

What Will Determine the Future of Research?

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Thank you very much for inviting me to join you today. I've been asked to speak about some of the factors that will affect the longer-term future of research, and I'm pleased that APLU is devoting time to that question. It's easy to get caught up in the crises of the moment. These crises will affect the future also, of course, but they're not the full story.

Overall, I'll be painting a "best of times, worst of times" kind of picture. While it imposes its wrath worldwide, COVID-19 – a global health catastrophe that is also imposing an enormous burden on academic institutions – has underscored the necessity of conducting research – something we literally can't live without. Science is the only way out of this mess.

I want to discuss three sets of concerns – and opportunities – that will have an impact on research: those that stem from federal policy, from societal attitudes, and from the conduct of science.

Let's start with federal policy. I don't need to identify for this group the biggest source of queasiness and instability; it's funding. But it's important to understand precisely why future funding is so hard to predict right now. The uncertainty has little to do with anything intrinsic to science. That's because the biggest factor affecting the amount of federal research spending has long been the total amount of overall federal civilian, discretionary spending. **(Chart 2)**

Almost all the year-to-year variation in federal science spending can be explained by looking at the ups and downs of the federal budget as a whole. In fact, the percentage of the federal discretionary budget that is spent on research hasn't wavered appreciably since the end of the Apollo program.

What that means is – absent any fundamental change in the political mindset – predicting science spending means predicting federal budget politics – and that's especially difficult right now. In the wake of COVID, will spending go up to recharge the economy, or will it go down to reduce the deficit? Indeed, will there be any clear pattern at all – at least until one political party or another is convinced it will hold the reins of power for a significant period of time? Your guess is as good as mine.

Under such circumstances, people in our positions just have to “plan for the worst; hope for the best” – not just for next year, but for many years to come. For those of us in the research enterprise that entails trying to diversify sources of funding. Within limits, diversifying has advantages beyond the merely financial. Working with industry, for example, can highlight research questions that academics might otherwise overlook, and that might result in more immediate practical benefits for society.

But the advantages can only get you so far because portfolios need to remain balanced. Industry as well as foundation funding increasingly comes with strings attached. Universities need to be sure that our research agendas are not becoming too narrow or short-term in an effort to meet the needs of partners who have shorter time horizons. And there can be practical problems with non-federal funds, as well, such as indirect cost reimbursement rates – which none of us has the luxury to ignore.

In short, the federal government is likely to remain the irreplaceable partner it’s been since World War II. So, what to do?

I mentioned a couple of minutes ago that science’s share of the federal budget will remain stable (or stagnant – depending on your point of view) absent a change in the political mindset. Is such a change conceivable?

Maybe.

Prompted by growing international competition that cannot be ignored, members of Congress on both sides of the aisle have been introducing legislation that would put research spending on a new trajectory. The most disruptive (in a positive sense) is the *Endless Frontier Act*, introduced in Senate by Minority Leader Chuck Schumer of New York and Republican Senator Todd Young of Indiana. It also has bipartisan sponsors in the House.

I won’t get into all the details, but the bill would authorize \$100 billion over five years for the National Science Foundation to establish a new Technology Directorate. That directorate would support *fundamental* research to advance 10 key technology focus areas that are critical to the future of the U.S. The focus areas include things like artificial intelligence and quantum computing. The directorate would have the option of operating like DARPA when that would advance its goals.

Some are understandably concerned that the bill would move NSF away from its longstanding mission of supporting curiosity-driven research but that’s

not the intent. In reality the bill is structured to keep the mission and operation of the existing NSF directorates intact.

This opportunity should spark some tough thinking in our own community. Transformative spending increases will not come to pass if they just provide more money for exactly the same things we are doing now, as worthy and rich the current funded portfolio is. How much change should we be willing to accept? It's not a simple question. It may not surprise you that some in academia had mixed feelings in 1945 when Vannevar Bush proposed an ongoing federal role in funding university research in his *Endless Frontier* report.

The X factor behind proposals to boost research spending is international competition – or to put it more bluntly, fear of China. As we all know, that fear is also generating a proliferation of proposals to limit the access of Chinese entities and students to the U.S. That fear and that defensive response are not likely to ebb anytime soon – fears are bipartisan, and the Chinese behavior – and the Chinese success – that feeds them are not going to diminish. The question is how academia will respond.

I think we need a balanced, two-pronged approach – not easy to manage at a time of political polarization and suspicion. On the one hand, academia does need to be more thoughtful about reviewing research agreements with Chinese entities – making sure they are truly mutually beneficial and reciprocal, evaluating their impacts on U.S. national and economic security, and on human rights. We also need to work with educators at all levels to do more to build the pipeline of STEM students who are U.S. citizens.

But at the same time, we need to make the case for why international research cooperation continues to be good for the U.S. and for the world – and especially why the U.S. should remain a magnet for the best students from around the globe. The development, attraction and inclusion of talent domestically and worldwide are key elements of the recently released National Science Board Vision 2030 report, two years in the making, which looked comprehensively via interviews with stakeholders country wide as to what it would take to keep U.S. science and technology at the forefront.

Political officials tend to focus on cutting off Chinese students because those students are visible and relatively easy to track, even though there's miniscule evidence that they're actually involved much in exfiltration or espionage – however those terms are defined. It's a little bit like the old line

about the drunk looking for his keys under the lamppost because that's where the light is – even though it's not where he dropped his keys.

We've had some success when we've made this argument in Congress – because the focus on students is often more reflexive than fully thought out. Broadly cutting off Chinese students would do little to solve any problem, but it would deprive the U.S. of a major source of productive scientists and engineers. And as noted in **Chart 3**, 83% of S&E Ph.D. students from China remain in the U.S. after they complete their studies. That number will drop noticeably only if we push it down.

In short, we in academia have to both get our house in order, and fight to save it. Those approaches ought to be seen as complementary moves – not as contradictory or as caving to outside demands. Let me add that one of the political benefits of the *Endless Frontier Act* is that it is leading a bipartisan group of China hawks to argue that universities are part of the solution to U.S. concerns about China, rather than accusing us of being a vulnerability.

I've spent a lot of time talking about federal policy, which does loom large – but as I noted at the outset, it's not the only area to consider in thinking about the future of research. I'll turn now to what I'm loosely calling societal concerns. I'm going to run through them briefly, not because they're unimportant – quite the contrary – but because they are hard to discuss in any depth at all without dwelling on them at length.

The first concern is one of the moment – COVID. The only point I want to make here is an unfortunate one: I don't think we can plan for a post-COVID era. We are going to be living *in* the COVID era for a long time, maybe indefinitely. Even if the optimistic estimates for a new vaccine pan out, we don't know how the virus will mutate over time, how often a vaccine would need to be reformulated, how wide of the mark a given year's vaccine might be.

I have no doubt that we will learn more about the virus, and that testing and therapeutics will advance, but I'm not willing to bet that we will get to a point anytime soon where planning for endemic COVID isn't a regular part of running a research enterprise. We all need to start adjusting to that. MIT began reopening its labs last week with appropriate COVID measures, and I can tell you, it's not an easy process. But even if we find a universal coronavirus vaccine that is accessible to all, we will never fully return to the pre-COVID state.

Next, as recent events that highlight systemic racism show, all of us, including the scientific community, have a great deal more to do to address diversity, equity and inclusion. We need to draw on the full talent pool. This is not just a matter of bringing more women and underrepresented minorities into scientific fields, though that is essential and too little progress has been made. It also means thinking about research questions that have been overlooked because they didn't connect to the interests of scientists from a narrower demographic. We're probably all aware of how research on women's health was long given short shrift; there are no doubt many fields like that.

Our community needs to concern ourselves about broad, societal attitudes toward research and toward universities. I know we all sometimes feel under siege these days, but surveys such as shown in **Chart 5** indicate that the public remains strongly supportive of science and scientists, at least in the abstract. But we can't take that for granted.

Views of academic science can be shaped by a wide variety of issues. For example, if the public continues to feel a greater skepticism toward elites, if it harbors doubts about the economic value and affordability of college, if it thinks academia is awash with left-wing biases, those notions will erode support for research. So far, other concerns about academia have not bled into research debates, but there's no natural barrier between those issues.

Finally, I want to underscore that we also need to keep an eye on the internal conduct of science. Are we policing academic integrity sufficiently? What can be done to address concerns about the replicability and reproducibility of research? Public trust is something you only get to lose once – and that trust is the ultimate basis of all our financial and political support.

I don't have time to discuss the specifics of scientific conduct here, but they will play a critical role in determining what the future of research will be.

Many decisions that will affect the future of research are in the hands of outside actors – the decisions will be made by government, industry, foundations, the general public – but all those sectors will be responding to our behavior. Do we produce the public good we promise? Are we credible? Are we exemplary members of a changing society? Is science doing its part to take humanity to a better place?

I'm afraid I'm leaving you with more questions than answers. But I hope I've at least prompted your own thoughts and questions. I look forward to an engaged question period now. Thank you.