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STATEMENT OF
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BEFORE THE
HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY
ON
FEDERAL FUNDING MECHANISMS
IN SUPPORT OF UNIVERSITY
RESEARCH

Mr. Chairman and Members of the Committee:

We are pleased to be here to discuss our two recently issued reports on federal funding mechanisms in support of university research. The first report describes the characteristics of funding mechanisms used by the major federal funders of university research and provides an inventory of those mechanisms.¹ The second report assesses selected federal funding mechanisms from the perspective of the recipients at the

¹University Funding: Federal Funding Mechanisms In Support of University Research, GAO/RCED-86-53, February 13, 1986.

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universities.² For our purposes, a "funding mechanism" is defined as a category of federal financial support for scientific research performed at and by universities. I will summarize each report separately.

FEDERAL FUNDING MECHANISMS IN SUPPORT
OF UNIVERSITY RESEARCH

The objectives of our first report, the inventory of federal funding mechanisms, were

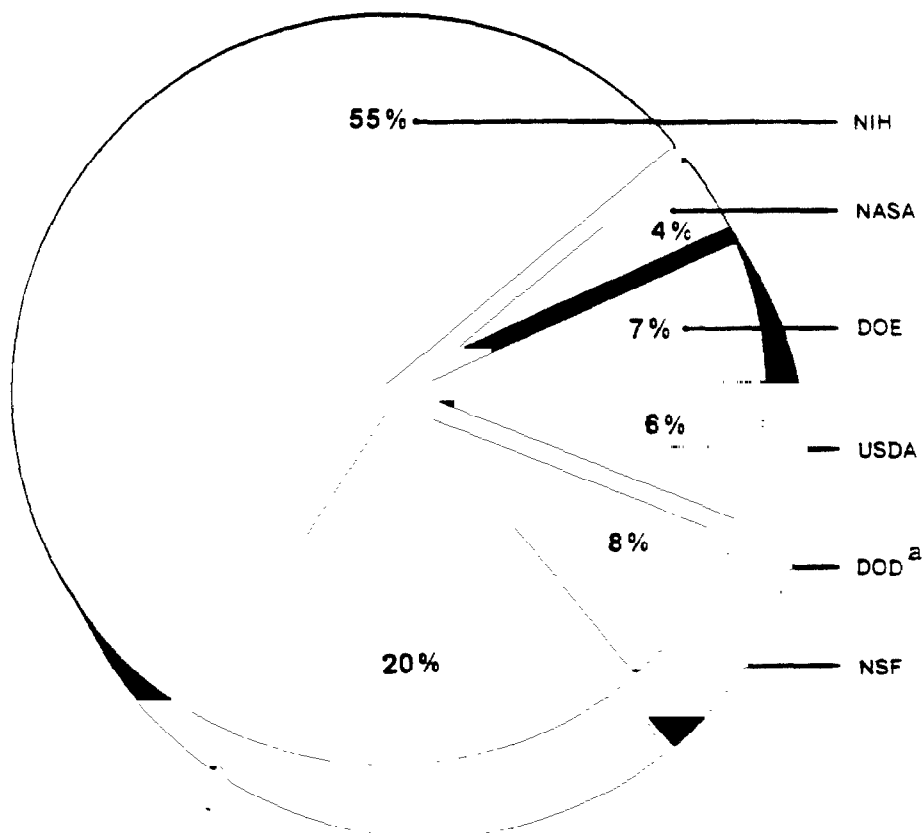
- to describe the past and present federal funding mechanisms, including relative magnitudes of support, that federal agencies use to fund university research, and
- to describe the trends over time in federal agencies' use of funding mechanisms.

To prepare this report, we collected data for fiscal year 1984 from the six federal agencies that fund 90 percent of the support for scientific research performed at universities and colleges. These agencies, which obligated \$4.8 billion for fiscal year 1984 for university research, are the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Energy (DOE), the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and the U.S. Department of Agriculture (USDA). As figure 1 shows, the National Institutes of Health and the National Science Foundation provide over three-fourths of the total funds obligated.

²University Funding: Assessing Federal Funding Mechanisms for University Research, GAO/RCED-86-75, February 7, 1986.

Figure 1:

Percent of Obligations for University Research by Federal Agency
(Fiscal Year 1984)



^aIncludes only basic (DOD 6.1) part of DOD's funding of university research.

Source: GAO, based on data reported by six agencies.

Past and Present Funding Mechanisms

To address our first objective, we developed six categories of funding mechanisms that could be applied across agencies. These categories are based on literature review and advice from experts and are shown in figure 2. They fall into two groups--direct support and support of the research infrastructure. The agencies reported 84 different awards within these 6 categories.

Figure 2:
Federal Funding Mechanisms

<u>DIRECT SUPPORT OF RESEARCH</u>	<u>Percent of total support</u>
<u>Individual Project Support</u>	71
<ul style="list-style-type: none"> --support for an individual researcher called a principal investigator. Support may include funding for graduate student assistants, equipment, travel, salaries, etc. --research in a discrete research area and of limited duration 	
<u>Program Support</u>	9
<ul style="list-style-type: none"> --support for more than one principal investigator, each conducting research projects related to an overall objective --broad coherent area of research, often multi-disciplinary and long term 	
<u>Center Support</u>	9
<ul style="list-style-type: none"> --research projects are coordinated into a coherent program in a particular broad field of interest at a university --core funding for equipment, facilities, and administrative unit called a research center 	
<u>RESEARCH INFRASTRUCTURE</u>	
<u>Special Training Needs</u>	4
<ul style="list-style-type: none"> --scientific human resource development specifically through fellowships, traineeships, and training grants 	
<u>Major Equipment and Facilities</u>	2
<ul style="list-style-type: none"> --purchase of major research equipment or instrumentation and construction of buildings for research 	
<u>Institutional Support</u>	<u>5</u>
<ul style="list-style-type: none"> --usually unspecified support to enhance research capability and training, often through formula or block grants 	
Total	<u>100</u>

Three mechanisms that directly support research are the individual project award, the program project award, and the research center award. In fiscal year 1984, the six agencies awarded about 89 percent, or \$4.3 billion, of their research funds through these three funding mechanisms. Three mechanisms which support research by providing funds for infrastructure are major equipment and facilities, special training needs, and general institutional support. These three mechanisms accounted for 11 percent, or \$523 million, of the total obligations for fiscal year 1984.

It is important to note that these mechanisms can provide support for similar research needs. Funding mechanisms for the research infrastructure designate support specifically for research equipment and graduate student training; at the same time, direct support funding mechanisms also commonly provide some support for equipment and student training necessary to perform the particular research. In addition, the research infrastructure is supported through indirect cost reimbursements on research projects.

Direct Support: Individual Project Award

The funding mechanism receiving the most support by far is the individual project award. About \$3.4 billion, or 71 percent of total support, was provided through this mechanism in fiscal year 1984. In general, this funding mechanism supports scientific research under the direction of a single university researcher who is issued an award competitively for a research proposal. There is wide variation in award amount--from an average award of \$67,000 by NSF to an average award of \$152,000

by DOE. Some awards are designated for specific recipients or purposes, such as for young investigators and for short-term, preliminary projects.

Direct Support: Program and Center Support

The second and third categories of direct support of research are for program projects and research centers. These categories accounted for about 18 percent of total agency obligations, or \$900 million, in fiscal year 1984. Agencies reported that research performed under these mechanisms is often multidisciplinary and is related to a broader, more extensive research goal or program. They are longer in duration and larger in dollar size than are individual research projects. Project and center awards can be granted for up to 5 years and range from an average of \$89,000 for a NASA program grant to an average of \$3 million for a DOE center award.

Research Infrastructure

Of the three funding mechanisms that support the research infrastructure, institutional support received 5 percent of total funding, due mostly to USDA's formula awards; major equipment and facilities received 2 percent; and special training needs received 4 percent.

Funding Trends

To describe the trends over time in federal agencies' use of funding mechanisms--our second objective--we used data collected by the National Science Foundation as presented in its

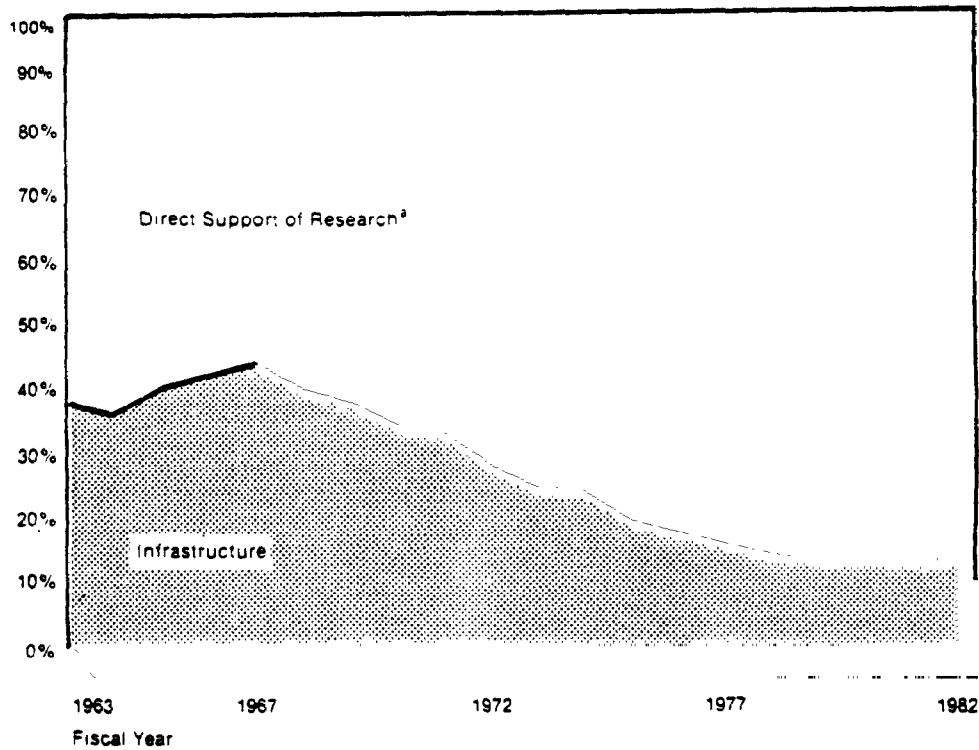
annual publication, Federal Support to Universities, Colleges, and Selected Nonprofit Institutions. This publication describes federal funding from 1963 to 1982 by categories of support that we correlated with the six funding mechanisms we developed.

Direct Support of Research Has Increased

As figure 3 shows, federal funds in direct support of research--which includes individual project, program, and center support--have increased as a percentage of total research funds over the last two decades from 62 percent in fiscal year 1963 to 87 percent in fiscal year 1982. There has also been an increase in absolute dollars. Using constant 1972 dollars, direct support of research has increased from \$1.1 billion in 1963 to \$2.2 billion in 1982.

Figure 3:
Percent of Federal Scientific Research Obligations
to Universities/Colleges by Funding Category
(Fiscal Years 1963-1982)

Direct Support of Research vs.
Research Infrastructure



^aMay include support for equipment as well as graduate assistantships as part of the costs of research projects.

Source: GAO, based on Federal Support data.

Support of Research Infrastructure Has Decreased

The converse of the NSF trend data, of course, is that the percentage of total obligations supporting research infrastructure, which includes mechanisms specifically

designated for major equipment and facilities, special training needs, and institutional support, has decreased over the same period, from 38 percent in fiscal year 1963 to 13 percent in fiscal year 1982. There has also been a decrease in absolute dollars. Using constant 1972 dollars, research infrastructure funding decreased from \$688 million in fiscal year 1963 to \$331 million in fiscal year 1982.

As we stated earlier in our testimony, the research infrastructure is also supported through direct funding mechanisms such as individual project, program, and center support. For example, an NSF budget official told us that over \$100 million of NSF funds provided to universities in fiscal year 1984 through the individual project support mechanism was for equipment. This official also told us that NSF funded 11,000 research assistantships through direct support of research in fiscal year 1984.

Over the years, many award mechanisms used in the early 1960s specifically to support the research infrastructure have been discontinued. By the mid-1970s, most of the federal programs specifically for training, facilities, and institutional programs designated had been discontinued.

ASSESSING FEDERAL FUNDING MECHANISMS

Our second report assessed the relative merits of different types of funding mechanisms for performance of research. Our objectives were specifically

--to determine whether particular funding mechanisms play a rôle in helping universities improve program quality as perceived by the scientific community and

--to examine whether two different types of funding mechanisms--individual project awards and center awards--had different impacts on the performance of research.

The Role of Funding Mechanisms In
Improving the Quality of University Science

To meet our first objective, we chose five university departments in the southeastern U.S. which, according to two national surveys of U.S. doctoral research programs, had improved program quality. We wanted to learn how they were able to improve their research programs after the federal government had largely eliminated special financial assistance for program improvement in the early 1970s. We wanted to know, in particular, whether their success was attributable to any particular federal funding mechanism.

In general, at the university departments we visited we did not find the type of funding mechanism to be a significant factor in improving program quality. Instead, the common element reported to us was an explicit commitment from the university to improve its program and to do so through increases in internal and external funding and through personnel changes.

According to department chairmen and others we interviewed, seed funding from either government or private sources was a prerequisite to program improvement. Two of the five university departments--the University of Georgia and the University of Texas--received institutional support through substantial

National Science Foundation Science Development grants in the late 1960s. The Science Development grant program was one of the broad institutional programs created in that decade to increase the number of institutions of recognized excellence in research and research education in the sciences. It was discontinued after fiscal year 1972. University officials at both schools agreed that the availability of these federal grants was a major factor in their program improvement strategy and enabled each department to attract excellent researchers, renovate research space, and purchase critical equipment.

The other three university departments--Emory University, the University of Alabama, and the Georgia Institute of Technology--sought and received seed funding from industrial sponsors, state appropriations, and the university itself. For example, Emory University provided \$620,000 to its Department of Microbiology and Immunology to increase the number of tenured faculty. The university also agreed to renovate space for the department at a cost of over \$1.5 million.

After the initial investment, all five departments were able to "leverage" that seed money into success in competing for continuing federal support.

The Role of Funding Mechanisms in the Performance of Research

We used a case study approach to meet our second objective--to examine whether two funding mechanisms had different impacts on the performance of research. Using five fields of science, we compared five university departments where researchers receive individual project awards with five university research centers. These are listed in figure 4.

Figure 4:
Matched Pairs of Universities by Field of Science

<u>Field of science</u>	<u>Center locations</u>	<u>Department locations</u>
Mathematics	University of Wisconsin-Madison	University of Michigan
Space science	University of Chicago	University of Iowa
Artificial intelligence	Massachusetts Institute of Technology	University of Texas
Cell biology	Yale University	New York University
Plant sciences	Michigan State University	Cornell University

We administered a questionnaire to 70 researchers to obtain their perception of the impact on the performance of research of individual project awards compared with center awards.

We assessed individual project awards and center awards against four factors that have the potential to affect the performance of research.

- Coverage of resource requirements.
- Stability of financial and resource support.
- Type of research supported.
- Administrative burden.

Coverage of resource requirements

The performance of research requires adequate resources-- facilities, equipment, and people. Responses from scientists to questions on the adequacy and availability of such resource requirements varied by field of science rather than by funding mechanism. For example, in response to the question "Has the

quality of research facilities changed since 1970," 28 of 36 scientists reported that the quality of facilities had increased or stayed the same since 1970. No scientists in plant sciences or artificial intelligence reported decreases. However, some scientists in each of the other fields reported decreases.

Stability of financial and resource support

Scientists generally consider stable financial and resource support, which reflects the continuity and duration of support, beneficial for conducting research. To determine the impact of the two funding mechanisms on the stability of support, we asked scientists about the effect of the cyclical nature of support, funding gaps, and award duration on the performance of research.

For the cyclical nature of support, scientists reported that factors other than the funding mechanisms, such as agency policy decisions, affected their ability to perform research. For example, we were told by scientists that NSF's decision to divide available funds for mathematics by subfields resulted in destabilizing research environments for certain subfields and individuals.

Concerning the effects of funding gaps on research, in response to the question "Have funding gaps been a problem?", 21 of 29 researchers working in centers said they did not have a problem with funding gaps. However, 17 of 34 researchers with individual project awards agreed that funding gaps have been a problem. In addition, some scientists receiving center support told us that the informal sharing of resources possible under center funding contributes to stability of funding. They also

believed that center funding provides seed money to start research that would otherwise be unfunded and that it can provide continuous support for technicians.

Although scientists receiving both types of funding expressed concern about award duration or continuity of support, scientists in most centers we studied believed they had a longer term commitment under the center awards than scientists receiving individual project awards.

Type of research supported

The type of research supported reflects the influence of funding availability on the ability to pursue new and different areas of research. To determine which mechanism more often supports innovative, high-risk, and interdisciplinary research, we asked scientists questions about their research.

Some differences in the types of research supported emerged between scientists with individual project awards and those with center awards. More scientists in centers than scientists in departments told us they proposed more research into new areas and performed research bridging two or more fields. Twenty-five out of 32 center scientists stated they proposed research into new areas, as opposed to 14 out of 33 department scientists.

Administrative burden

The administrative burden for researchers varied more by field of science and agency requirements than by type of funding mechanism. This factor can be measured by the amount of time spent in preaward activities, such as applying for awards, and postaward activities, such as responding to award requirements

and reviewing proposals. Defense agency award requirements include more postgrant reporting, while civilian agency award requirements include more preaward reviews of proposed research. Accordingly, on the average, scientists in fields that receive awards from defense agencies, such as artificial intelligence, reported they spent more time in postaward activities than in preaward activities. Scientists in fields that receive awards from civilian agencies, such as plant science, reported spending more time in preaward activities.

SUMMARY

To briefly summarize the major points of our two reports:

- In fiscal year 1984, 89 percent of federal obligations for university research was in direct support of research, and 11 percent was specifically in support of infrastructural needs of research.
- The funding mechanism supporting individual research projects received almost three-quarters of federal obligations for university research. There is great variation in purpose and size among the six agencies' use of this funding mechanism.
- From 1963 to 1982, federal agencies have increasingly devoted a larger percent of their funds to direct support of research as opposed to research infrastructure. However, funds that provide direct support of research also provide for some infrastructural needs in the form of training, equipment, and indirect cost reimbursement.

--For improving the reported quality of university research programs, the particular funding mechanism played a lesser role than the universities' commitment to improving the program and its ability to obtain funds from a variety of sources.

--For the performance of research, scientists generally indicated that the field of science in which they worked had a greater effect on the degree of administrative burden and the adequacy and availability of facilities, equipment, and technicians than the particular funding mechanism. However, center researchers believed that they had more stability of financial and resource support and were more likely to perform innovative, high-risk, or interdisciplinary research than did researchers with individual project awards.

This concludes our prepared statement. We will be glad to answer any questions.