

Science in America

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I was on the elevator a few weeks ago when a postdoc from another department asked me if I'd heard about the new proposed budget cuts at NIH. This is an additional reduction proposed after the sequester, which had already went into effect. I had heard about the new cuts several weeks ago and had written my congressman and senator asking that they not support further reduction in NIH funding. I received a form letter response from the senator, which detailed how he had supported bio-medical research in the past. So many people today have no idea how research takes places in the United States, who funds it, and what the drastic budget cuts will mean for our economic growth, productivity and our ability to be innovative and competitive in the world economy.

I read a lot of articles predicting the profound negative impact that sequestration will have on our nation's investment in scientific innovation and how this will drastically impact our future economy. The thing that struck me in all the articles that was missing was the personal impact and how this will negatively affect everyone. So imagine you are just graduating with a Ph.D. in some area of science in the US. This means that you have spent four years in college and on average an additional 5 years in graduate school, according to an American Chemical Society study. You have a substantial debt from your undergraduate education and a dream of becoming an academic scientist, those few scientists employed at universities and colleges. If you graduated in 2011, a National Science Foundation survey recently showed that 34% of soon to be Ph.D.'s did not have a job or postdoctoral fellowship arranged for after graduation. About 53% of graduate students intended to become professors. In order to achieve this goal additional training is required in the form of a postdoctoral fellowship, which can last three or more years. Since the NIH budget has been stagnant for the last decade relative to inflation, an additional postdoc might be needed prior to finding a position. A recent report in the Economist showed that between 2005 and 2009 that America produced more than 100,000 doctoral degrees however only 16,000 new professorships were available. So what happens to these highly trained individuals who can't find a position? Industry? Teaching? Consulting? Wal-Mart? There is nothing wrong with a career in retail however 11 years of post graduate education would make one over qualified for this option.

According to NIH, 26% of biomedical science Ph.D. recipients in 2012 obtained tenure track positions, down from 34% in 1997. Say you are one of the lucky few, what is the chance that you will be able to get funded and possibly tenured? According to a 2011 National Center for Science and Engineering Statistics survey, the government funds 60% of research in the US, spending less than 1% of its budget on research (~30.9 billion). Incidentally, ~50% of the US budget goes towards the military. Eighty percent of the research budget goes towards grants, with ~50,000 grants awarded to 300,000 investigators at 2,500 universities, medical centers and other research institutions. This seems like a lot until you take into account that grants are typically awarded for 5 years. This means that on any given year only 20% of funds are not committed. About 50% of grants are renewed so only 10% of the budget is actually available for new applications. The sequester resulted in a ~5% NIH budget cut in 2013 totaling about 1.5 billion reduction, meaning that 700 fewer grants were awarded. An additional house

appropriations committee proposal would cut health, health research and other discretionary programs 8 percent in fiscal year 2014. This leaves only 2% of NIH's budget available to fund new grants. Keep in mind that between 2011 and 2012 China and India increased research spending by 20%, South Korea and Brazil by 10%, and Germany by 9%. In contrast, the United States decreased 5%. So what are the chances of the newly appointed faculty member getting a grant? The pay line at NIH/NIDDK in 2013 was between 7 and 10%. That means between 90 and 93% of submitted grants will not be funded. So what happens to these individuals who can't get funding? They lose their positions and have to start over elsewhere, if they can find another appointment, or have to look for an alternative career.

Are things any better for the mid-life scientist, those that started their career when the pay line at NIH was above 20%? These are hard working individuals who have devoted 20 years of their lives to education and research, have been funded continuously throughout their careers and have technicians, postdocs and students that depend on them for support. The answer is no. They are subject to the same 7-10% pay line at NIH/NIDDK and if they are unfortunate enough to lose their funding when going up for tenure, they lose their position and have to start over elsewhere or look for an alternative career. The technicians and postdocs who work in their labs and administrative support staff also lose their jobs in a trickledown effect.

How about the full professors who have been faculty since many of us were children and still have active research programs? Many start having difficulty getting funding and can see the writing on the wall and retire. Others since they are tenured cannot be fired but are increasingly forced into a more administrative role until they lose their lab space and retire. Still others are able to somehow against the odds bring in major grants but are forced to retire anyway by the universities that employee them. If you haven't figured it out by now, there is something wrong with this system. How many professions require employees to pay 60-80% of their salary through grants?

So what does all this mean for the economy and the average person? Scientific innovation drives the economy. As my Dad is fond of telling me, the US needs another space race to drive new technologies. My answer is always that there are enough creative people struggling to do research and if there were more funding, technological advances would occur without the need for that type of incentive. This idea is supported by the statistic that every \$1 of NIH funding generates \$2.20

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in economic growth. Basic research is the foundation for commercial application, novel drug development and improved quality of life, with scientists finding cures and improving management of diseases. Unfortunately most research requires continuous support to take an idea from the bench to the clinic. With the lack of resources being allocated to research, projects that have been funded for years and that have a good chance to impact quality of life, are being left on the bench. So as baby boomers age and require medical treatments, the reality is that novel cures and life improving technologies may not be there due to lack of research dollars now. Probably the most devastating impact of reduced research spending is that a generation of talented scientists will

switch careers or move to other countries where scientific investment is still a priority.

I was recently discussing the sequestration effects with a colleague, when he commented about scientists today that “rarely have such smart people worked so hard for so little return”. To me this was the perfect summation of science in America today. So my question for congress and the president, why are they pushing so hard to get children interested in science and technology when there are so little job opportunities? A little investment now (more than 1%), could go a long way towards improving the lives of the American people in the future.