LETTERS

University Research Funding: More than Supporting the Best to Do the Best

Howard Birnbaum argues that research funding needs reform at both the university and funding-agency levels (PHYSICS TODAY, March 2002, page 49). He suggests rather strongly that the decline in dollar amount (in constant dollars) of a typical academic research award is due to the diluting effects of such things as multi-investigator awards and the requirement that research proposals incorporate outreach programs.

I offer an alternative explanation of the same data: What has led to this decrease in funding is not new attitudes, new programs, and new requirements, but rather a great mismatch between the methods used in the recent past to secure congressional funding and those required today. In fact, the reform that Birnbaum is suggesting is exactly what the new programs and requirements are all about, and the attitude he exemplifies in his article is exactly the reason that funding for research at universities has been decreasing.

Although I agree that research at universities is funded to educate, create new knowledge, and provide service, I disagree on how best to accomplish these goals. How will the US produce the researcher pool needed now and in the future? How can we best nurture and harvest creative ideas and talent? How do we maintain our country's strong contribution to science and a robust economy? And very important, and perhaps more to his point, how do we ensure that we will have the dollars to make these goals possible? In answer to these questions, reform is now taking place via the very programs questioned in his article.

Over the past 40 years, the US culture has changed significantly. It no longer supports national goals based on authoritative arguments without compelling logic or decisive evidence. As a result, to say that research at universities needs to be supported because exploration is what we humans do or because it is the approach that has previously delivered so many good things, though still true, is no longer sufficient. We are now compelled to educate and convince our entire population of the crucial role that research at universities will play in the continued prosperity and defense of our way of life. It is, therefore, simply good strategy to engage every state in this endeavor. Both funding agencies and university administrators recognize the need and have adopted an attitude to develop and support experimental programs accordingly.

For example, to provide our nation with the needed labor pool in science and engineering, funding agencies have begun to reach out to at-risk youths and provide opportunities for talented individuals to choose and pursue careers in science and engineering. In the long run, this approach will build a stronger national infrastructure and a more competitive nation than would be true with an approach that supports the best to do the best. Funding agency outreach programs, like all experiments, must be critically evaluated. However, a crucial part of the evaluation of NSF outreach programs is the independent assessment that the research team must provide to reviewers. As a panel reviewer, I have seen proposals rejected due to an inadequate assessment plan or poor track record based on assessment of previous work. Although it has taken some time, accountability for outreach is now firmly built into the peer review system.

Of course, as Birnbaum says, all of this effort takes valuable time away from research. However, we have an obligation to find a research approach that will produce the talented labor pool needed by our country and will uncover new knowledge to fill our spirit, drive our economy, and improve our quality of life. The approach that is now taking shape requires that we engage talented science students and that we educate our nation on the value of research as a means to attain a higher quality of life. Although outreach and education will continue to take time away from research, all scientists must play a role and not expect others to do the job. I hold that science outreach and education programs can better engage all talented individuals while developing a public appreciation of the importance of research when they are led by each of us. I believe that this effort will lead to a more skilled, diverse workforce that will, in turn, generate and contribute the knowledge needed to meet the challenges ahead and win greater public and congressional support for university research.

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According to Howard Birnbaum, the " 'margarine method' of spreading research funds equally thin among all possible recipients is a waste of resources."

Quite the contrary. Despite the insulting sound, "margarine funding" is the best way to encourage serendipity, creativity, and originality in research. All university professors are expected to be efficient teachers and researchers. The highly competitive system of faculty appointments assures that, with rare exceptions, all university professors have the ability and training for both of those roles. Although equal grants for all are indeed impractical, there are viable and fiscally responsible alternatives to the present all-or-nothing funding model.

If we keep in mind the known rule of economics that the first dollars are the most cost-efficient, the funding model under which all active university researchers receive a

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small default grant, say, $3000 to $5000 per year (but could apply for higher amounts on a competitive basis, if they wish), makes much more sense, both economically and socially, than the "winner takes all" selectivity model. The award of such a minimal grant should be based only on evidence of ongoing productivity—for example, one or two peer-reviewed papers each year. No proposal writing should be required for these default grants, apart from perhaps a one-page summary that should not require a separate peer review if copies of the applicant's peer-reviewed papers are attached. More details and an extensive bibliography can be found in reference 1.

Reference

1. A. A. Berezin, *Interdisciplinary Sci. Rev.* **26**(2), 97 (2001).

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I would like to offer two components that I think Howard Birnbaum underemphasizes in his accurate and useful discussion of problems that have developed with university research funding. These are my personal observations, distilled from decades of trying to play the game.

The first concerns peer review of proposals, which many of us, forgetting that peer review can be no better than the peers, are loath to disparage. In my 40-plus years of experience, the process has changed almost beyond recognition. I remember when peer reviewing was essentially free of self-interest on the reviewer's part: A proposal showed up in the mail, often submitted not in response to some "announced opportunity" stating that research funds were available, but because an individual investigator had an idea he or she wanted to pursue—and one reviewed it in that light, then sent it back.

Today, the process seems anything but individual or disinterested. The peers have a level of awareness of each other and networks of connection and organization that surpass anything imaginable in the 1960s. Potential research collaborators formally combine with a deliberate effort to add so many prestigious names to a proposal that a junior reviewer would have to be very brave to do anything but approve it. The proposers are well aware that they will be among each other's reviewers and that personalities will matter.

The peer review process is enhanced by agencies that advocate "critical mass" and "adequacy of facilities" as necessary criteria for a proposal's viability. The funding needs for some research groups are so large and so continuous that every announced opportunity is followed up with a proposal, whether or not any prior interest or expertise in the specific area was present in the group. Groups propose first and ask questions afterward, often on a very short time scale; many are still looking for new collaborators a week or two before the proposal is due.

Formal but minimal commitments, in terms of time allotted, may be spread over many proposals for a single prominent investigator. Principal investigators will often appear on different multi-institutional proposals in competition for the same funding. That type of competition could only be altered by a new and uniform set of civil-service rules and procedures that the present generation of agency managers would not know how to enforce. Rules for dealing with, regulating, and avoiding conflict of interest within government agencies have been historically rather scrupulously enforced; but application of conflict-of-interest regulations in nongovernmental applications for agency programs seems often to be essentially nonexistent or unenforceable. (And if the agencies tried to implement such regulations, they would be said to be behaving "bureaucratically.")

My other topic is the use of now indispensable graduate student labor in university research programs, usually programs supported by federal grants. There is no cheaper source of high-quality labor, and it frequently comes with a level of motivation not available at any price. Graduate students are intensely interested in the research and would like to pursue it after they finish their education. It is insufficient to tell them when they are applying to graduate degree programs that the buyer should beware and that opportunities to continue doing basic research may be in very short supply when they finish their PhDs. Such warnings only filter out the brightest American students, who are typically better attuned to the practical consequences of their educational choices and better able to choose from a wide range of possibilities—the students who should continue doing basic research in physics for the rest of their lives. The productivity of any research group is surely much greater if several graduate students are involved. The only mechanism I can imagine that would end this practice would be to give funding agencies the authority and competence to stop rewarding universities for the overproduction of PhDs in physics. It would not be an easy task, and the overall national research effort would go more slowly. But difficult problems sometimes do not have easy solutions.

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BIRNBAUM REPLIES: I had hoped that my article would open a discussion of this important factor in US science. After that article was published, I received communications from many individuals; most agreed with the points I made but were not anxious to go public with their views. I appreciate these three writers' willingness to engage in such a discussion.

Gregory Salamo's letter focuses on the role and effect of outreach programs in the funding of science. He argues that it is the scientists' responsibility to involve all parts of our society in the understanding and excitement of science and to extend to underrepresented segments of society opportunities to engage in science and engineering. This statement, with its aspects of "motherhood and apple pie," is one I fully agree with. The issue is how this involvement is done and whether the programs are effective. Such programs as EPSCOR have existed long enough to allow a careful determination of their effectiveness in extending science opportunities to researchers in states that have not received their share of federal funding. In the absence of such a determination, the suspicion, which I would hope is not correct, arises that this is one more entitlement program. I cannot agree with Salamo that such a program can be justified on the basis that "it is, therefore, simply good strategy to engage every state in this endeavor."

Certainly the responsibility for communicating the importance and excitement of science and engineering to young students, our political structure, and other segments of society rests on all who are engaged in teaching and research. Outreach efforts require both time and funds.