RENEWING THE PARTNERSHIP

THOUGHTS ON THE CURRENT STATUS OF AMERICAN RESEARCH UNIVERSITIES:
A PRESENTATION TO THE NATIONAL ACADEMY'S BOARD
ON HIGHER EDUCATION AND WORK FORCE

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As the National Academies undertake the charge to "assess the organizational, intellectual, and financial capacity of public and private American research universities relative to research universities internationally," given by Senators Alexander and Mikulski and Congressmen Gordon and Hall, it is perhaps useful to begin with the document that has framed the partnership of the federal government and research universities since the end of the Second World War: Vannevar Bush's report, Science The Endless Frontier.[i] Bush's seminal report outlined the role for the federal government in the support of basic research to ensure the nation's health, security, and economic and industrial growth. He insisted that the major investment in research should be channeled through the nation's universities, where free, curiosity-driven research flourished and where the nation's scientific talent could be educated. The research capacity of our universities, he argued was essential to the future. He wrote:

> *Publicly and privately supported colleges and universities and the endowed research institutes must furnish both the new scientific knowledge and the trained research workers. These institutions are uniquely qualified by tradition and by their special characteristics to carry on basic research….It is chiefly in these institutions that scientists may work in an atmosphere which is relatively free from the adverse pressure of convention, prejudice, or commercial necessity….*
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> *To serve effectively as the centers of basic research, these institutions must be strong and healthy. They must attract our best scientists as teachers and investigators. They must offer research opportunities and sufficient compensation to enable them to compete with industry and government for the cream of scientific talent.*

[i] Science The Endless Frontier. A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945. (U.S. Government Printing Office, Washington: 1945)

Bush also added:

> *A nation which depends upon others for its basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill.*

The government-university partnership Bush outlined has served the country exceedingly well. In the decades after the Second World War, the federal government implemented the basic components of Bush's program, building new federal agencies and programs supporting university research and graduate education, all competitively funded based on merit-review procedures.

Over that same period, the states invested substantial resources of their own to expand student access to higher education, enhance university research capacity, and increase the quality of both the research and education programs of their public universities. Alumni and donors contributed generously to private universities, enlarging their research missions as well. The combination of strong, well-endowed private universities and large, comprehensive flagship public universities made American higher education the envy of the world in an era in which the vast expansion of knowledge became the basis for economic growth and national security.

Although America's universities remain among the very best in the world, much has changed since the nation implemented Bush's vision, and there is reason to worry about whether the nation's research universities can long sustain their position of worldwide leadership. It is difficult to assess the accuracy of the various comparative international rankings of universities, but it is certainly the case that the preeminent position of American universities has slipped over the last decade. State support for public flagship universities, measured on a per-student basis, has been declining for two decades. In every state, the competing claims on revenue by primary and secondary education, welfare, Medicaid, and law enforcement have shrunk available discretionary funds and made investment in higher education a lower priority. The global recession has caused sharply declining revenues in most states and brought about substantial additional reductions in state support for universities. In some states, notably California, whose public research universities are among the best in the world, the reductions have been massive, resulting in steep increases in tuition and reduced access. Close observers of public higher education doubt that state support will ever recover the levels appropriated even a decade ago.

The recent economic collapse has also necessitated sharp cutbacks at private universities, whose endowments in many cases lost nearly a third of their value. Some endowment accounts cannot sustain the commitments they have made. Assuming a 5 percent payout and 3 percent rate of inflation, earnings of 10 percent per year will allow only a 2 percent per year recovery of what has been lost, meaning that, under relatively favorable and stable conditions, it will take between fifteen and twenty years for these endowments to recover from recent losses**.**

Meanwhile, having witnessed the role of American universities in the nation's innovation and economic growth, other nations are investing in research universities to provide the

foundation for their research enterprises and economies. China has put large sums into its universities, with the nine top Chinese universities recently organizing what they have called their "ivy league" of institutions. Germany, Korea, Japan, and India are also making similar strategic investments in building strong research universities. The economic vitality of the United States has resulted in part from the fact that our research universities have been a destination of choice for graduate students from all over the world who have brought new skills and ideas to the American economy. It will be increasingly difficult to maintain this positive flow of talented students from abroad unless the United States maintains the preeminence of its research universities.

The recent report of the National Academies, Rising Above the Gathering Storm, was an extremely important call to action, alerting the nation of the need for greater investment in the physical sciences. Congress responded with bi-partisan support. This new study reviewing the condition of America's research universities is even more important to the future of the country, for the quality of research can only be as strong as the foundation upon which it rests. If the fundamental operations of our research universities are deteriorating, the research superstructure will inevitably decline as well. We should recall Vannevar Bush's admonition: *"To serve effectively as the centers of basic research these institutions must be strong and healthy. They must attract our best scientists and teachers as investigators."*

Issues of Concern

1. The Lack of a National Strategy

Unlike several of the nations which have embarked on national strategies to develop their research universities, the United States does not have a centralized ministry for research or a central planning agency that directs the allocation of resources toward specific institutions for specific purposes. Although the federal government has supported the creation of universities, as in the Morrill Act creating the land-grant universities, and has invested large amounts in financial aid to students from the post-World War II GI Bill to the present, the United States has relied on a decentralized system of higher education, with public universities created by the states collaborating and competing with independent private universities. American universities enjoy wide degrees of independence and self-government with minimal interference by the federal government in the internal academic affairs of the institutions. The federal role has concentrated on need-based financial assistance to students and the funding of research through a competitive, merit-reviewed process.

This decentralized, competitive system has served the nation very well and it should form the foundation for the consideration of any program going forward. Nevertheless, as recent history has shown, our current system is subject to the vicissitudes of state funding, endowment returns, and federal appropriations for research. The doubling of the budget of the National Institutes of Health between FY1999 and 2003 was followed by five years of flat or reduced budgets, cutting nearly in half the percentage of applications that could be funded and undercutting the investments universities had made in facilities construction and faculty recruitment. There is reason to worry whether the substantial

increases in research expenditures made under the American Recovery and Reinvestment Act will have a similar impact when the funds expire.

State governments, faced with substantial revenue shortfalls and demands by taxpayers to both control tuition increases and provide increased access for undergraduates to public universities, often view graduate education less favorably than undergraduate education. A high percentage of graduate students at state flagship campuses are non-residents; many are international students. Moreover, after completing their graduate work, they often find employment elsewhere. Thus, many state legislators argue, while graduate education should be a national priority, it should not be a state obligation, and the additional institutional costs of graduate education – smaller graduate classes, fewer undergraduate classes taught by faculty who direct graduate work, and other costs associated with graduate education – should be the responsibility of the federal government.

Although it would be unwise for the United States to consider any form of centralized planning to guide its investment in research and research universities, it should nevertheless be possible to develop a national strategy that would reduce damaging fluctuations in the research appropriations, provide more predictability for universities to plan their own investments in research, and create incentives for states to provide more consistent and sustained funding for their research universities. Because graduate education is a national priority, and because graduate education in American universities is inextricably intertwined with the conduct of university research, a national strategy should consider ways for relieving state governments of a portion of the costs of graduate education. A program for the future should seek to achieve these objectives.

2. Research Costs Borne by Universities

Declining state support and endowment losses have eroded the operating budgets of our research universities. Several other factors further impair the ability of these institutions to sustain their critical missions. One important factor is the steadily increasing percentage of universities' operating budgets that must be dedicated to research. The attached chart of data from the National Science Foundation demonstrates the problem. During the growth of federal investment in research in the post-Sputnik era, federal expenditures grew from 57.6 percent in 1956 to a high of 73.1 percent in 1968 as a percentage of research and development expenditures at universities. Since that time, there has been an overall decline to a low of 58.33 percent in 2000, with a slight rise in 2008 to 60.16 percent. During this span, the proportion of state and local government expenditures for university research shrank from 14.2 percent in 1956 to 6.5 percent in 2008. The proportion of university research support provided by industry has fluctuated slightly, but over the past two decades, has averaged between 5.5 and 7 percent, while that from other sources has also been relatively constant at around 7 percent. As a consequence of the declining federal and state support and the failure of other external sources of support to fill in the gap, the dramatic change has been the percentage of

research costs carried by universities themselves, which has grown from a low of 8 percent in 1964 to its current high of 20.10 percent[ii].

This significant increase in the use of institutional funds to support research demonstrates the strain that universities are under in sustaining their research missions with declining investment by federal and state governments. It is also a reflection of the failure of the federal government to reimburse its fair share of the cost of federally sponsored research at universities. Beginning in 1991, the Office of Management and Budget imposed a cap of 26 percent on the Administrative portion of the indirect costs (officially called Facilities and Administrative costs or F&A costs) of research that universities could recover from federal grants. More recently, a cap has also been imposed by Congressional action on the ability of universities to recover the costs of basic research conducted by the Department of Defense. As the Council on Governmental Relations (COGR) study of the finances of research universities concluded, "F&A costs incurred by universities are real costs of doing research and caps result in under-recovery of reimbursement, which then forces universities to cover the unreimbursed costs through other unrestricted revenue sources. Furthermore, only universities are subject to the 26 percent administrative cap. Private industry, not-for-profit research institutions, and other entities are not affected by this restriction, and in the case of private industry, a profit factor is allowed as an additional reimbursement item."

COGR has identified a number of factors contributing to universities' increased subsidy of sponsored research. Some research-related activities, such as training grants for graduate students, are excluded from F&A cost calculations. Steadily increasing compliance costs have driven up the administrative costs of conducting federal research. These include animal care, laboratory and hazardous waste safety, human research subject protections, conflict of interest reviews, export control requirements, effort reporting, data security, and campus-wide education programs to ensure compliance with ever-accumulating regulations. These compliance costs have fully appropriate objectives but need to be examined for their efficacy and should be fairly reimbursed.

The increased costs that universities have been forced to bear for sponsored research have come at the expense of other programs, most notably in the humanities and social sciences, which are woefully underfunded by the federal government. While the nation's future economic development and national security rely on its investment in science and technology, its security, well-being, and the health of democratic institutions also rely on the broad scope of inquiry and analysis undertaken by fields other than the physical and biological sciences and engineering. Again, it is instructive to recall the words of Vannevar Bush:

> *It would be folly to set up a program under which research in the natural sciences and medicine was expanded at the cost of the social sciences, humanities, and other studies so essential to national well-being….Science cannot live by and unto itself alone.*

[ii] These numbers undoubtedly underreport the amount universities invest in research since NSF does not require reporting that figure and some universities do not report any institutional investment. However, because the reporting requirements have remained constant over time, it is likely that the changes in the relative percentages are reasonably accurate.

The under-reimbursement of research costs drains not only university funds but faculty time. Essential administrative support personnel cannot be included in the direct costs of research grants but instead must be included in the administrative cost portion of the federal indirect cost reimbursement for those grants. But the 26 percent cap on administrative costs in the reimbursement calculation has reduced the administrative support available to researchers themselves. As a consequence, more of the researchers' time is redirected from research to administrative tasks; in a recent Federal Demonstration Partnership survey, researchers estimate that they spend 42 percent of the time devoted to research on administrative tasks**.** This is an extraordinary diversion of time and talent from the central mission of scientific research and teaching, a loss of vital productivity, and a cost to the research enterprise that is not accounted for in the calculations of institutional contributions.

A program for the future should seek the means to free researchers to concentrate on research by relieving universities of all unnecessary administrative and reporting costs and reimbursing universities more fairly for the costs of undertaking research on behalf of the federal government.

3. Encouraging the Next Generation of Faculty

"Strong and healthy universities," which Vannevar Bush saw as the cornerstone of a successful research enterprise for the United States, depend on the education, training, and nurturing of young talent. It has been axiomatic that graduate education in the United States should be linked closely with research, so that graduate students emerge from their educations capable of undertaking independent research projects themselves.

One of the greatest assets of American universities has been their merit-driven egalitarianism. Young faculty have found it easier here than elsewhere to challenge inherited wisdom, to propose new ideas and methods, to open new fields of inquiry. Progress in any discipline will stagnate if young minds are not constantly brought into a field to challenge established researchers. But budgetary cutbacks naturally lead universities to protect the programs they have at the expense of programs they might wish to initiate; fiscal constraints always cripple the capacity for innovation. If we are to recruit the most talented and creative students into careers of research and thereby sustain strong and healthy research universities, young scholars must be able to see career paths open to them that will enable them to realize their potential and maximize their contributions.

As competition for research funds has intensified during extended periods with flat or less than inflationary increases in federal appropriations for research, the average age at which researchers can expect to receive independent funding has increased. Currently, the average age of a first RO1 grant from NIH is 42. Although constrained research funding is not the sole factor contributing to the increasing age of receipt of independent funding, the fact remains that in the face of a poor job market, young researchers spend longer periods of time in postdoctoral positions. This is not a career path that is inviting to undergraduate or graduate students.

The present circumstances of universities have made it difficult for them to recruit new, young faculty. The elimination of mandatory retirement and, more recently, the senior faculty's loss of retirement assets in the current economic recession, have resulted in slowing retirements, leaving fewer positions to be filled by the young. And fiscal constraints have sharply reduced the capacity of universities to hire new faculty.

Moreover, the cost of launching a new scientist or engineer to the point that she is able to compete for federal funds has increased enormously over the past several decades, to the point that often the start-up costs, rather than salary, have become the major factor limiting universities' ability to hire new faculty.

A program for the future should give special attention to ensuring that universities are able to recruit young faculty. It should provide young faculty with the resources to launch successful research careers and enable them to undertake research projects that may risk uncertain results, but also potentially yield great contributions.

4. Maintaining Access to Research Universities

The major research universities in the United States are selective in their admission of undergraduate students, and some are highly selective. Their students are, on the whole, very able and capable of taking advantage of the rich educational and research opportunities offered by research-intensive universities. Virtually all research universities endeavor to capitalize on their unique capacity by providing research opportunities for undergraduates. As a consequence, the major public and private research universities produce a large majority of the undergraduates who go on to graduate studies.

A major national concern is whether, when facing deteriorating financial circumstances, our universities will be able to continue to provide access to highly qualified students from lower socio-economic backgrounds. This concern was voiced by the Commission on the Future of Higher Education in 2007, and has been expressed more recently by President Obama. While the very well-endowed private universities have made substantial commitments of financial aid to students with need, private universities with limited endowments cannot provide comparable financial aid, and public universities generally have found it very difficult to provide sufficient financial aid to offset the tuition increases that declining state revenues have forced them to impose.

The prospect of graduating with a heavy burden of debt will discourage students from following careers in academia in preference to more remunerative opportunities. In consequence, the nation will be further constrained in its effort to increase the portion of its academic and research talent drawn from its own citizens. A program for the future that substantially expands the capacity of research universities to provide broader access to undergraduate students with substantial financial need will have the dual benefit of expanding individual educational opportunity and increasing the scope and quality of the nation's home-grown research capacity.

Some Guiding Principles

As we consider how to enhance the partnership between the federal government and the research universities that has served the nation for the past sixty years, we should begin with the principles that have been fundamental to America's success. These principles can provide the foundation for a national strategy for enhancing research universities.

The first principle is open competition with a rigorous merit review process. Block grants that perpetuate funding based on a formula rather than competitive review, as practiced in some other countries, or have been the means of supporting much of the university research funded by the Department of Agriculture, do not generally produce the scientific breakthroughs produced by research that has been supported through a competitive merit review process. Open competition does not arbitrarily select some institutions or researchers for support; rather, it allows researchers from all universities, public and private, large and small, to compete, limiting awards to those whose proposals have the most promise for advancing knowledge.

To realize this principle, any additional federal support for research universities should be provided by the federal research funding agencies using rigorous merit review processes free from political intrusion, such as those carried out by the National Institutes of Health and the National Science Foundation.

A second principle is that the federal government should fairly reimburse universities for the costs of research. Facilities and Administrative costs should not be arbitrarily limited, but universities, like private industry, should be able to recover the full costs of administering research.

Third, consistent with the need for accountability, researchers should be freed from as many unnecessary administrative and reporting responsibilities as possible so that more of their valuable time can be devoted to research and teaching. This may require changes in how support personnel are funded.

Fourth, any allocation of funds from the federal government in support of public research universities should not be a substitute for state funds; maintenance of efforts by states should be required and audited. When possible, federal funds should be employed as an incentive for state funding.

Some Suggestions for Sustaining Research Universities

A plan for consistent funding of research agencies. As noted earlier, the fluctuations of federal funding for research support have damaged the research enterprise. The doubling of NIH was an extraordinary accomplishment that promised to bring tremendous benefits to society through the expansion of biomedical research, but it was followed by a period of stagnant funding that has significantly reduced the purchasing power of NIH's research budget. The investment in the physical sciences promised under the America COMPETES Act would have provided a comparable, needed increase in federal funding for research in the physical sciences and engineering, but those funds have not been

forthcoming as planned. While we cannot expect a doubling every few years, there have been and will be times when such increases are needed to maintain our leadership position in research. But they must be followed by a commitment to sustaining growth at least at the rate of inflation to provide predictability about the availability of federal research funds.

A program of general support for research universities. As a means of assisting universities through an especially difficult period, the government should consider providing a subsidy above the recovery of indirect costs. As a small percentage of total competitive research dollars acquired by an institution, these flexible funds would help research universities reduce the percentage of research funding they must contribute. The federal government should also consider providing support for graduate education by means of institutional grants as a percentage of competitively funded research conducted by each institution.

A program for facilities and equipment. During the 1960s, when the largest expansion of American research universities occurred, NSF and NIH created programs for the construction of facilities and for the acquisition of large, expensive equipment. At their highest annual level, these programs awarded grants for facilities of slightly less than $1 billion in 2009 dollars. Today, virtually all of that funding has disappeared, but universities must continue to provide researchers with state-of-the-art laboratories and equipment, which often must be housed in costly new facilities. While some equipment may be acquired through federal grant funds, and F&A calculations allow for some depreciation of buildings, there remains a major unmet need for facilities and equipment expenditures. A federal facilities funding program that requires matching funds from states, industry, and/or donors for the construction or renovation of facilities would ease the cost burden on universities and strengthen their capacity to support frontline research.

A program for supporting young faculty. Start-up funds for new faculty are a heavy cost for research universities. A competitive program to match institutional costs for the start-up of new faculty would be helpful. This should be limited to the recruitment of assistant professors beginning their careers.

An expanded program of career awards for young faculty. One of the most successful programs provided by the federal government has been the provision of career awards for young faculty. An expansion of these programs would be desirable.

Responsibilities of Research Universities

In their letter calling upon the National Academies to undertake this review of research universities, members of Congress asked that the study review what actions should be undertaken by the federal government, the states, and the universities to address the needs of the nation. This paper has suggested a number of ways that federal and state governments can help expand the nation's research capacity. What actions can universities take to contribute to the national effort to strengthen our capacity for discovery and innovation?

A plan for improved access to research universities. As we have noted, successive Administrations have stressed the importance of providing access to higher education for students with economic hardship. Vannevar Bush already recognized this need in 1945:

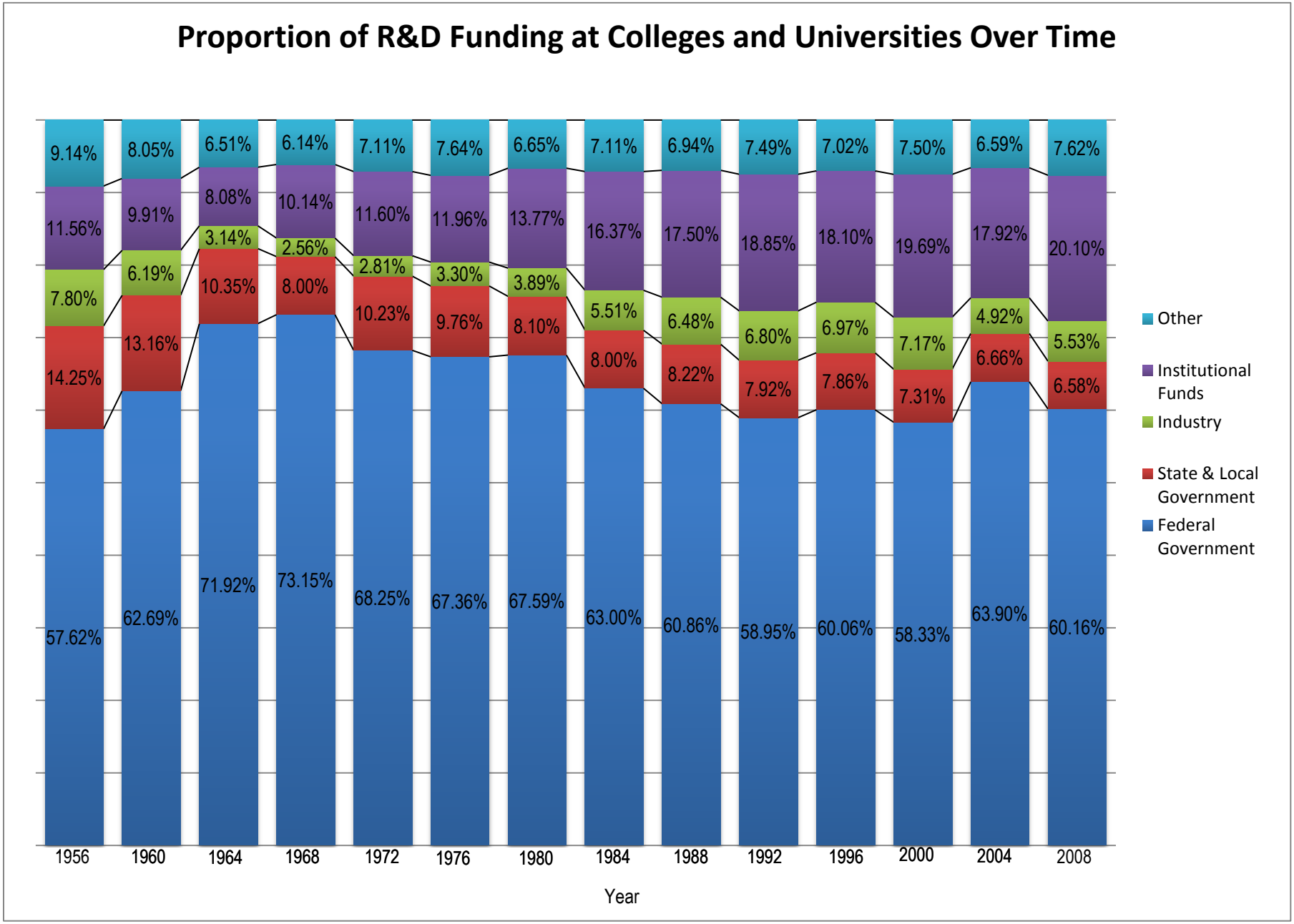
> *Studies clearly show that there are talented individuals in every part of the population, but with few exceptions, those without the means of buying higher education go without it. If ability, and not the circumstance of family fortune, determines who shall receive higher education in science, then we shall be assured of constantly improving quality at every level of scientific activity.*

In the federal government-university partnership, research universities have a responsibility to help meet the national goals of increasing college attendance and graduation rates of students from colleges and universities. They should expand their efforts to train qualified teachers for the public schools in the STEM disciplines by developing and replicating successful science teacher-training programs. They should expand their outreach programs to assist public schools which have large numbers of economically disadvantaged students. They should work with community colleges to facilitate increasing the number of students who transfer to research universities for baccalaureate degrees.

A plan for increasing the number and quality of American math, science, and engineering graduates. To encourage more undergraduate students to major in STEM disciplines, research universities should develop or expand undergraduate research opportunity programs for their own students as well as create or expand summer research opportunity programs for disadvantaged or minority students from colleges which cannot provide comparable research opportunities. They should continue to establish and build on professional science masters programs. They should develop academic personnel policies and provide institutional resources to enable more women to pursue challenging STEM careers in academia.

Conclusion

No doubt other ideas for sustaining the strength of America's research universities will emerge in the course of the study by the National Academies. Whatever the means, the goal must be clear: that in order to maintain our leadership in the world, to attract and educate the most talented young people, and to provide a secure and prosperous future for the American people, we must make certain that our research universities have the resources necessary to fulfill their missions. The health of these institutions is essential for the nation's future.


Proportion of R&D Funding at Colleges and Universities Over Time
9.14%
8.05%
6.51%
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6.94%
7.49%
7.02%
7.50%
6.59%
7.62%
11.56%
9.91%
8.08%
10.14%
11.60%
11.96%
13.77%
16.37%
17.50%
18.85%
18.10%
19.69%
17.92%
20.10%
7.80%
6.19%
3.14%
2.56%
2.81%
3.30%
3.89%
5.51%
6.48%
6.80%
6.97%
7.17%
4.92%
5.53%
14.25%
13.16%
10.35%
8.00%
10.23%
9.76%
8.10%
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8.22%
7.92%
7.86%
7.31%
6.66%
6.58%
57.62%
62.69%
71.92%
73.15%
68.25%
67.36%
67.59%
63.00%
60.86%
58.95%
60.06%
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2000
2004
2008
Year
Other
Institutional Funds
Industry
State & Local Government
Federal Government