not have applied research that develops into technologies that can be commercialized.