CHAPTER 3

The Federal Research System: The Executive and Legislative Branches

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In the final analysis, after science and technology decisions have been subject to the judgment of conflicting objectives, . . . they are then subject to the reality of the Federal budget process. First research and development programs must compete with other Federal programs for the availability of limited Federal dollars . . . for there will always be more programs and projects than there will be funds to implement them. Thus another set of choices in how to allocate the funds to gain the greatest benefits must be faced.

Don Fuqua[1]

Introduction

It is often said that the best scientists not only know how to solve problems, but how to pick them. Choosing where to put valuable time and resources is central to the success of any scientist, laboratory, or university. The same is true for the Federal Government.

Decisionmaking occurs on many levels within the Federal research system. The most macroscopic level for research decisionmaking concerns a spectrum of general research problems such as space exploration, aging, or AIDS (acquired immunodeficiency syndrome). The President and Congress are ultimately responsible for decisions made at this level. At mid-levels, the focus shifts to fields such as astrophysics, virology, or artificial intelligence. Most often Federal agencies and specific congressional committees take the lead in these decisions. Priorities within a single field of science or technology usually involve specific government programs and congressional subcommittees. And, finally, at the most microscopic level, the focus is on areas of research specialization and often involves specific processes of funding allocation.[2]

A focus of this report is the tremendous diversity within the Federal Government in the selection of priorities for research. Every Federal agency and congressional committee seems to do it differently.[3] If the government is to respond to changing fiscal conditions, many choices within the organization and management of the research budgets must be made.

This chapter discusses the highest level of decisionmakers-the President, the executive branch, and Congress. (Chapter 4 introduces the Federal agencies and other participating bodies.) Although in this discussion the executive and legislative branch% are treated separately, there is important interaction between them, both formally at congressional hearings and executive branch briefings and informally among staff.

The Executive Branch

When President Bush awarded the National Medal of Science and the National Medal of Technology to 30 scientists and engineers in November 1990, he remarked: ‘‘More and more our Nation depends on basic, scientific research to spur economic growth, longer and healthier lives, a more secure world and indeed a safer environment. ”4

Traditionally, Presidents have been very supportive of science and engineering, or what is categorically known as research and development (R&D). However:

> Every administration refers each year to its “R&D budget,” which is described in various documents—most notably, Special Analysis J, produced by the Office of Management and Budget. In actuality, there is no Federal R&D budget, if by

[1] Don Fuqua, ‘‘Science Policy: The Evolution of Anticipation, “ *Technology in Society*, vol. 2, 1980, p. 372.

[2] For overviews, see Bruce L.R. Smith, *American Science Policy Since World War II* (Washington, DC: The Brookings Institution 1990); and David Dickson, *The New Politics of Science (New* York, NY: Pantheon, 1984).

[3] And viewed in a cross-national framework, the U.S. research system is distinctive. See app. D for a discussion of priority setting in Other countries.

[4] Quoted in “National Medals Are Pinned on 30 Scientists,” *The Washington Post, Nov. 15,* 1990, p. A23.

Photo credit: Michael Jenkins

The House Committee on Agriculture, which has jurisdiction over the Department of Agriculture and its research programs, votes.

"budget" is meant a plan for matching priorities with spending. What each administration presents to the public is an after-the-fact compilation of the R&D spending plans of the individual mission agencies and NSF, plans that were developed through a complex and fragmented sequence of local interactions among individual groups with the agencies, the White House Office of Science and Technology Policy, and a slew of congressional committees.[5]

The most consistent indicator of Presidential priorities over the last 30 years has been the Presidential Budget Message, presented to Congress every year, which accompanies the Presidential budget. A review of these documents, extending back to the Kennedy Administration, gives an interpretation of Presidential direction, at least rhetorically, of the Federal research system.[6]

During the 1960s, the mastery of space and space science, as symbolized by a manned lunar landing, was a central mission. Competition with the Soviets both in research and economically was the center of the debates. Domestic research needs received increasing emphasis from 1964 through 1968, linked to the programs and aspirations of the Great Society, but tempered by economic constraints stemming from increasing involvement in Vietnam. Pollution also became a major item of concern from 1964 onward. Specific research emphases included: National Aeronautics and Space Administration

[5]Joseph G. Morone, "Federal R&D Structure: The Need for Change," *The Bridge,* vol. 19, fall 1989, p. 5. Special Analysis J was discontinued in 1990, but is discussed below.

[6]The following is based on Mark Pollack, "Basic Research Goals: Perceptions of Key Political Figures," OTA contractor report, June 1990. Available through the National Technical Information Service, see app. F. Readers will note below the lumping of "R" and "D," as well as the lack of distinction between "basic" and "applied" research. The macro view seeks the big picture, e.g., R&D relative to transportation, veterans' affairs, and other national needs. Refinement.s come in later chapters,

(NASA) pursuit of manned flight, planetary probes, and scientific satellites; National Science Foundation (NSF) support of facilities at universities and colleges to strengthen science education; health research, including the prevention of cancer, heart disease, strokes, mental illness, mental retardation, and environmental health problems; environmental research, including resource conservation and development, oceanographic studies, and water and air pollution abatement; transportation research; and defense research.

During the 1970s, as space flight and research were scaled back, energy research issues became increasingly prominent, emphasizing the development of energy alternatives and the improvement of existing ones. These issues were linked to growing concern about dependence on foreign oil, and also to environmental concerns of pollution and conservation of natural resources. Specific energy research programs were emphasized by President Nixon and others, including fusion power and geothermal and solar energy. President Carter stressed conservation and alternative energy sources and advancement in nuclear power technology. Defense research was consistently supported, and preservation of national economic preeminence remained a strong goal on all fronts.[7]

During the 1980s, economic recovery, competitiveness, and leadership were the rhetorical focal points of discussions of the goals and justifications for research. Specific attention to the category of "basic research," begun in Presidential addresses during 1978, was linked to goals of economic, military, and technological leadership (although these goals were not necessarily reflected in the distribution of research finds, e.g., defense basic research funding did not increase markedly in the 1980s). In the Presidential messages of 1982 to 1986, the shift of Federal aid to scientific research and away from application and development became explicit. Cuts in applied energy research and agricultural sciences were made, while basic energy, defense, and biomedical research were augmented. In the late 1980s, as in the early 1960s, big science research projects were featured on the Presidential agenda. The Space Station, the Strategic Defense Initiative, AIDS, the Human Genome Project, and the Superconducting Super Collider (SSC) all figured prominently.

Photo credit: Jamie Netter, OTA staff

The President can be a major architect of the research system, and some Presidents have shown more interest in research and development issues than others.

American Presidents of the last three decades have paid heed to maintaining the science base-the broad spectrum of researchers and research supported by the Federal Government-but have also felt the need to concentrate resources toward achieving stated research goals. During the 1960s, when research budgets were increasing rapidly, the President could add new objectives to the system while maintaining other research programs. Now, Presidents must make more choices in fiscal allocation. For example, President Reagan distinguished between basic and applied research, favoring the former with budget increases and decreasing the latter in specific areas such as energy. (Under the Bush Administration, this distinction faded and several applied energy projects have been pursued.)

However, Presidents have generally been less involved in decisions about research policy than in areas such as economic, space, or defense policy (with the possible exception of decisions about particle accelerators). Until recently, Presidents often viewed research as within the purview of specific agencies, intertwined with the development of technologies and the procurement of certain goods or services, but rarely a policy objective per se. To keep abreast of research issues, the President

[7] David Birdsell and Herbert Simons, "Basic Research Goals: A Comparison of Political Ideologies," OTA contractor report, June 1990. Available through the National Technical Information Service, see app. F.

relies on many groups including the Office of the Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB).

The Science Advisor

Science Advisors most often have impeccable technical credentials and extensive experience within the scientific community[8] (see figure 3-l). President Eisenhower appointed James Killian the first titled Science Advisor in 1958. At present, D. Allan Bromley holds that position. He is typical of past science advisors: physicists with outstanding research records and a history of participating in government advisory committees on science and technology.[9] Advisors over the last 30 years have come from industry and university settings.

One criticism of Science Advisors has been that they favor the physical sciences, while Presidential goals have included life and social science objectives as well.[10] Another criticism of the position is that, while acting as the representative of the President, advisors are also seen as allies of the science community from which they were recruited, expected to give advice on all scientific matters as a "scientist." This dual role can be difficult. Some advisors, notably Keyworth and Graham in the Reagan Administration, were regarded as outsiders by the scientific community. They were less trusted and seen more as voices articulating the President's ideological agenda.

Since the Office of Science and Technology Policy Act in 1976, the Science Advisor has also been the director of OSTP.[11] OSTP was created by Congress to strengthen the role of the Science Advisor by creating a position that was parallel to the Director of OMB and the Chairman of the Council of Economic Advisors.[12] OSTP currently includes a small staff-less than 75—with a portion of the personnel detailed from various Federal agencies. With the confirmation of a new advisor (which usually coincides with the beginning of a Presidential administration), a new OSTP staff is assembled. Consequently, few senior OSTP staff will serve in their positions for longer than 4 to 5 years. However, many have extensive experience within the executive branch, Congress, or the scientific community. While this staff turnover requires that the Science Advisor and OSTP "start from scratch" and provides limited institutional memory, it also allows OSTP to construct a new agenda with each advisor.

In addition to providing a resource for scientific and technical information for the President, the responsibilities of OSTP include coordination of R&D activities throughout the agencies. The Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), under the chairmanship of Science Advisor Bromley, provides a forum for coordination.[13] Bromley has paid special attention to FCCSET during his tenure, increasing the participation of senior agency personnel. In 1989, there were nine active FCCSET committees.[14]

The Science Advisor also chairs the President's Council of Advisors in Science and Technology (PCAST), which provides independent expert advice to the President. PCAST was created in 1989 in the image of the President's Science Advisory

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8William Golden, *Science and Technology Advice to the President, Congress, and Judiciary (New* York, NY: Pergamon Press, 1988).

9James Killian was a notable exception. He was trained as a humanist who rose through the ranks at the Massachusetts Institute of Technology as an administrator. He was accepted into the scientific community and treated as an equal member. Harvey Brooks, Harvard University, personal communication, February 1991.

10In an interview soon after his appointment, Bromley admitted the overrepresentation of physical scientists on such bodies as the president's Science Advisory Committee, pointing out that ". . . the life sciences must be brought in more strongly than they are now." See Jeffrey Mervis, "New Science Advisor Sees Strong Ties to Bush, Public Support as Keys to Job," *The Scientist,* vol. 3, No. 11, May *29, 1989,* p. 3.

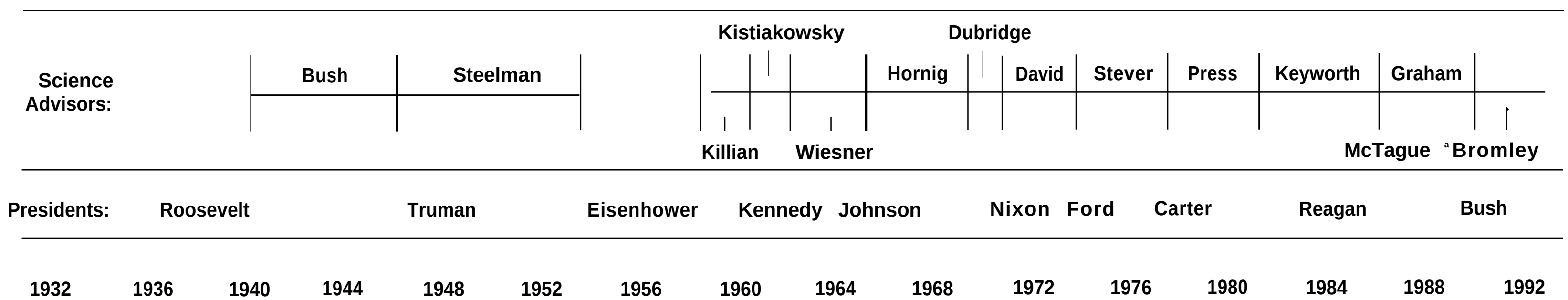
11The forerunner of the Office of Science and Technology Policy was the Office of Science and Technology (OST). The position of OST director was created by President Kennedy in 1961.

12Richard C. Atkinson, "Science Advice at the Cabinet Level," in Golden, Op. cit., footnote 8, p. 12.

13For a history of the Federal Coordinating Council for Science, Engineering, and Technology, see Congressional Research Service, Interagency *Coordination of Federal Scientific Research and Development: The Federal Council for Science and Technology,* Report to the Subcommittee on Domestic and International Scientific Planning and Analysis, Committee on Science and Technology, U.S. House of Representatives, 94th Cong. (Washington DC: U.S. Government Printing Office, July 1976).

14Genevieve J. Knezo, "White House Office of Science and Technology Policy: An Analysis," *CRS Report for Congress* (Washington, *DC:* Congressional Research Service, Nov. 20, 1989), pp. 61-62.

Figure 3-l—Science Advisors to the President, 1932-90



[a]McTague was acting Science Advisor between Keyworth and Graham.

SOURCE: Adapted from William G. Wells, School of Government and Business Administration, George Washington University, "Science Advice and the Presidency, 1933-76," unpublished dissertation, 1977, p. 18.

Committee (PSAC), which had been disbanded by President Nixon in 1973.[15] (Although the authorization to constitute a new PSAC was included in the 1976 legislation which created OSTP, no action was taken until 13 years later.) Members of PCAST, appointed by the President, are distinguished leaders in science and engineering from industry, philanthropy, and academia. Although PCAST can be asked to comment on specific scientific and technological matters, it can also offer opinions on other issues and solicit its own outside analysis. (PCAST has only been in operation for a little over a year, so it is difficult to determine the role that it may play in the 1990s.[16])

PCAST, OSTP, and the Science Advisor are advisory to the President. As such, they have not been given much power. As a former staff member in the George Keyworth-led OSTP writes:

> The position of the President's Science Advisor (and director of OSTP) is strictly a staff function, with no line authority and no control over budgets. The primary tool available to the President Science Advisor is persuasion. How effective he is in convincing agencies to shape or modify their R&D budgets depends largely on the strength of his personal relationship with inner circles of the White House.[17]

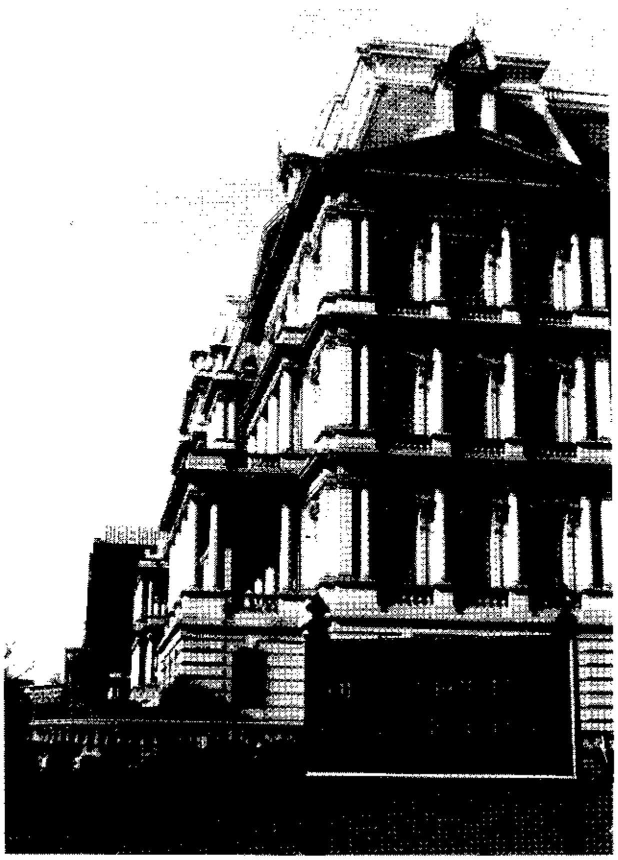


Photo credit: Jamie Netter, OTA staff

The Old Executive Office Building is home to much of the Office of Science and Technology Policy and the Office of Management and Budget.

Two general comments can be made about the roles of these advisory bodies for the next decade. First, global problems such as climate change and pollution involve issues of cooperation and planning, while President Bush's goals for science and mathematics achievement by the year 2000 highlight the urgency of education and human resources for the Nation's vitality. Both will require domestic policy coordination, and tough research funding tradeoffs may be needed. Second, while the role of science advice will not wane in the 1990s, it is unlikely that the role of the Science Advisor, OSTP, or PCAST will be strengthened legislatively. To some, OSTP has to ". . . brighten its image on the White House political screen. "[18] Yet, in the executive branch where influence is often equated with budgetary control, the advantage resides primarily with the research agencies and OMB.

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[15] Created by President Eisenhower in 1957 after Sputnik, the President's Science Advisory Committee (PSAC) relocated science advice from the Office of Defense Mobilization to the White House. Among its first actions, PSAC proposed establishing a counterpart group of representatives from the Federal research agencies to improve coordination of the Nation's R&D effort. The result was the founding, in 1959, of the Federal Council for Science and Technology. See Ralph Sanders and Fred R. Brown (eds.), Science *and Technology: Vital National Assets* (Washington, DC: Industrial College of the Armed Forces, 1966), ch. 5, especially p. 76.

[16] See Jeffrey Mervis, "PCASTMembersReady toSpeak; President Seems Ready toListen," *The Scientist*, vol. 4, No. 10, May 14,1990, pp. 1,14-15. One role tbat the President's Council of Advisors in Science and Technology has already played is defining a pool of eligibles for key R&D agency posts. From among its 12 members, President Bushnominated physicist Walter Massey to head the National Science Foundation and cardiologist Bernadine Healy as director of the National Institutes of Health.

[17] Morone, op. cit., footnote 5, p. 6.

[18] Some say this is already occurring under Science Advisor Bromley, who is the frost Science Advisor elevated to the title of Assistantto the President. Robert Rosenzweigquoted in 'A Good Budget for Science, But Troubles Lie Ahead,' *Science and Government Report*, vol. 20, No. 18, Nov. 15,1990, p. 2.

Office of Management and Budget

Research budgets are strongly influenced within the Executive Office of the President by OMB. As Science Advisor Bromley has remarked: ''It became evident a long time ago that if you control the budget, you control public policy. This is one of the facts of life that a science advisor must learn, that OMB is a tough player and not necessarily sympathetic.''[19] OMB crafts the budgets of research programs to reflect the priorities of the President,[20] and helps to set realistic targets for the next year's budget in all research programs while attempting to balance the competing needs of the Federal departments and agencies.

The manner in which these concerns are negotiated with the agencies is left to the discretion of the OMB budget examiners. Budget examiners concerned with research are located in at least three of its six divisions: Natural Resources, Energy, and Science (which includes NSF, agriculture, and space); Human Resources, Veterans, and Labor (which includes health and education); and National Security and International Affairs (defense). Through Special Analysis J, OMB traditionally presented proposed R&D agency budgets for the new fiscal year. The publication of this analysis was discontinued after the fiscal year 1990 budget, but since that time, R&D has been discussed (with the information traditionally presented in Special Analysis J) in a separate introductory chapter to the President's budget.[21]

OMB's role in research priority setting and fiscal allocation is not public. The deliberations of the agency are internal, building on agency submissions preliminary to OMB decisions (see box 3-A). Behind-the-scenes negotiation between OMB examiners and agency budgeters is common. This closed-door policy minimizes contention, and perhaps stifles controversy, both within and without the government on specific funding issues.

A strong perception of OMB standards and policies on research has grownup outside of OMB and the executive branch. Most importantly, many observers state that OMB has an active role in deliberations over research agendas, particularly in support of projects such as the Space Station and the SSC. New programs, especially Presidential initiatives such as the Moon/Mars mission, require that OMB be involved early in the fiscal process.[22] But because these deliberations are shielded from public view, critics claim that these policies are not sufficiently debated.

The fiscal 1991 budget act placed a separate cap on discretionary spending in three budget categories: defense, domestic, and international programs. These caps limit spending for each of fiscal years 1991 through 1995 and specify methods of enforcing deficit targets.[23] The caps will force tradeoffs within each category of the budget; this will effectively reduce flexibility and foster more negotiation within the executive branch (i.e., among OMB, OSTP, and the agencies) in the allocations for specific programs.[24] Members of OMB staff also stress, however, that these caps will force greater priority setting based on the research issues, because the overall spending levels will be set.[25] Observers agree that the Omnibus Budget Reconciliation Act of 1990 has enhanced OMB's authority relative to Congress because OMB ". . . will have a final say on cost estimates for all programs." [26] (For further information on the budget act, see box 3-B.)

[19] Mervis, op. cit., footnote 10, p. 3.

[20] Under President Bush, the Federal Coordinating Council for Science, Engineering, and Technology and the Science Advisor have participated in the implementation of several presidential priorities. For the fiscal *year* 1991 budget, they included global climate change, high-performance computing, and mathematics and science education.

[21] These analyses, in turn, form the basis for an analysis and spring colloquium on the R&D budget, held in Washington, DC, and presented by the American Association for the Advancement of Science. These proceedings, edited and published the following fall, serve an important interpretive function for the scientific community, relating the budget to topical issues in science and technology. For the 15th annual proceedings, see Susan L. Sauer (cd.), *Science and Technology and the Changing World Order* (Washington, DC: American Association for the Advancement of Science, 1990).

[22] Hugh Loweth, ''Science Advising and OMB,'' *The Presidency and Science Advising,* vol. 3, Kenneth W. Thompson (ed.) (Lanham, MD: University Press of America, 1987).

[23] See ''Title ~—Budget Enforcement,'' *Congressional Record—House*, Oct. 26, 1990, pp. H12743-H12744.

[24] Karl Erb, Office of Science and Technology Policy, personal communication November 1990.

[25] Robert Grady, associate director, Natural Resources, Energy, and Science, Office of Management and Budget, personal communication, Feb. 7, 1991.

[26] See Thomas J. DeLoughry, ''Deficit-Reduction Plan Could Tighten Budgets for Student Aid and Research,'' *The Chronicle of Higher Education,* vol. 37, No. 10, Nov. 7, 1990, pp. 1418, A28.

Box 3-A-OMB and the Research Budget

The Office of Management and Budget (OMB) reviews the budgets of all Federal agencies before submission of the President's budget to Congress arid perform crosscutting budget analyses, espcially for topics of partieuiar interest to the President. Traditionally, OMB has been very supportive of research in the Federal budget. This reflects the importance attached to research and development (R&D) in the budgeting process and the overall real and symbolic value of Federal research support as an indicator of future planning and direction in government investments.

Under President Bush and OMB Director Darman, the process of planning the research budget has changed. Before the budget is collated, R&D is the subject of several separate briefings and detailed analyses of issues concerning research initiatives (e.g., funding for individual investigators and big science projects on a case-by+ase basis). The Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) committees and the Science Advisor have also participated extensively in the implementation of programs in severa1 Presidential priority areas, especially global climate change, high-performance computing, and mathematics and science education. Important criteria for R&D investment used by OMB include the support of excellent science and engineering, long-term competitiveness and economic concerns, commercial spinoffs, national prestige, and "national security"—in the broadest military and economic sense.[1]

In the budget process for fiscal years 1991 and 1992, OMB asked the research agencies to submit budgets at five levels of funding, which include scenarios with real cuts as well as augmented funding, In addition, OMB requested that, for areas of particular Presidential interest, agency budget requests be "... described and justified relative to the goals, objectives, and research priorities. . ." outlined in various framework documents, such as the U.S. Global Change Research Program.[2] In areas not of highest priority, less crosscutting analysis is performed, and the manner in which these concerns are negotiated with the agencies is left more to the discretion of OMB budget examiners,

Tradeoffs are made among agency programs, and between the "research budget" and other areas of domestic discretionary finding. Under the new budget agreement, when OMB "passes back" the agency budgets after the first review, OMB has budgeted up to the caps determined for the agencies. If an agency wishes to increase specific levels of funding, decreases to the agency budget must also be specific to allow the total budget to remain under the spending cap. Tradeoffs are then made explicitly among agency programs.[3]

In summary, OMB provides a unique crosscutting function in research budgeting within the executive branch, Under President Bush, the implementation of research priorities has been accompaniedby an increased roll for the Science Advisor and the FCCSET committees.[4] In addition, general research priority setting has been elevated in the presentation of the President's budget. However, priority setting unrelated to targeted Presidential concern remains primarily at the discretion of the budget examiners for the specific agencies, and tradeoffs are within agency budgets.

[1] OTA meeting with Robert Grady, Joseph Hezir, and Jack Fellows, Office of Management and Budget, Feb. 7,1991.

[2] Robert E. Grady, Associate Director, Natural Resources, Energy, and Science, Office of Management and Budget, "Terms of Reference Memorandum on the FY 1992 U.S. Global Change Research Program," unpublished document, June 18,1990.

[3] The Darman Office of Management and Budget (OMB) was said to consider R&D as yielding especially high future returns on Federal investment. To this end, the process instituted by OMB encourages the research agencies to develop coherent proposals and discourages both within-agency disagreements and unresponsiveness of an agency to the requests of either OMB or the Office of Science and Technology Policy. Ground rules and deadlines are spelled out in the "terms of reference" issued by OMB in every priority area designated for an agency crosscut.

[4] Part of this increased Office of Science and Technology Policy (and Office of Management and Budget-reinforced) role has led to requests of the agencies for evaluative data. Of special relevance to this OTA report is the information gathering in progress on the "structure of science," an activity of the Federal Coordinating Council on Science, Engineering, and Technology Committee on Physical, Mathematical, and Engineering Sciences.

External Advice and Interest Groups

Much scientific and technical advice is solicited from the scientific community by the executive branch. This partnership between the scientific community and government has led to a complex policy structure that takes into account a range of views on many decisions. Active debate occurs both informally and within the scientific literature on programs, policies, and projects initiated by the Federal Government, and this debate often influences government decisions.

Box 3-B—New Layers of Complexity for the Federal Budget

A budget process many critics had said was too complicated has become even more so, thanks to sweeping changes adopted by Congress and approved by President Bush.[1] Here are the major revisions to the 1985 Balanced Budget Act that will dramatically alter the way the budget will be drafted through fiscal 1995.

Discretionary Spending

For fiscal years 1991 to 1993, the law establishes separate ceilings for each of three categories of discretionary spending: defense, international aid, and domestic programs. If Congress chooses to increase spending for any discretionary program, it must offset the increase by cutting spending within the same category.[2] If it fails to make an offsetting reduction, an automatic spending cut--a sequester, in budget jargon-would slice enough from all other programs in that category to bring spending to below the ceiling.

The spending caps, in billions of dollars, are as follows (BA is budget authority, the amount Congress authorizes the government to spend in current or future years; O is outlays, the actual spending expected in each year):

	1991	1992	1993
Defense			
BA	$288.9	$291.6	$291.8
O	297.7	295.7	292.7
International			
BA	20.1	20.5	21.4
O	18.6	19.1	19.6
Domestic			
BA	182.7	191.3	198.3
O	198.1	210.1	221.7

For fiscal years 1994 to 1995, the new law establishes a single pot of money for all discretionary spending. The White House and Congress will have to decide how to allocate that money between the three spending categories. Spending above that overall limit would trigger a sequester to bring spending down to that ceiling. Total discretionary funds for those two years, in billions of dollars, are as follows:

	1994	1995
BA	$510.8	$517.7
O	534.8	540.8

Pay-as-You-Go Spending

Under the new law, Congress is required to offset the costs of any new entitlement spending programs and any tax reduction legislation. If Congress creates an entitlement program or tax benefit that is not ‘‘revenue neutral" ‘--not financed by an offsetting tax increase or spending cut—it would then have to adopt a deficit cutting ‘‘reconciliation bill to find the needed savings. Failing that, a sequester would cut enough from all other entitlements (except those, such as social security, that are already exempt from the ‘‘sequester’ under the 1985 Balanced Budget Act) to make up the difference.

Adhering to broad sentiment in Congress, the new law takes the social security trust funds out of the deficit calculations. As a result, the funds’ growing surpluses will not be used in determining whether the government has met its annual deficit targets. That is a victory for those who complained that the trust fund surpluses were masking the budget deficit’s true size.

Sequesters

Unlike the 1985 law, which called for a sequester in October of each year in which Congress failed to meet specific deficit targets, the new law creates a schedule under which sequesters can occur several times a year for discretionary programs and once a year for entitlements and tax cuts.

[1] The following is an edited version of "Adding New Layers of Complexity to Budget," a box appearing in Lawrence J.Haas, "New Rules of the Game, " *National Journal, vol.* 22, No. 46, Nov. 17, 1990, p. 2796.

[2] The defense category, however, does not include the costs of Operation Desert Storm in the Persian Gulf, which the law assumes Congress will finance separately.

Continued on next page

Box 3-B—New Layers of Complexity for the Federal Budget-Continued

First, a sequester directed at budget-busting appropriations bills can be triggered, if required, within 15 days of the end of a session of Congress. Second, a sequester can occur within 15 days of the enactment of such appropriations bills if the enactment takes place before July 1. Third, if those appropriations bills are enacted after July 1, a sequester would be applied to spending bills for the next fiscal year, which begins on October 1.

For entitlements and tax cuts, the law calls for a one-time review of all bills to determine whether they will, in total, increase the deficit. If they will, nonexempt entitlements would be sequestered at the same time as the end-of-session appropriations.

Deficit Targets

The new law sets deficit targets for the next 5 fiscal years. They are (in billions of dollars):

1991	$327
1992	317
1993	236
1994	102
1995	83

For fiscal years 1991 to 1993, the targets are not binding on the White House and Congress. Along with the spending caps for defense, international aid, and domestic programs, they will be adjusted to account for changes in economic and technical assumptions. For fiscal years 1994 to 1995, the President may adjust the deficit targets, if he chooses, for economic or technical reasons. If he does not adjust them, failure to reach those targets will trigger a sequester like that required under the 1985 budget law.

Scorekeeping

Furthering a trend that began when the Balanced Budget Act was revised in 1987, the Office of Management and Budget (OMB) has been given additional authority to tabulate the cost of tax and spending legislation. Previously, OMB had the power to decide whether, based on the costs of all such legislation and other factors, a sequester was required. But the Congressional Budget Office and Congress's Joint Committee on Taxation had the duty of tallying the costs of each tax and spending bill as it moved through Congress. Now, OMB's cost calculations will be binding on Congress.

While the Science Advisor and numerous advisory committees allow the scientific community, or more accurately, the various research constituencies within it, a voice in government decisions, other channels also exist to influence Federal policy. An unrivaled source of authority is the independent, congressionally chartered (in 1863) National Academy of Sciences (NAS). The presidents of NAS, the National Academy of Engineering, and the Institute of Medicine act as opinion leaders and buffers between the science community and the Federal Government (discussed further in chapter 5). Both the executive branch agencies and Congress call on (and pay for) NAS to conduct studies on issues of some urgency and importance in science, technology, and medicine.[27] The academies' elected membership of eminent specialists, working through panels and commissions, lends credibility to the reports they issue.[28]

Various interest groups have also traditionally played major roles in the formulation of Federal research funding and regulatory policy. Of an estimated 6,000 public and special interest groups active in Washington, many have a stake in some aspect of the diffuse Federal research activities.[29] Prominent interest groups that lobby on behalf of science include many industrial groups, professional societies, the higher education associations, and other more specialized groups that encourage research in targeted areas, such as the environment or health.

[27] And the congressional appetite has grown from 9 National Academy reports mandated by the 95th Congress (1979 to 1980) to 24 by the 101st. See "Congress Hungry for NAS Advice,' *Science,* vol. 250, Dec. 7, 1990, p. 1334.

[28] For a definitive look at the National Academy of Sciences as a social institution see Philip Boffey, *The Brain Bank of America* (New York, NY: McGraw-Hill, 1975). The National Academy Press also publishes a quarterly journal, *Issues in Science& Technology,* which provides a policy forum for an array of opinion leaders in and out of government. The National Research Council's (NRC's) *NewsReport* also provides a record of National Academy of Sciences' studies undertaken by NRC.

[29] Deborah M. Burek et al. (eds.), *Encyclopedia of Associations,* vol. 2 (Detroit, MI: Gale Research, Inc., 1989).

As discussed below, interest group lobbying is most often associated with the legislative branch since the congressional decisionmaking process is more open and decentralized. However, lobbying of executive agencies also occurs and can sometimes have a significant effect on specific research programs. For example, program managers at the Agricultural Research Service in the U.S. Department of Agriculture (USDA) and at the Conservation and Renewable Office in the U.S. Department of Energy (DOE) state that agribusiness and energy industry lobbies, respectively, play a large role in setting agency priorities. In the current system, this involvement is important, because agribusiness and the energy industries are considered the eventual clients of these programs. Interest groups can also provide additional technical information (which may not be available to agency personnel) that can be used for decisionmaking, and they can influence the development of debate on specific programs. Outside interest groups can be seen as an informal extension of the advisory committee system and can be very beneficial to agency operations. However, in a more ideal system, the influence of interest groups and their interactions with the government would be made more public.[30]

After the executive branch agencies, OMB, and others produce the President's budget, it goes to Congress. Research program budgets and their accompanying support documentation are subsequently reinterpreted by congressional committees to determine agency priorities (e.g., increases over inflation or predicted spending targets in specific programs are interpreted as strong executive branch support, while corresponding decreases are interpreted more negatively). Congress then has an opportunity to comment on and change these priorities.

The Legislative Branch

Congress has traditionally been very supportive of the research enterprise in the United States, and rarely do debates over research issues divide along partisan lines. In particular, there has existed over at least the last 30 years a broadly shared supportive ideology covering goals, values, programmatic priorities, and rationales. The same arguments about health, economic competitiveness, and national prestige are part of members' arguments about science policy from all ideological perspectives.[31] Nevertheless, emphases given to specific programs have varied over the years.

During the 1960s, research was perceived as a means of increasing national prestige, enhancing security, and providing benefits. The goals of outdistancing the Soviets and maintainingg a leadership position in the world through research were supported by Democrats and Republicans, liberals and conservatives, hawks and doves. However, while some members were convinced that research monies for defense could be better spent on domestic problems, others believed that direct expenditures on defense research would be more effective for boosting the economy and national defense.

During the late 1960s and early 1970s, science was burdened with greater material expectations, especially after the success of the Apollo Moon program.[32] Preservation of national preeminence remained a strong goal on all fronts, but different groups stressed different tangible rewards. The Democratic party platform in 1972 argued that research should protect the environment and improve employment for scientists.[33] In the same year, Republicans sought a science that would improve U.S. economic competitiveness internationally.[34] Liberals and conservatives clashed over the pace and extent of environmental initiatives. However, these disagreements were most often expressed over specific programming rather than the importance of a clean environment.

During the mid- to late 1970s, Democratic and Republican priorities diverged, despite agreement on some specific program areas. For example, 1976 Democrat and Republican party platforms supported energy research. However, the Democrats made a case for government investment, calling for". . . major

[30] See the Byrd Anti-Lobbying Provision (Public Law 101-121).

[31] Birdsell and Simons, op. Cit., footnote 7.

[32] See J.W. Fulbright, ''Is the Project Apollo Program To Land Astronauts on the Moon by 1970 a Sound National Objective?' *Congressional Digest,* vol. 44, February 1965, pp. 47, 49, 51, 53; and Barry M. Goldwater, "Is the Project Apollo Program To Land Astronauts on the Moon by 1970 a Sound National Objective?' *Congressional Digest, vol. 44,* February 1965, pp. 53,55.

[33] Bruce D. Johnson, *National Party Platforms: Volume II, 1960-76* (Urbana, IL: University of Illinois Press, 1978), pp. 802-803.

[34] Ibid., pp. 876-877.

Photo credit: Michael Jenkins

Two members of the Senate Committee on Energy and Natural Resources, which has jurisdiction over the research programs at the Department of Energy and Interior, confer.

initiatives, including major governmental participation in early high-risk development projects. . . ."[35] The 1976 Republican party platform detailed the importance of maintainingg a balance among private, university, and government efforts at scientific research. It pledged to ". . . support a national science policy that will foster the public-private partnership to insure that we maintain our leadership role. '[36] This position in the Republican platform was deepened considerably in OMB's *Issues* '78, which accompanied President Ford's final budget.[37] ***Issues*** '78 stressed the importance of leaving a role for the private sector and avoiding government involvement in readying technologies for commercial development.

During the 1980s, Republicans took the 'Issues' agenda a step further, arguing that ''partnerships" among government, universities, and industry were the best way to promote research, leaving all development issues to industry except in cases of a pressing defense interest. Democrats contested this rationale, arguing that a massive increase in the research funds oriented toward defense tarnished relations between the government and the scientific community .38

In general, Congress is empowered to be an architect of the research system. To implement or guide initiatives in the U.S. research system, Congress can adjust the research budget, craft legislation, or monitor and influence Federal agencies through the oversight function. (See appendix A for a summary of major legislation passed by Congress since 1975 affecting U.S. R&D.) Unfortunately, because it must consider the priorities set by the Federal agencies *after they* have been codified in the President's budget or ***after they*** have been acted on in a program, Congress' position has often been reactive rather than proactive.

The following describes the congressional committee structure, budget process, and the oversight function. These processes are well understood. The relatively new phenomenon of earmarking appropriations to universities (for eventual use in the conduct of research) is described in more detail.

The Congressional Committee Structure and the Budget Process

Almost one-half of the 303 committees and subcommittees of the 10lst Congress claimed jurisdiction over some aspect of research.[39] While inhibiting development of coordinated public policy, this fragmentation has characterized the long history of Federal involvement in research. Furthermore, congressional history shows that Congress has generally chosen to decentralize decisionmaking further rather than to consolidate and coordinate the Federal legislative process.

The Committee System

Congress' internal party organizations in each house assign members to committees, considering their preferences, party needs, and the geographical

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[35] Ibid., p. 934.

[36] Ibid., p. 984.

[37] Office of Management and Budget, *Issues* '78 (Washington, DC: U.S. Government Printing Office, January 1977).

[38] The Democrats have always been proponents of more active Federal intervention in R&D that affects the civilian economy. This can be traced to the Kilgore v. Bush debate of the late 1940s over the role of a national science foundation. Brooks, op. cit., footnote 9.

[39] Much of the following section is breed on U.S. Congress, Office of Technology Assessment, *Delivering the Goods: Public Works Technologies and Management, OTA-SET-477 (Washington* DC: U.S. Government Printing Office, April 1991). Also see Morris P. Fiorina, *Congress: Keystone of the Washington Establishment,* 2d ed. (New Haven, CT: Yale University Press, 1989).

Table 3-l—Congressional Authorization Committees and Appropriations Subcommittees With Significant Legislative Authority Over R&D

Jurisdictions of authorization committees: [a]	Agency
House:	
Agriculture	USDA
Armed Services	DOD,DOE
Energy and Commerce	DOE, ADAMHA, NIH,CDC,DOT
Interior and insular Affairs	DOI
Science, Space, and Technology	NASA, NSF,DOE,EPA,NOAA, DOT,NIST,DOI
Public Works and Transportation	NOAA,DOT
Merchant Marine and Fisheries	USDA,NOAA,DOT
Veterans Affairs	VA
Foreign Affairs	A.I.D.
Senate:	
Agriculture, Nutrition, and Forestry	USDA
Armed Services	DOD,DOE
Commerce, Science, and Transportation	NSF, NASA,DOT,NOAA,NIST
Energy and Natural Resources	DOE,DOI
Labor and Human Resources	NIH,ADAMHA, CDC,NSF
Environment and Public Works	EPA
Veterans Affairs	VA
Foreign Relations	A.I.D.

Jurisdictions of appropriations committees: [a]	Agency
Labor, Health and Human Services, Education and Related Agencies	NIH,ADAMHA,CDC
HUD and Independent Agencies	NASA,NSF, EPA,VA
Energy and Water Development	DOE
interior and Related Agencies	DOE,USDA, DOI
Agriculture, Rural Development and Related Agencies[b]	USDA
Commerce,Justice, State, the Judiciary, and Related Agencies	NOAA,NIST
Transportation and Related Agencies	DOT
Foreign Operations	A.I.D.
Defense	DOD

KEY: ADAMHA=Alcohol, Drug Abuse, and Mental Health Administration; A.I.D.=Agency for international Development; CDC=Centers for Disease Control; DOD=U.S. Department of Defense; DOE=U.S. Department of Energy; DOI=U.S. Department of the anterior; DOT=U.S. Department of Transportation; EPA=U.S. Environmental Protection Agency; HUD=U.S. Department of Housing and Urban Development; NASA=National Aeronautics and Space Administration; NIH=National Institutes of Health; NIST=National Institute of Standards and Technology; NOAA-National Oceanographic and Atmospheric Administration; NSF= National Science Foundation; USDA=U.S. Department of Agriculture; VA=U.S. Department of Veterans Affairs.

aThe jurisdictions of the authorizing committees are not exclusive. For this table, repeated authorization of a number of R& D-related programs was required to establish jurisdiction.

bThe corresponding subcommittees of the Senate and House Committees on Appropriations have the same name with one exception: the Senate Subcommittee on Agriculture, Rural Development, and Related Agencies and the House Subcommittee on Rural Development, Agriculture, and Related Agencies.

SOURCES: Office of Technology Assessment, 1991; and Elizabeth Baldwin and Christopher T. Hill, "The Budget Process and Large-Scale Science Funding," *CRS Review,* February 1988, p. 15.

and ideological balance of each committee.[40] Most bills are referred to one standing committee, but the complexity of public policy issues means that major bills are often sent to multiple committees with overlapping jurisdictions. Individual committee rules determine a bill's subcommittee assignments, which also can overlap. Table 3-1 shows the committees with important legislative jurisdiction over research.

Overlapping committee jurisdictions can slow and even stall policy development and send mixed signals to the executive branch and lower levels of government. Committees that try to develop comprehensive research policies are often frustrated by

[40] In the 101st Congress, the Senate had 16 standing committees and 87 subcommittees; the House operated with 22 committees and 146 subcommittees. In addition, the 101st Congress has 9 special or select (with 11 subcommittees) and 4 joint committees (with 8 subcommittees) whose functions are primarily investigative. The average Senate committee had five subcommittees, compared to seven in the House. Every House member, except top party leaders, served on at least one standing committee. Senators served on at least two committees.

the vested interests of their sister committees, executive branch agencies, and various research communities.

Congressional committees have evolved into permanent bodies with authority to propose legislation, an independence that has given committees almost unassailable influence over legislation in their specialized areas.[41] Committee chairmen consequently wield enormous power.[42] They tend to be long-lived in their positions, holding them much longer than the terms of most presidents or Federal agency executives. This longevity allows committee chairmen to influence the long-term course of events in a particular area and to implement detailed agendas. However, some committees are better positioned on certain issues than others.

The Budget Process and the Authorization and Appropriations Committees

Authorizing committees in both houses report annual or multiyear authorization bills for Federal programs under the jurisdiction, thereby setting the maximum amount of money an agency may spend on a specific program. The exceptions are entitlement programs, such as social security and Medicaid, which operate under permanent authorization and are effectively removed from the authorizing process. Authorizing (or legislative) committees and subcommittees are influential through their oversight functions when major new legislation is first passed, when an agency is created or its program substantially modified, and when setting funding authorizations to initiate, enhance, or terminate a program. During the 1980s, deficit reduction laws and trends restricting spending, shortcomings in the budget process, and new programs greatly expanded the roles of the "money" committees-Appropriations, Budget, and Ways and Means on the House side, and Appropriations, Budget, and Finance in the Senate—at the expense of authorizing committees.

After the Presidential budget reaches Congress, the Budget committees in the House and Senate provide a concurrent resolution that sets an overall ceiling and limits for major spending areas, like health or transportation. Appropriation bills, originating within the House Committee on Appropriations and its 13 subcommittees, effectively control spending since authorized funds may not be spent unless they are also appropriated.

Photo credit: Michael Jenkins

Members of the House Committee on Agriculture debate the 1990 Farm Bill, which affected many research programs at the Department of Agriculture.

No less than nine subcommittees of Appropriations have jurisdiction over research. While these nine subcommittees will decide what monies are appropriated for research, the initial distribution of funds by the full committee among the subcommittees can have serious implications for research funding. For example, the Veterans Affairs, Housing and Urban Development, and Independent Agencies Appropriations Subcommittee is responsible for the budgets of NASA and NSF, or 35 percent of the civilian R&D budget. If this subcommittee is for some reason "left short," then science funding could suffer significantly as it competes with housing, veterans' affairs, and other programs. Furthermore, research budgets will be largely negotiated within the new "domestic" spending category, making decisions all the more difficult. As noted earlier, the Budget Reconciliation Act of 1990 establishes limits on discretionary spending by category (a new Title VI of the Congressional Budget Act of 1974). It also states:

> As soon as possible after Congress completes action on a discretionary spending . . . bill, and after consultation with the [House and Senate] budget

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[41] Judy Schneider, updated by Carol Hardy, *The Congressional Standing Committee System--An Introductory Guide* (Washington, DC: Congressional Research Service, May 1989), p. 2.

[42] This power was enhanced in the "House revolution of 1910," limiting the role of the Speaker by establishing seniority as the major criteria for determining committee chairmanship and moving up in its ranks. Ibid., p. 3. In battles of information where larger support staffs can determine the victor, committee chairmen have a distinct advantage with additional committee personnel.

committees, the Congressional Budget Office (CBO) is to provide the Office of Management and Budget (OMB) with an estimate of the bill's effect on spending and revenues. . . . OMB is required to explain differences between its estimates and those of CB0.[43]

Some research agencies fared very well in the congressional appropriations process during the 1980s. For example, even under tight budgetary constraints, the National Institutes of Health was routinely given more money by the Labor, Health and Human Services, Education, and Related Agencies Subcommittee than the Administration had originally proposed.[44] USDA, and to some extent DOE, have also consistently received more in actual budget authority than allocated in the President's budget. Although in theory, policy and oversight is reserved for authorizing committees, appropriations committees frequently insert legislative provisions and funding for special projects into bills (see the discussion below on congressional earmarking). The appropriations committees' control over spending and the tendency to modify authorizing legislation creates tensions and intensifies intercommittee rivalries, particularly in the House where a smaller proportion of members serve on the Committee on Appropriations.

In Congress, jurisdiction or turf can mean additional staff, publicity, and power, prompting committees to seek broad jurisdictions and resist moves to narrow them, perpetuating conflicts and overlaps. Research issues are particularly susceptible to fragmentation and competition, because they cut abroad swath across national life. Historically, each issue has developed independently based on different goals and objectives, establishing supportive committee connections and constituencies that are hard to alter. Larger jurisdictional areas allow greater flexibility in linking issues within comprehensive legislation. However, they can also pit unrelated issues against each other for attention on a committee's agenda.

External Advice and Scientific Interest Groups

The congressional process is open and decentralized and is designed to incorporate public opinion. Like the executive branch, Congress solicits advice from scientific experts on many issues. This partnership and the active open involvement of the scientific community has lent strength to government decisionmaking on research.

In addition to solicited advice, scientific information is also offered by the thousands of public and special interest groups that actively lobby the Federal Government. These groups organize the opinions of their constituents. They employ technical experts to press their cases to Congress, testifying at hearings, providing privileged information, drafting model legislation, publishing and distributing reports, and meeting with members and staff. For example, in the global climate change debates in Congress, various environmental groups (both for and against action on global climate change) have presented comprehensive technical analyses detailing the current state of scientific knowledge and the most notable gaps. These analyses have influenced the allocation of monies for research in these areas.

The number of interest groups and politically active professional organizations increased dramatically during the 1970s and 1980s. This proliferation coincided with an expansion of congressional subcommittees, which provided more opportunities for lobbying and greater public participation in executive agency rulemaking.[45] While often seen as detrimental to the process, interest groups can furnish valuable information to debates and can present important arguments. Nevertheless, as with executive branch lobbying, because of the informal nature of the relationship of interest groups to

43'' *Title* XIII,'' Op. Cit., footnote 23, p. H12745. A later section on ''scorekeeping'' underscores the point: "Section 251(a)(7) and 252(d) of Gramm-Rudman-Hollings as amended by this conference agreement provides that the Office of Management and Budget must make its estimates in conformance with scorekeeping guidelines determined for consultation among the Senate and House Committees on the Budget, the Congressional Budget Office, and the Office of Management and Budget" (pH12749). See Lawrence J. Haas, "New Rules of the Game,' *National Journal,* vol. 22, No. 46, Nov. 17, 1990, pp. 2793-2797.

44 American Association for the Advancement of Science, *Congressional Action on Research and Development in the FY 1991 Budget* (Washington, *DC: 1990),* p. 7.

45 The research lobbies are a heterogeneous lot, ranging from, for example, the Industrial Research Institute, the Pharmaceutical Manufacturers Association, and Research! America to the education lobbies, such as the National Association of State Universities and Land-Grant Colleges and the Association of American Universities, and the Federal liaisons for the research universities who work closely with State congressional delegations.

Congress, interactions can appear unseemly. Every issue, including research funding, has a constituency and, therefore, special interests.[46]

Congressional oversight

Congress has invested the executive branch with broad authority over the multitude of Federal agencies and programs. However, in 1946, Congress officially reaffirmed its responsibility for oversight in the Legislative Reorganization Act. In 1970, Congress required that House and Senate committees publish oversight reports every 2 years, and increased committee staff size. Congress further acted in the 1974 Congressional Budget and Impoundment Act to strengthen the role of the General Accounting Office (GAO—a congressional support agency) to acquire fiscal and program-related information.[47]

In addition, House committee rules adopted in 1974 stipulated that committees with more than 15 members (raised to 20 members in 1975) create oversight subcommittees or require that legislative subcommittees provide oversight. Legislative subcommittees can only carry out oversight within their jurisdiction, while oversight subcommittees operate within the full committee's jurisdiction.[48]

Oversight can be exercised through: 1) hearings and investigations; 2) the authorization and appropriations processes; 3) GAO audits and investigations; 4) other studies by congressional support agencies; 5) legislatively mandated periodic reporting from executive branch agencies to Congress; 6) the Senate confirmation process of high-level political appointees; 7) casework and constituent questions about Federal agencies; 8) creation of special task forces; and 9) informal, nonstatutory controls, such as informal contacts between agency personnel and congressional staff. Groups outside of Congress and the executive agencies aid these processes by providing information to Congress about potential and existing problems in the executive agencies.

Congressional oversight has been important in determining the budgets of specific research programs and encouraging coordination between the research agencies.[49] Congressional oversight addresses the problems of research management and priority setting. Recently, fraud and misconduct by scientists in federally sponsored research projects have also been a focus of congressional investigations.[50] Combined with the power of the purse, Congress has effective tools to initiate change within the Federal research system.[51]

One tool that has been increasingly used by Congress in the last decade is academic earmarking-the provision of funds as line items in the budget for specific research facilities and projects. Because this practice is seen as circumventing normal procedures, it has been a subject of heated debate within the scientific community and Congress.

[46] Sometimes, the best strategy for serving that interest is disputed among the lobbyists themselves. All work behind the scenes; some also place advertisements in the *The Washington Post* and *The New York Times.* For example, see Joseph Palca, "Grants Squeeze Stirs Up Lobbyists," Science, vol. 248, May 18, 1990, pp. 803-804.

[47] Congressional Quarterly, *Congressional Quarterly's Guide to Congress,* Michael D. Wormer (cd.) (Washington, DC: Confessional Quarterly Inc., 1982), pp. 459-462.

[48] In 1990, there were 11 House committees with oversight subcommittees: Armed Services; Banking, Finance and Urban Affairs; Energy and Commerce; Interior and Insular Affairs; Merchant Marine and Fisheries; Post Office and Civil Service; Public Works and Transportation; Science, Space and Technology; Veterans Affairs; Ways and Means; and Select Intelligence. In addition, there are four committees whose implicit function is oversight: Appropriations, Budget, District of Columbia, and Government operations. The House rules also give seven committees special oversight abilities to cross jurisdictional lines: Armed Services; Budget; Education and Labor; Foreign Affairs; Interior and Insular Affairs; Science, Space and Technology; and Small Business. Three Senate committees had oversight subcommittees: Agriculture, Nutrition, and Forestry; Finance; and Government Operations. Two Senate committees have implicit oversight responsibilities: Appropriations and Budget. Together, the House and Senate committees have oversight over all of the R&D programs in the Federal agencies.

@See Morris S. *Ogul* and Bert A. Rockman, "Overseeing Oversight: New Departures and Old Problems," *Legislative Studies Quarterly, vol. 15,* February 1990, pp. 5-24.

[50] See Marilyn J. Littlejohn and Christine M. Matthews, "Scientillc Misconduct iuAcademia: Efforts to Address the Issue," *CRS Report for Congress, 89-392* SPR (Washington, DC: Congressional Research Service, June 30, 1989); Rosemary Chalk and Patricia Woolf, "Regulating a 'Knowledge Business'," *Issues in Science & Technology,* vol. 5, No. 2, winter 1988-89, pp. 33-37; U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Investigations and Oversight, *Maintaining the Integrity of Scientific Research,* 101st Cong. (Washington, DC: U.S. Government Printing Office, January 1990); and U.S. Congress, House Committee on Government operations, *Are Scientific Misconduct and Conflicts of Interest Hazardous to Our Health?* 101st Cong. (Washington, DC: U.S. Government Printing Office, September 1990).

[51] For an analysis, see Marcel C. LaFollette, "Congressional Oversight of Science and Technology Programs,' paper prepared for the Committee on Science, Technology, and Congress, Carnegie Commission on Science, Technology, and Government, New York, NY, September 1990.

Congressional Earmarking

Since the early decades of this century, powerful legislators, especially committee chairmen and ranking members, have made the congressional earmark (a specific project funded directly by congressional appropriation) a routine, albeit small, part of the process by which the Nation's budget is disbursed to regions, States, and districts. Through earmarks a range of goods and services are procured. The practice of congressional earmarking is now a well-entrenched and important component of this political system, and it has historically been regarded as a redistributive device that addresses fiscal inequities through legislative power.[52]

While earmarking has been a traditional funding mechanism in many areas of government spending, explicit ''academic earmarks' appear to be a relatively new phenomenon, dating to the early 1980s.[53] That this funding mechanism has been extended to academic research is not surprising, given the geographical and other inequities in research funding. However, for the scientific community in which the ethic of peer review is so strong, earmarking is contrary to the established mentality of ''fair' funding allocation. It signals a departure from the old social contract that delegated authority to representatives of the scientific community to judge technical merit and advise the Federal Government on research investments.[54]

What Is an Academic Earmark?

For the purposes of this discussion, OTA defines a congressional academic earmark as a project, facility, instrument, or other academic or research-related expense that is directly funded by Congress, which has not been subjected to peer review and will not be competitively awarded.[55] Among the largest examples of 1990 earmarks under this definition are the Soybean Laboratory at the University of Illinois-Urbana, the Waste Management Center at the University of New Orleans, a medical facility at the Oregon Health Sciences University, and a geology research project awarded to the University of Nevada system.

There are other definitions of academic earmarks.[56] One states that an earmark is any research project or facility *directly* funded by Congress. This definition implies that the executive branch role in setting budgets and priorities and administering the Federal Government's research programs is more valid than decisions made by Congress. Not surprisingly, some members consider this definition an insult to Congress. Another definition stresses that earmarks are projects that are initiated by Congress and receive appropriations, but not approved by authorizing committees. This definition reflects some members' view that the legislative process should work as is formally intended, i.e., authorizations should always precede appropriations. Consequently, this definition is sometimes used within Congress to oppose earmarking, as earmarkers violate the norms of the budget process .57 Still other definitions seek to make exceptions for direct appropriations for projects in the Agriculture appropriations bill, because agricultural research is said to have a distinct culture where such projects are the norm. Finally, other definitions make a distinction

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52John A. Ferejohn, *Pork Barrel Politics* (Stanford, CA: Stanford University Press, 1974), p. 252. One story has it that the word ''earmar k' ' derives from a practice as old as the Republic itself. Pigs' ears were cut off prior to the animals grazing in a common area with the pigs owned by others. Credit for a stolen or slaughtered pig could be established by possession of the physical evidence-the ''mark' of the ear.

53Hugh Loweth, who retired after 35 years from the Office of Management and Budget (OMB) in 1986 as deputy associate director for energy and science, cites as the origin of the current wave of academic earmarks Science Advisor George Keyworth. In 1982, without consulting either with OMB or the materials research community, Keyworth attempted to insert $140 million in the Department of Energy budget as a "Presidential initiative" for a National Center for Advanced Materials at Lawrence Berkeley Laboratory in California. A storm of protest led, depending on the source, to a scaling back of the project or a temporary deferral by Congress. See Wil Lepkowski, "Hugh Loweth, Key Science Policy Official, Retires," *Chemical & Engineering News,* vol. 64, No. *29, July 21, 1986,* pp. 16-18; and Robert P. Crease and Nicholas P. Samios, ' 'Managing the Unmanageable, " *The Atlantic Monthly*, January 1991, p. 88. Crease and Samios interpret the significance of this event this way: ''After that episode Congress lost the restraint with which it had traditionally approached the basic research budget. If Presidential initiatives were possible, it was argued, so were congressional initiatives, and universities began to lobby Congress directly for them. "

54See Richard C. Atkinson and William A. Blanpied (eds.), Science, Technology, *and Government: A Crisis of Purpose*, proceedings Of a symposium, March 1988 (La Jolla, CA: University of California, San Diego, 1989), pp. 53-61.

55In this context, peer review refers t. the competition of proposals for funds, which are rated by independent scientific experts selected to advise an agency. See ch. 4 for a more complete definition of peer review.

56What follows is based on James Savage, University of Virginia, "Academic Earmarks and the Distribution of Federal Research Funds: A Policy Interpretation," OTA contractor report, July 1990. Available through the National Technical Information Service, see app. F.

57Congress is not of one mind on earmarking, and while many congressional representatives e armark, others are steadfastly opposed to it. See Dan Morgan, "Nunn Says He'll Investigate Some Defense Bill Projects, " *The Washington Post*, Oct. 10, 1990, p. A4.

between earmarks and direct appropriations for historically Black colleges and for other traditionally federally funded institutions such as Gallaudet University in Washington, DC.

The Debate Over Congressional Earmarking for Research

Within much of the scientific community, academic research earmarking is disdained: it is seen as circumventing peer review, politicizing science, and reducing the quality of research by diverting funds that otherwise would be awarded competitively for facilities and projects.[58] However, no one claims that simply because a project was funded through earmarking that ipso facto it would produce bad science. There is in fact evidence that earmarks can produce well-respected research;[59] some universities have defended their earmarks by pointing to positive evaluations of the earmarked projects by the relevant Federal agency (after the project has been initiated). Opponents to earmarking state that, given limited Federal resources, many worthy projects are likely to be denied funding, and thus some means of evaluating and ranking *all* research proposals are desirable. Some appropriations subcommittees may seek the advice of the cognizant agency on the merits of an earmark before funding it, particularly on facilities projects, but there is no evidence that such advice is sought systematically.

Earmarks often originate with legislation proposed by powerful members of Congress and strategically placed members on specific committees. There is much benefit to obtaining an earmark, especially since such projects are a relatively inexpensive way to help ensure reelection by bringing Federal funds to the member's district. These members are thought to be able to stifle debate on the merits of these projects, or cooperation between members is thought to circumvent it. This lack of open debate is seen as potentially jeopardizing the quality of the projects funded by earmarks and contributes to the perceived waste of national resources.[60]

On the other hand, many support earmarking, claiming it as legitimate political decisionmaking without which fair distribution of Federal funds would never take place. Proponents contend that there must be a tradeoff between efficiency and distribution, and that policymakers must work so that a portion of the wealth can be distributed to poor areas of the country.[61]

Congressional earmarking must also be viewed in relation to the almost absolute power of executive agencies to disburse Federal monies (subject to oversight by Congress). By seeking support for a specific program or project, executive agencies can designate monies for specific geographical areas or institutions-much like an earmark. For example, the SSC is to be built in Texas. DOE is thus supporting research in a specific geographical area and in the institutions and groups that will participate in the creation of the SSC.[62] Congress wonders whether it is responsible democratic government to confine all direct spending power in the executive branch. If agency processes do not meet desired ends, many claim that there must be some method for Congress to directly correct inequities. Earmarks thus are seen by many-both inside Congress and out—as expenditures having merit in furthering socially justifiable goals.

As congressional earmarking is currently practiced, it can disrupt agency budgeting. If additional money is not set aside for earmarks, then funds that were planned by the agency for their new or

[58] These arguments are reviewed in Daryl E. Chubin, "Scientific Malpractice and the Contemporary Politics of Knowledge," *Theories of Science in Society*, S.E. Cozzens and T.F. Gieryn (eds.) (Bloomington IN: Indiana University Press, 1990), pp. 149-167. Also see Ken Schlossberg, "Earmarking by Congress Can Help Rebuild the Country's Research Infrastructure," *The Chronicle of Higher Education,* vol. 36, No. 19, Jan. 24, 1990, p. A48; and Bob Davis, "Federal Budget Pinch May Cut Amount of 'Pork' to Colleges Living Off of the Fat of the Land,"*The Wall Street Journal, May 2,* 1990, p. A18.

[59] OTA interviews in the spring of 1990 at the Department of Energy (DOE) found that many earmarks of the early 1980s produced research centers highly regarded by some DOE program managers who had originally opposed them.

[60] U.S. General *Accounting* Office, *Budget Issues: Earmarking in the Federal Government* (Washington, DC: January 1990), p. 1.

[61] Earmarking can be in conflict with peer review, and perhaps should be. The two processes are *designed* to achieve different goals.

[62] Phil Kuntz, "Pie in the Sky: Big Science is Ready for Blastoff," *Congressional Quarterly Weekly Report,* vo1. 48, Apr. 28, 1990, p. 1254.

continuing programs must be reallocated to cover the congressionally mandated expenditures.[63]" For example, to cover earmarked projects in fiscal year 1989, DOE's Office of Basic Energy Sciences reallocated $20 million from programs it had planned.[64] To the extent that this is undesirable, it could be remedied if Congress would increase appropriations to cover the expense of earmarked programs or facilities. In addition, an earmark includes permission for the agency to spend less in another area (e.g., when Congress designates money for equipment at a specific university while also appropriating monies for programs that disburse funds to universities for the same type of equipment), and this tradeoff could be made explicitly in the congressional budget.

There are few sources of academic earmarking information, and longitudinal data are even harder to compile.[65] Table 3-2 shows that for fiscal years 1980 to 1989 over 300 earmarks in appropriations bills for academic facilities and projects represented a total dollar value exceeding $900 million. In the fiscal year 1991 budget, at least $270 million was designated for earmarks.[66] The data focus on appropriations, reflecting the fact that most earmarks originate in appropriations rather than authorization bills. Eventually the focus of data collection and analysis will have to expand, however, because academic earmarks have appeared in authorizing legislation, and some are added in amendments to legislation on the House and Senate floors.

Academic Earmarks: Increasing Research Capacity and Equity?

Two issues have been linked to earmarking. The first is that the Federal Government has decreased its funding for facilities since the 1960s. Because many earmarks are specified for facilities construction, some argue that a Federal facilities program would decrease the frequency of earmarking in Congress.[67] However, since the potential demand for new facilities is so large, no Federal facilities program could immediately address all of the need, and earmarking would still be important to allow some institutions to receive facilities monies in advance of others. A similar argument holds for the earmarking of equipment.

The second issue addresses the most commonly stated reason for pursuing earmarked funds-that existing proposal review systems are biased in favor of certain institutions over others for the distribution of Federal funds. Academic institutions that are not research intensive (the so-called have-nets) seek earmarks to acquire the scientific infrastructure that gives research universities (the so-called haves) a competitive edge in winning research awards. Earmarking thus is seen as a means of reducing inequities

@The Office of Science ad Technology Policy identified over $800 million in congressional earmarks for R&D projects in the fiscal year 1991 budget. Over one-third of these came from accounts". . . that were either cut or held constant by Congress-which means that the money had to be taken directly from other projects.' See Colin Norman, "Science Budget: Growth Amid Red Ink,'' *Science*, vol. 251, Feb. 8, 1991, pp. 616-618, quote from 617.

'Corey S. Powell, ''Universities Reach Into Pork Barrel With Help From Friends in Congress," *Physics Today*, vol. 42, No. 4, April 1989, pp. 43-45.

[65]Sources include *systematic listings in The Chronicle of Higher Education* of institutions receiving earmarks, occasional stories in *Science & Government Report*, in *the* newsletter *Higher Education Daily*, and *a* recent study for the House Committee on Armed Services. A General Accounting Office (GAO) study of 17 Department of Defense projects ". . . either congressionally mandated or established by the Army . . ." included four projects that were ". . . established non-competitively. ' However, the focus of the GAO report is oversight of university research and is not a comprehensive assessment of academic earmarks. See U.S. General Accounting Office, International Security and International Affairs Division, *Defense Research: Information on Selected University Research Projects*, GAO/NSIAD-90-223FS (Washington, DC: August 1990). *The* most comprehensive data on "apparent academic earmarks" have been assembled by James Savage for the Office of the President, University of California. They are based in part on Susan Boren, ''Appropriations Enacted for Specific Colleges and Universities by the 9&h Through th100th Congress," CRS Report 89-82 EPW, Feb. 6, 1989. See James Savage, Office of the President, University of California ''The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, FY 1980- 1989," mimeo, Mar. 7, 1989; and James Savage, Office of the President, University of California, "Apparent Academic Earmarks in the FY 1990 Federal Appropriations Bills,' mimeo, Dec. 19, 1989. Michael Crow, Iowa State University, personal communication August 1990, insists ". . . that there is currently no reliable data source from which to draw meaningful conclusions about the impact of academic earmarking. A comprehensive, well-defined effort is needed.' OTA endorses the call for more systematic study.

[66]Eliot Marshall and David p. Hamilton, 'A Glut of Academic Pork,'' *Science, vol. 250, Nov. 23*, 1990, pp. 1072-1073. Another estimate comes from Colleen Cordes, "Congress Earmarked $493 Million for Specific Universities; Critics Deride Much of the Total as 'Pork Barrel' Spending," *The Chronicle of Higher Education*, vol. *37, No. 24*, Feb. 27, 1991, pp. Al, A21.

[67]For more on the issue of research facilities, originated through earmarks or not, see Congressional Research *Service, Bricks and Mortar: A Summary Analysis of Proposals To Meet Research Facilities Needs on College Campuses*, report to the Subcommittee on Science, Research, and Technology, Committee on Science, Space, and Technology, U.S. House of Representatives, 100th Cong. (Washington DC: U.S. Government Printing Office, September 1987).

Table 3-2—Apparent Academic Earmarks: Fiscal Years 1980-89

Fiscal year	Dollar value	Number
1980	$ 10,740,000	7
1981	—a	—
1982	9,370,999	9
1983	77,400,000	13
1984	39,320,000	6
1985	104,085,000	36
1986	115,885,000	39
1987	113,800,000	41
1988	232,292,000	72
1989	202,537,000	87
1990	132,381,087	94
Total	$1,037,811,086	407

[a]The only direct appropriations in 1981 were to historically Black universities (three) and two other institutions within the District of Columbia, which Savage does not count as academic earmarks.

SOURCE: James Savage, Office of the President, Universit y of California, "Apparent Academic Earmarks in the Fiscal Year 1990 Federal Appropriations Bills," mimeo, December 1989, table 1.

or leveling the playing field.[68] (See table 3-3 for a 10-year breakdown of earmarking by appropriations subcommittee.)

Congress is concerned with equity in all of the funds that it disburses. The historical concern within Congress over equity in science funding has centered on ***geographical*** equity, not the contemporary emphasis on *institutional* development. Geographical distribution suggests that certain institutions from each major region should be competitive in receiving Federal funding. In this manner, each region would have some opportunity to develop centers of excellence.@ Institutional equity refers to the ability of ***each*** institution to be able to rise to prominence through Federal research funding. However, since there are 3,400 colleges and universities in the United States (1,300 that award science and engineering degrees, and 100 institutions that already command the largest share of Federal resources and produce most new Ph.D. researchers), the Federal Government faces a daunting task.[70]

The present situation is this: **much like the stratified distribution of competitively awarded Federal research funds, academic earmarking over the last decade has primarily benefited a handful of States and academic institutions, although the total amount of earmarked dollars has been relatively small. Table 3-4 ranks the recipients of earmarked funds by States for fiscal years 1980 to** 1989. More than 40 percent of these funds went to just 5 States, while two-thirds were awarded to only 10. The bottom 10 States received less than 10 percent of the earmarks.

> . . . 3 of the top 10 earmarkers include Massachusetts, New York, and Illinois, which rank in the National Science Foundation's list of top 10 State recipients of Federal research funds. . . . NSF's top 10 research States received more than a third of all earmarks.[71]

This same pattern of concentration is evident at the institutional level: 10 universities received nearly 40 percent of the earmarks during the last decade. (For the full distributions by State and by institution, see figure 3-2. For a ranking of institutions by Federal R&D funds awarded, see appendix B.)

A question for analysis might be: How have earmarked funds affected the research capability of the institutions receiving them? Between fiscal years 1980 and 1989, 20 academic institutions each received roughly $14 million in earmarked funds, or collectively 60 percent of the total earmarked dollars. But to determine the relationship between earmarking and research capability, other questions need to be addressed empirically: How have institutions used their earmarked funds? And if an institution improves its research capabilities and performance, as indicated by a change in its ranking of Federal research funds received or by its publication and citation output, is this due to the earmarks it receives? Or could it be that a university adminis-

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[68]See William C. Boesman and Christine Matthews Rose, "Equity, Excellence, and the Distribution of Federal Research and Development Funds," *CRS Report for Congress* (Washington, DC: Congressional Research Service, Apr. 25, 1989). But evidence shows that even research-intensive institutions pursue earmarks.

[69]For evaluation of an early National Science Foundation program dedicated to this proposition, see David E. Drew, Science Development: *An Evaluation Study,* technical report presented to the National Board on Graduate Education (Washington, DC: National Academy of Sciences, June 1975).

[70] Science and engineering research requires a huge capital investment in facilities and instrumentation, followed by sustained operating support Of that infrastructure, to attract and retain cutting-edge researchers. This capability in turn breeds success in the competition for Federal research funds. See Norman M. Bradburn, "The Ranking of Universities in the United States and Its Effect on Their Achievement" *Miner-vu,* vol. 26, No. 1, spring 1988, pp. 91-100. In fiscal year 1989, 100 institutions received 85 percent of Federal academic R&D funds. See National Science Foundation, *Selected Data on Academic Science/Engineering R&D Expenditures: FY 1989,* NSF 90-321 (Washington DC: October 1990), and CASPAR database, table B-35.

[71]A list of 74 Universities and colleges receiving more than $1 million in earmarked funds in fiscal years 1980 to 1989 can also be found in Savage, "The Distribution of Academic Earmarks in the Federal Government's Appropriation Bills," op. cit., footnote 65, pp. 6-7, 20-22.

Table 3-3—Apparent Academic Earmarks, by Appropriations Subcommittee: Fiscal Years 1980-90 ((number of projects) dollars, in millions)

Fiscal year	Total (all bills)	Energy and Water	Agriculture	Defense	Interior	Labor-HHS-ED	Treasury-Postal	VA-HUD Transportation	Independent Agencies	Commerce
1980	(7) $10.7	—	(5) $4.2	—	—	(2) $6.5	—	—	—	—
1981	—[a]	—	—				—	—	—	—
1982	(9) 9.4	(1) 1.1	(7) 7.3	—	(1) 1.0	—	—	—	—	—
1983	(13) 77.4	(1) 6.1	(3) 11.6	—	(4) 26.1	(5) 33.7	—			—
1984	(6) 39.3	(2) 10.0	(1) 1.0	(1) 0.8	—	(1) 19.0	—	(1 '8.5	—	—
1985	(39) 104.1	(9) 29.6	'16) 39.0	—	(7) 17.7	(4) 5.6	—	(1 ,0.3	1) 8.0	(1 4.0
1986	(39) 115.9	(5) 35.3	'16) 15.5	(9) 39.8	(6) 16.5	(3) 8.8	—	—		
1987	(50) 170.4	(9) 58.7	,21) 38.0	(9) 56.6	(5) 12.5	(3) 4.0	—			'3' 0.6
1988	(72) 232.3	(28) 128.3	,28) 49.2	(2) 28.5	(6) 6.3	—	'1) 4.0	(3) 8.6	(1) 1.7	'3' 5.6
1989	(87) 202.5	(9) 73.9	49) 51.9	(3) 21.5	(6) 9.9	(2) 4.6	) 38.6			[illegible] 2.2
1990	(94) 132.4	(7) 37.5	60) 47.5	—	(9) 6.3		,7' 23.1	2) 5.0	5) [illegible]2	[illegible] 2.8
Total	**(416) $1,094.4**	**(70) $380.4**	**(206) $265.2**	**(24) $147.2**	**(44) $96.3**	**(20) $82.1**	**(17) $67.7**	**(7) $22.4**	**(7) $19.9**	**(20) $15.3**
Percent of total	**100%**	**34.7%**	**24.2%**	**13.4%**	**8.8%**	**7.5%**	**6.2%**	**2.0%**	**1.8%**	**1.4%**

[a] The only direct appropriations in 1981 were to historically Black universities (three) and two other institutions within the District of Columbia, which Savage does not count as academic earmarks.

KEY: ED=U.S. Department of Education; HHS=U.S. Department of Health and Human Services; HUD=U.S. Department of Housing and Urban Development; VA=U.S. Department of Veterans Affairs.

SOURCE: James Savage, Office of the President, University of California, "The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, Fiscal Years ' 90 Mar. 7, 1989, table 2.

Table 3-4-Apparent Academic Earmarks Contained in the Fiscal Years 1980-89 Appropriations, Ranked by State (includes District of Columbia)

Earmark rank[a]	Earmarked funds	Percent of funds (cumulative)	Fiscal year 1988 Federal research rank[b]
1. Massachusetts	$92,416,000		4
2. New York	82,901,333		2
3. Oregon	78,150,000		26
4. Florida	62,377,000		16
5. Illinois	60,819,000	41.6%.	7
6. Louisiana	56,700,000		30
7. South Carolina	37,700,000		33
8. West Virginia	34,423,000		43
9. Alabama	34,400,000		22
10. New Hampshire	30,045,000	62.9	34
11. Pennsylvania	26,800,000		6
12. Hawaii	25,317,500		35
13. Iowa	24,858,000		27
14. Mississippi	23,426,000		40
15. Arizona	22,575,000	76.5	25
16. California	21,740,000		1
17. North Dakota	20,259,333		44
18. Oklahoma	17,515,000		38
19. Washington	15,920,000		12
20. District of Columbia	15,020,000	86.5	29
21. Indiana	13,050,000		17
22. Texas	11,700,000		5
23. Nevada	11,100,000		41
24. Utah	11,000,000		23
25. North Carolina	9,900,000	92.8	9
26. Kansas	9,321,000		32
27. New Jersey	8,810,000		21
28. New Mexico	6,100,000		28
29. Ohio	5,700,000		10
30. Kentucky	5,304,000	96.7	37
31. Rhode Island	5,000,000		31
32. Maryland	4,350,000		3
33. Connecticut	3,750,000		14
34. Idaho	3,690,000		47
35. Wisconsin	3,550,000	98.9	11
36. Michigan	3,250,000		8
37. Minnesota	1,800,000		20
38. Vermont	1,450,000		39
39. Arkansas	1,200,000		45
40. Georgia	517,000	99.8	13
41. Virginia	450,000		18
42. Nebraska	315,000		36
43. Alaska	290,000		42
44. Missouri	225,000		19
45. South Dakota	195,333	99.9	51
46. Montana	50,000	100.0%	49
Total	$905,429,999		

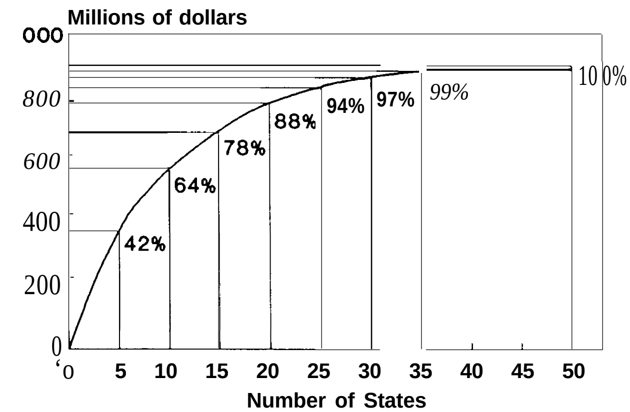
[a]No earmarks were identified for the States of Maine, Tennessee, Delaware, Colorado, or Wyoming.
[b]Ranking in terms of Federal R&D expenditures at doctorate-granting institutions.

SOURCE OF FEDERAL RANKING: National Science Foundation, *Academic Science/Engineering R&D Funds, Fiscal Year 1988*, NSF 89-326 (Washington, DC: 1989), p. 32, table B-24.

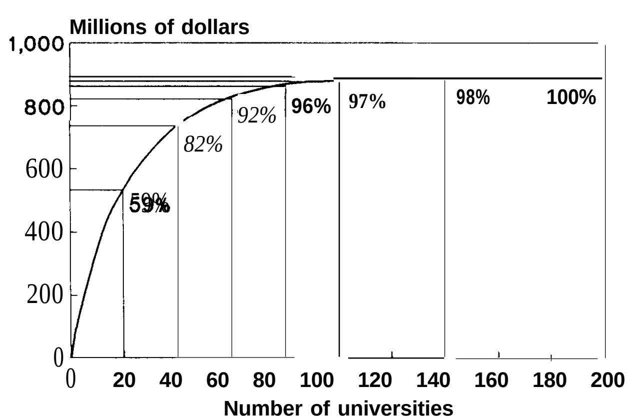
SOURCE: James Savage, Office of the President, University of California, "The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, Fiscal Years 1980-1990," mimeo, Mar. 7, 1989, table 2.

Figure 3-2—Apparent Academic Earmarks by State and at Universities and Colleges: Fiscal Years 1980-89

Cumulative distribution of academic earmarks, by State: FY 1980-89



Cumulative distribution of academic earmarks at universities and colleges: FY 1980-89



SOURCE: James Savage, University of California, Office of the President, "The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, Fiscal Years 1980-1989," mimeo, Mar. 7, 1989, tables 3 and 6.

tration that seeks earmarks is also engaged in a broader campaign to strengthen the research mission of the institution?

At present, there are no answers to these questions.[72] Nevertheless, data could be collected and the effect of earmarking evaluated over time.[73] If the results of these studies show that science performed in earmarked projects or with earmarked facilities or equipment is markedly inferior to other research projects supported under other agency programs, then steps could be taken to isolate problems inherent in earmarked projects. On the other hand, if these studies show that earmarked projects have an impact on research that is equal to (or even greater than) other projects supported through executive branch programs, then perhaps some of the concern over congressional earmarking is misplaced.[74]

Conclusions

This chapter has presented an overview of the highest level of decisionmaking for research in the Federal Government. Both the executive branch and Congress attempt to respond to changing national needs and potential research opportunities. However, due to their respective political agendas, modes of organization, and spheres of responsibility, they often disagree about the appropriate Federal role to pursue them.

The President, OMB, OSTP, Congress, and interest groups have separate roles in the decisionmaking process. They differ primarily in their concerns and priorities. For example, OMB is mostly concerned with fiscal issues, whereas OSTP is more concerned with coordination and comprehensiveness. Thus, long-term budgetary planning is very difficult.

In particular, the "research budget" is rarely considered as a whole in the Federal budget process. Separate parts of what might be considered the research budget are contained in many different budgets. Consequently, issues of concern to many parts of the research system are not considered across-the-board. "Nowhere in government is the

[72] Institutions that have won earmarked money say its biggest impact is on their ability to recruit talented scientists. But it may also help to relieve the squeeze on research space, and in general upgrades the technical capabilities of the researchers involved. See Colleen Cordes, "Congressional Practice of Earmarking Federal Funds for Universities Offers Both Promise and Peril," *The Chronicle of Higher Education*, vol. 36, No. 17, Jan. 10, 1990, pp. A19, A24. It is too soon to tell how the quality of research produced at facilities created through earmarked funds compares with the research emanating from exclusively peer-reviewed, project-based academic centers.

[73] Crow, Op. cit., footnote 65, points out that: "A single earmark can provide a university with the opportunity. . . for the development of relationships and personal acquaintances that might yield nonearmarked collaboration with that Federal agency in the future. A single earmark might provide the opportunity to develop new and continuing relationships with business and industry or State government. . . . Thus, while a university's total research funding may increase only marginally over a 5- to lo-year period (less than 5 percent) as a result of an earmark, the earmark might still have had substantial impact because of its impact on a specific program (e.g., a 50-percent increase in competitive funding over a 5- to 10-year period)." Also see "How Iowa State University Wins Millions in Earmarked Funds," *The Chronicle of Higher Education*, vol. 37, No. 24, Feb. 27, 1991, p. A21.

[74] However, the problem of regional inequity will remain regardless of earmarks. This could be addressed by both the executive branch and Congress.

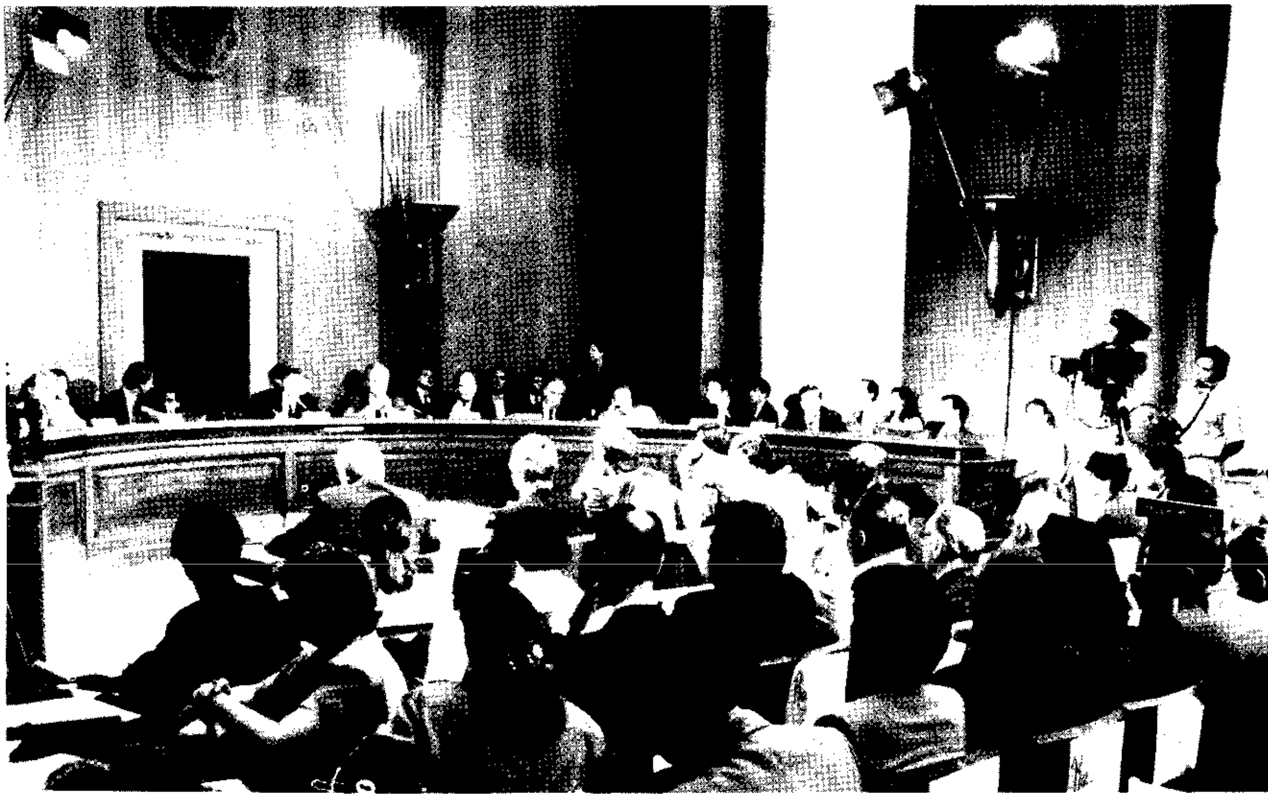


Photo credit: Michael Jenkins

The Senate Committee on Energy and Natural Resources holds a public hearing.

big picture considered; nowhere is the overall health of U.S. science and technology a primary mission or responsibility. '[75]

An important aggregation of the research budgets could occur in the congressional appropriations process. Earmarking is also one visible, albeit minor, means of congressional budget negotiation. In the next chapter, OTA introduces the major research agencies, their priority setting for research, and funding allocation mechanisms.

[75] Morone, op. cit., footnote 5, p. 12.