

Federal R&D in the FY 2009 Budget: An Introduction

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AN OVERVIEW OF R&D IN THE FY 2009 BUDGET

On February 4, 2008, President Bush released his proposed budget for fiscal year (FY) 2009. The \$3.1 trillion budget projects a deficit exceeding \$400 billion next year, despite excluding most 2009 war costs and holding domestic spending flat. Within a flat domestic budget, the 2009 budget for R&D continues to propose large increases for the three physical sciences agencies in the American Competitiveness Initiative (ACI), increases for human spacecraft development, flat funding for biomedical research in the National Institutes of Health (NIH), and mostly increases for other parts of the federal research and development (R&D) portfolio but cuts to key environmental and agricultural R&D agencies. Defense R&D would continue to increase, and defense basic research in the physical sciences would share in the gains. Despite tough budget conditions, the overall federal investment in R&D would increase \$4.9 billion or 3.4 percent to \$147.4 billion (see Table I-1), driven primarily by increases in development funding. The federal investment in basic and applied research would fall 0.3 percent to \$57.3 billion in 2009 as proposed gains in the ACI agencies would be offset by cuts in other agencies' research funding, primarily cuts in congressional earmarks (see Table II-1). Federal research funding would fall for the fifth year in a row in real dollars.

In its broad outlines, President Bush's proposed budget for FY 2009 once again offers the same themes as in previous years: big increases for defense and homeland security, trims in some entitlement programs, extensions of expiring tax cuts, and plans to reduce the budget deficit primarily by cutting domestic discretionary spending and by not budgeting for future war costs. There is also continuity in the President's proposals for the federal R&D portfolio: despite appropriations setbacks, the budget stays on track with the third year of the American Competitiveness Initiative (ACI) vision of doubling between 2006 and

2016 the budgets of the National Science Foundation (NSF), the Department of Energy (DOE) Office of Science, and the National Institute of Standards and Technology (NIST) laboratories in Commerce. The three research-oriented ACI agencies lead the pack in R&D gains (see Figure 1), followed closely by proposed gains for development programs in DOE, the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD; see Table II-1). But in other areas of the federal R&D portfolio, cuts in past budgets turn into requested increases this time around. While biomedical research in the National Institutes of Health (NIH) would remain flat, in a tight domestic budget most other R&D funding agencies would see gains. As a result, most federal R&D agencies would see real increases for their R&D programs if the budget is enacted, although there would be cuts to agricultural and environmental R&D agencies.

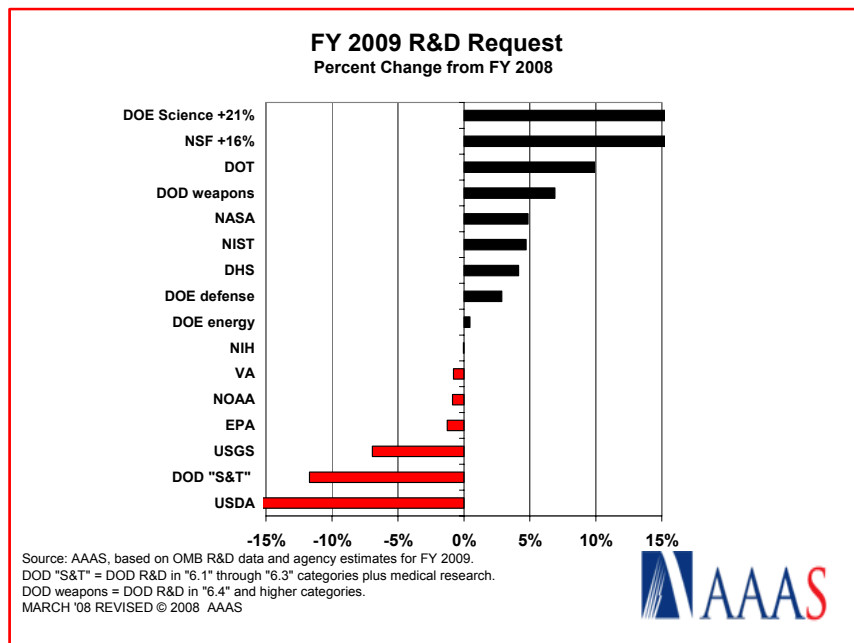


Figure 1.

- The proposed federal R&D portfolio in FY 2009 is a record \$147.4 billion, \$4.9 billion or 3.4 percent above this year's current funding level (see Table II-1). Once pending war-related supplementals for DOD development in 2008 and 2009 are added, federal R&D totals for both years will climb even higher.

- **Total federal support of research (basic and applied) would fall 0.3 percent** or \$163 million to \$57.3 billion, even after large proposed increases for physical sciences and related research in NSF, DOE's Office of Science, and NIST (see Table II-1). Removing 2008 congressional earmarks from the new budget request (\$1.1 billion in research earmarks for DOD alone) accounts for the cut; excluding earmarks from the 2008 base, federal research spending in 2009 would increase by enough to keep pace with expected inflation of 2.0 percent. NIH basic and applied research funding would stay flat at \$28.5 billion, while most other agencies would see gains in non-earmarked research funding. In real terms, the federal research portfolio would fall for the fifth year in a row and would be down 9.1 percent from 2004.

- **President Bush's American Competitiveness Initiative (ACI) would once again be the big winner among domestic programs.** The three ACI agencies (NSF, NIST laboratories, DOE Office of Science) would collectively receive \$12.2 billion in the 2009 budget, a 15 percent increase over this year (see Table I-7; includes R&D and non-R&D). The NSF budget of \$6.9 billion would be a 14 percent increase, with increases approaching 20 percent for the Mathematical and Physical Sciences (MPS), engineering, and computer science directorates and smaller increases for non-physical sciences directorates. DOE's Office of Science request for \$4.7 billion would be a 19 percent increase restoring funding for physics, fusion, and other basic research projects hard hit by the 2008 appropriation. And the NIST labs would receive a large increase, though at the cost of proposed eliminations of NIST's external programs (the Technology Innovation Program and the Hollings Manufacturing Extension Partnership). In a surprising development, DOD requests a 4 percent increase in its basic research ("6.1") portfolio to \$1.7 billion, a 16 percent boost if earmarks in the 2008 base are excluded. DOD is a key sponsor of the physical sciences, but until now physical sciences advocates have been unsuccessful in convincing DOD to boost this investment.

- The National Institutes of Health (NIH) would receive exactly the same amount (\$29.5 billion) in 2009 as in 2008; nearly all of NIH's institutes and centers would also get the same budgets as this year. Several biomedical research advocacy organizations have already decried the 2009 proposal for leaving NIH 13 percent below the 2004 funding level after adjusting for biomedical research inflation. The number of new

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grants, the average real size of a grant, and the expected success rate for grant competitions are all expected to fall in 2009.

- **NASA R&D would increase to fund the development and construction of new human spacecraft.** NASA R&D would gain 4.9 percent to \$12.8 billion, but the entire increase and more would go to two big projects: finishing the International Space Station and developing the Crew Launch Vehicle and Crew Exploration Vehicle combination (see Table II-12). As a result, NASA support of research in the physical sciences, environmental sciences, aeronautics, and other disciplines would fall once again.

- **Nondefense R&D would increase 3.1 percent to \$62.9 billion, compared to the flat funding requested for all nondefense discretionary programs** and well ahead of the 2.0 percent expected inflation rate (see Table II-1). Boosts for the ACI and space vehicles development help to offset requested cuts to earmarks and other smaller nondefense R&D programs, and flat funding for NIH R&D.

- **Most R&D agencies would see increases in 2009, especially if congressional earmarks are excluded** (see Figure 1). While R&D in the U.S. Department of Agriculture (USDA) would decline 1 percent even when \$369 million in 2008 R&D earmarks are not counted, and Environmental Protection Agency (EPA) R&D and U.S. Geological Survey (USGS) R&D would fall 0.4 percent and 7 percent, respectively, because of proposed program cuts, most other R&D funding agencies would see gains ahead of expected inflation (see Table II-1). Even DOE's energy R&D programs, coming off extraordinary congressional and requested increases in 2008, would gain another 0.5 percent to reach \$2.4 billion and R&D in the Department of Homeland Security (DHS) would rebound from budget troubles in recent years with a 4.1 percent gain to \$1.0 billion (see Table 1) that becomes a 13.5 percent boost without 2008 earmarks.

- Defense R&D continues to climb to record levels in wartime, and will be boosted further in both 2008 and 2009 when billions of dollars in war-related supplemental funds are enacted later this year. Total defense R&D would reach \$84.5 billion in 2009, up 3.7 percent over FY 2008. Although the total in real terms would be slightly below the record 2007 funding level, both 2008 and 2009 are likely to hit all-time highs after supplementals are enacted. DOD weapons systems development would

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increase dramatically by \$4.5 billion or 6.9 percent to a new high of \$69.0 billion, but once again there would be steep cuts in DOD's S&T (DOD "6.1" through "6.3" plus medical research) programs because of the proposed elimination of earmarks. DOD S&T would plummet 11.7 percent to \$11.7 billion, but would increase 5.6 percent if 2008 earmarks are excluded. DOD basic research would do especially well with \$1.7 billion, a 4 percent increase that becomes a 16 percent increase if earmarks are excluded.

- **Multi-agency initiatives on nanotechnology, information technology, and climate change science would all do well in the 2009 budget because of the emphasis on the physical sciences in the ACI and a generally solid R&D budget request. Climate Change Science Program (CCSP)** funding would climb above \$2 billion for the first time since 2003 with a 9.6 percent or \$177 million increase to \$2.0 billion (see Table I-9), thanks to environmental sciences programs at NSF and DOE Science benefiting from ACI-inspired increases for these agencies and a restructuring of NASA spending to boost spending on the earth sciences and especially satellite-based observations of climate change. After several rough years, NASA contributions to the CCSP would rebound with a \$126 million or 11.7 percent increase to \$1.2 billion in 2009. Squarely in the mainstream of the physical sciences, the **Networking and Information Technology R&D** initiative would enjoy a 6.2 percent increase to \$3.5 billion because of surging requests for two of its key sponsors, NSF and DOE Science. And the **National Nanotechnology Initiative** would benefit from ACI increases for NSF, DOE Science, and NIST to reach \$1.5 billion (up 2.4 percent), partially offsetting steep cuts in DOD's contributions. (For more on the NNI, see Chapter 23; for more on NITRD, see Chapter 22; for more on CCSP, see Chapter 15.) (Details of R&D in the largest R&D funding agencies can be found in Chapters 5 through 12.)

THE ROLE OF R&D IN THE U.S. INNOVATION SYSTEM

Science and technology are recognized as key drivers of economic growth, as well as improved health and quality of life in the United States and throughout the world. Economists estimate that up to half of U.S. economic growth over the past five decades is due to advances in technology. A study of recent U.S. patents released several years ago found that nearly two-thirds of the papers cited in these patents were

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published by researchers at organizations supported by federal funds—and these linkages have been growing at an accelerating pace.

Recent advances in genetics and biotechnology, as well as computers and information technology, have raised public awareness of the vital economic role of research-based technology. High-tech industry is sought after by economic development organizations in virtually every state and locality. Policymakers regard universities as catalysts for high-tech economic development both through entrepreneurial activity that spins off from their research and through the concentrations of highly trained human resources they attract and generate. The federal government plays a central role in research in the nation's universities.

R&D is a substantial and growing enterprise in the United States. All in all, the U.S. invested an estimated \$343 billion in R&D in 2006. This represented 2.60 percent of the nation's Gross Domestic Product (GDP). The largest share of this money (65 percent) came from industrial firms. Most of the balance (28 percent) came from the federal government. Colleges and universities, private foundations, other nonprofit institutions, and state and local governments provided the remainder. Industry's share of national R&D funding has been growing steadily for several decades. From the end of World War II to 1980, the federal government supported the largest share of the nation's R&D.

Despite its relatively modest share of total U.S. R&D funding, the federal government's role is critical to the nation's science and technology enterprise. Federal agencies support the majority (58 percent) of the nation's *basic* research and nearly two-thirds (63 percent) of the R&D performed in U.S. colleges and universities (see Table I-10). Basic research is the primary source of the new knowledge that ultimately drives the innovation process. At the same time, federally funded research at colleges and universities plays a key role in educating the next generation of scientists and engineers. Federal applied research and development programs also provide direct support for key government missions, such as improving the nation's health and medical care, exploring space, and national security.

R&D IN THE FEDERAL BUDGET

Although the President's budget presentation each year generally contains a section devoted to R&D and a number of tables summarizing

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proposed federal R&D expenditures, it is important to recognize that *there is no overall “R&D budget”* and no special treatment for R&D within the budget.

Expenditures for R&D programs are regular budget items. They are contained, along with other types of expenditures, within the budgets of more than 20 federal departments and independent agencies as shown in Table II-1. For some of those agencies, such as NSF, NASA, and NIH, R&D is a dominant activity. For others, such as the Department of Housing and Urban Development (HUD), it is a small part of a much larger set of programs. Some R&D programs are “line items” in the budget and are relatively easy to identify as R&D. Others are included within larger line items and are more difficult to ferret out.

Federal R&D expenditures represent 4.7 percent of the overall proposed \$3.1 trillion federal budget for FY 2009. Nearly all federal R&D comes from the discretionary budget, the one-third of the budget that is subject to annual appropriations decided by the President and the Congress. (The remaining two-thirds of the federal budget goes to mandatory programs (entitlements) such as Social Security, Medicare, Medicaid, and interest on the national debt. Less than 0.2 percent of the federal R&D portfolio is mandatory spending.) Federal R&D is roughly one out of every seven discretionary dollars (see Table I-3). On the whole, trends in R&D funding have closely followed trends in federal discretionary spending. Despite the fact that R&D funding trends are the combination of hundreds of different budget decisions that are only aggregated after a budget is done, the two trends match almost perfectly on the nondefense side for the past 35 years. On the defense side, R&D has grown as a share of the defense budget over the years as high-tech weapons systems have claimed increasing shares of defense spending.

FEDERAL R&D BY PERFORMER

Although the government maintains several hundred laboratories around the country, less than a quarter of federally supported R&D is actually carried out in these labs. The largest share of federally funded R&D is performed by industrial firms under contracts (41 percent of the total; see Figure 2). Less than a quarter is conducted under federal grants in colleges and universities. Other nonprofit institutions perform a small portion, and 9 percent of the portfolio is performed by FFRDCs (federally funded R&D centers) operated by contractors, such as the

Department of Energy's (DOE) Oak Ridge National Laboratory in Tennessee, which is operated in partnership by the University of Tennessee and the Battelle Memorial Institute. Although these figures apply to the overall federal R&D portfolio, each federal funding agency has its own mix of performers depending on the agency's mission and historical relationships with performers. The majority of DOD's R&D portfolio is performed by industry, for example, while DOE sends the majority of its R&D portfolio to its network of FFRDCs; nearly all of the NSF portfolio, however, goes to universities.

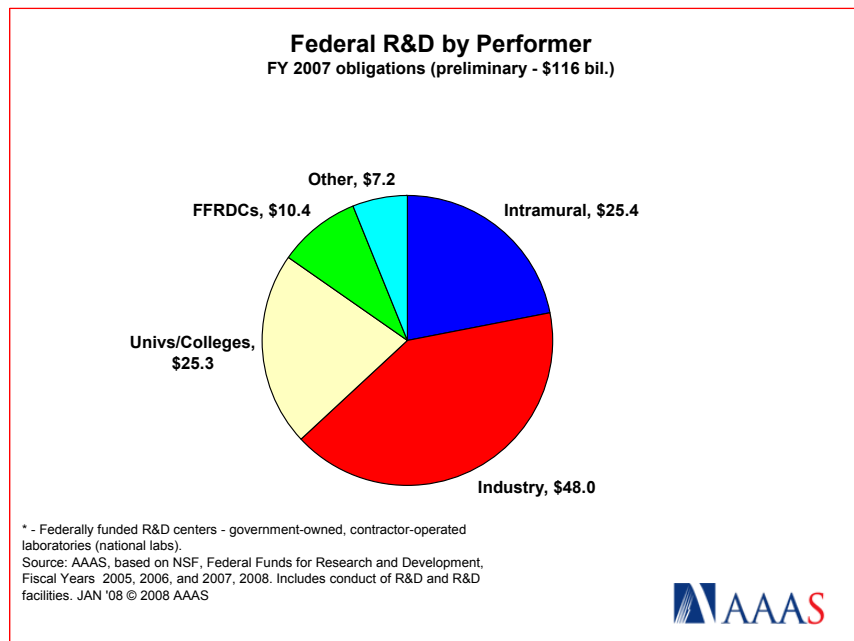


Figure 2.

Altogether, including the research that firms support with their own funds and that which is conducted under government contracts, industry is responsible for performing more than two-thirds (71 percent) of the nation's total R&D. U.S. academic institutions perform 14 percent, while federal laboratories, nonprofit institutions (research institutes, hospitals, etc.), and FFRDCs perform the remainder.

FEDERAL R&D BY NATIONAL MISSIONS

Most of the federal government's R&D is mission oriented; that is, it is intended to serve the goals and objectives of the agency that provides the funds (*e.g.*, agricultural research in the U.S. Department of Agriculture). Only NSF, whose mission is to support basic and applied research, research facilities, and education across a wide range of science and engineering disciplines, has a primary mission to support science and engineering. For the remaining 97 percent of the federal R&D portfolio, R&D investments are the means to achieve other government ends.

The federal government divides the budget into 20 "functional" groupings to illustrate these national missions, each with a function number.¹ The President's budget and the congressional budget resolution divide the total budget "pie" into functional "slices," which serve as non-binding guides for appropriators in allocating funds to agencies and programs. Viewing the R&D budget by function sheds light on the funding priorities assigned to different areas over time, and allows for international comparisons with other nations' spending on R&D by objective. Table I-4 shows R&D by function in the FY 2009 budget.

The Administration priorities of basic physical sciences, space exploration, and defense development show up clearly in the federal R&D portfolio by mission (see Table I-4). The priority missions would all receive large increases, while R&D for most other national missions would gain modestly. Proposed ACI boosts to the DOE Office of Science and NSF make up the 16.9 percent gain for general science R&D to \$10.2 billion, while the NIST labs' increase offset partially by NIST extramural cuts would boost commerce R&D by 3.3 percent. Space-related R&D would gain 5.6 percent to \$12.3 billion, entirely from gains in development funding of new space vehicles instead of the broader space R&D portfolio. R&D for other national missions including agriculture (down 17.5 percent) and the environment (down 4.3 percent) would fall primarily from the proposed elimination of earmarks. Energy R&D would gain 0.6 percent to \$2.5 billion. Funding for health R&D, the largest nondefense mission, would increase slightly by 0.5 percent to \$30.8 billion because of flat funding for NIH and Department of

¹ AAAS separates the general science, space, and technology function (function 250) into its subfunctions of General Science (251) and Space (252). AAAS also counts Department of Veterans Affairs R&D programs in the health (550) function instead of veterans affairs (700).

Veterans Affairs (VA) R&D combined with a large increase in biodefense countermeasures R&D in the Department of Health and Human Services (HHS) to \$250 million.

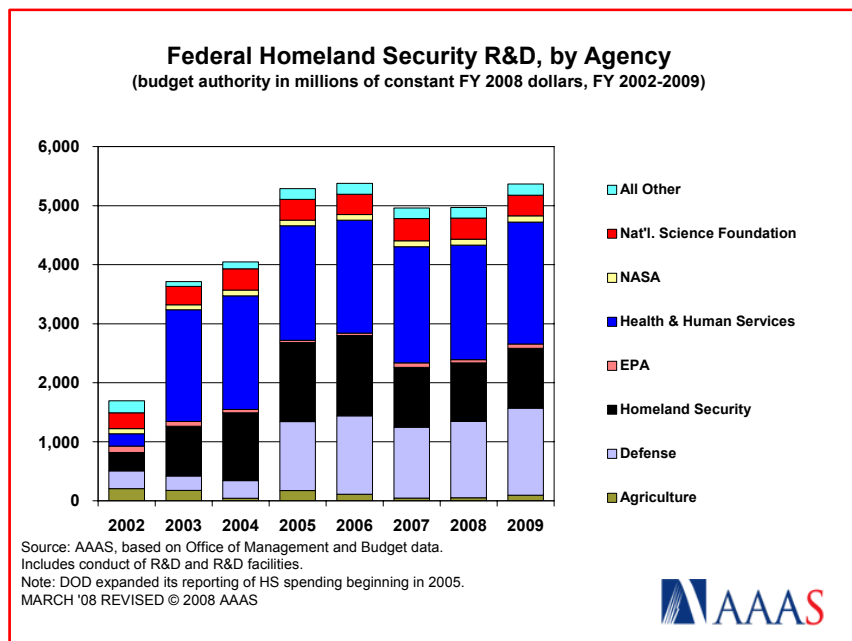


Figure 3.

Although there is much talk of homeland security becoming a major new federal mission, in the budget homeland security spending is a category that cuts across spending on traditional government missions such as national defense, transportation, and justice. R&D in the new Department of Homeland Security (DHS), for example, serves the three missions of administration of justice, general science, and transportation. (See Chapter 11 for more information on DHS.)

Federal homeland security-related R&D would gain 10.2 percent to \$5.5 billion in FY 2009, a gain of \$507 million reflecting a budget proposal that favors defense spending and homeland security over most domestic priorities (see Table I-6). The majority of the multi-agency portfolio remains outside the Department of Homeland Security (DHS), with the largest part in NIH for its biodefense research portfolio. NIH's portfolio, mostly in the National Institute of Allergy and Infectious Diseases (NIAID), would total \$1.9 billion in FY 2008 (up 1.0 percent).

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The largest domestic increase would be a \$250 million allocation (more than double the \$102 million this year) in the Biomedical Advanced Research and Development Authority (BARDA) for R&D on biomedical countermeasures. DOD would continue to increase spending on homeland security-related activities with \$1.5 billion, up 16 percent, primarily in Defense Agencies such as the Chemical and Biological Defense Program (CBDP) and the Defense Threat Reduction Agency (DTRA) but with the largest 2009 increase coming from the Air Force. Large increases would also go to food safety research in USDA and decontamination and drinking water protection projects at EPA.

R&D BY CHARACTER OF WORK

The total federal R&D portfolio is made up of five different kinds of investments, known as the “character of work” of R&D. Within the R&D portfolio, distinctions are made among basic research, applied research, development, R&D facilities construction, and capital equipment for R&D (See Appendix 2 for definitions. AAAS tables combine R&D facilities construction and capital equipment for R&D, often described together as “R&D facilities” or “R&D plant.”) Basic and applied research together make up “research”, while the two research categories plus development make up “conduct of R&D.” Adding in R&D facilities construction and capital equipment results in “total R&D” or “R&D.”

The figures shown in Tables I-5 and II-1 represent agencies’ best attempts to classify basic and applied research, development, and R&D facilities within their R&D portfolios. The data reported here are imprecise and reflect the agencies’ judgments as to how their R&D fits into the definitions for character of work.

The total federal investment in research (basic and applied research) would fall 0.3 percent to \$57.3 billion (see Table II-1). Large proposed increases for the three ACI agencies of NSF, DOE Office of Science, and NIST would be more than offset by steep cuts in other agencies’ research.

Once again, development funding would hit a new high of \$85.4 billion (up \$4.8 billion or 6.0 percent) because of large increases for DOD weapons and NASA spacecraft development. R&D facilities funding would gain 6.2 percent to \$4.7 billion (see Table II-1) because of large increases for NASA’s International Space Station and DOE Science

support on projects such as the International Thermonuclear Experimental Reactor (ITER).

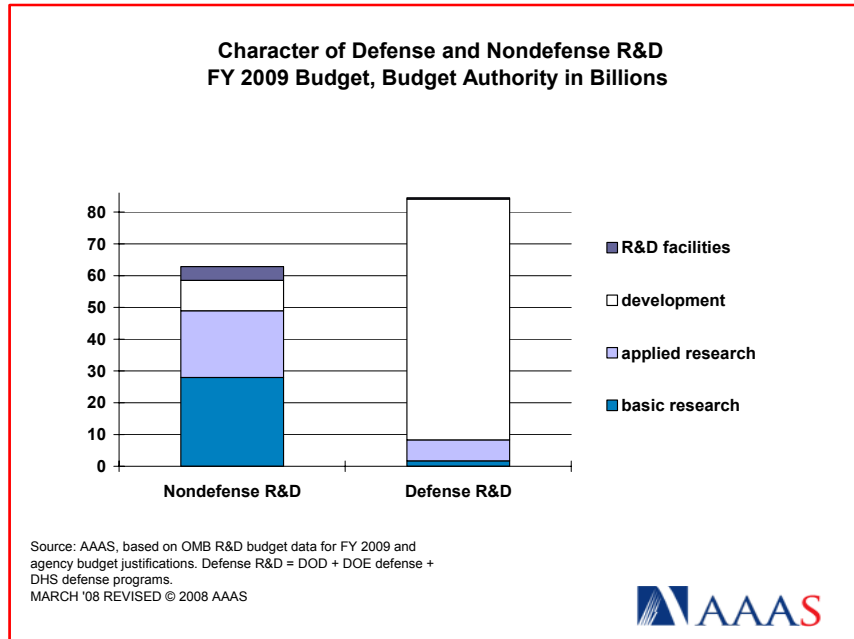


Figure 4.

The character of work is quite different in defense and nondefense R&D, a point illustrated in Table I-5 and Figure 4. Development would be by far the largest component of defense R&D, accounting for 90 percent of the FY 2009 total, while applied research would be 8 percent and basic research would be only 2 percent. In nondefense R&D, by contrast, basic research would be the largest category at 45 percent, with development at only 15 percent and applied research at 33 percent. A major reason for the difference between the character of defense and nondefense R&D is that development in DOD includes testing and evaluation of weapons systems. These activities are extremely expensive compared to other types of R&D. R&D facilities construction and capital equipment costs make up 7 percent of nondefense R&D and 1 percent of defense R&D.

PRIORITY-SETTING FOR FEDERAL R&D INVESTMENTS

Priorities for R&D programs generally depend on the priorities of the agencies in which they are located and the priority of the missions of those agencies. From the standpoint of serving the nation's interests, at least in the short term, this makes good sense, since these R&D programs are not ends in themselves but means to the ends (missions) that their sponsoring agencies serve. From the standpoint of the long-term health of the research enterprise, however, it can cause problems. The mission orientation of R&D programs may make it difficult for policymakers to assess the overall health of the research enterprise, to coordinate programs among different agencies, and to address issues of balance among various scientific and engineering fields and disciplines.

The Office of Management and Budget (OMB), which has overall responsibility for preparation of the President's budget, is able to provide some coordination, although it is hampered by the fact that the agencies that support R&D are treated individually by its different sections in the budget review process. Some coordination also takes place under the National Science and Technology Council (NSTC), an interagency body comprised of cabinet officers and the President. NSTC has organized a number of interagency initiatives in areas of R&D, including global change research, information technology, and nanotechnology. Budgets for three of these initiatives are shown in Table I-9, and are discussed in Chapters 15 (CCSP), 22 (NITRD), and 23 (NNI).

Even the modest level of coordination in R&D in the executive branch is not matched by Congress. Congressional treatment of R&D, like most other aspects of congressional budget and policymaking, is characterized by fragmentation and diffusion of power. R&D programs are considered at two main levels in Congress, that of authorizations and that of appropriations. Authorizing committees (such as the House Science and Technology Committee and the Senate Committee on Health, Education, Labor, and Pensions) develop special expertise in the programs they oversee and review the substance of these programs. However, the legislation they prepare does not directly result in spending but only provides guidance and sets appropriations ceilings.

For discretionary programs, including R&D, the power to write the legislation that provides actual spending authority resides in the Appropriations Committees of the House and Senate. These committees

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are divided into 12 subcommittees, each of which is responsible for a bill that controls one portion of the budget.

Table I-8 shows the distribution of R&D funds among the appropriations subcommittees; each subcommittee produces its appropriations bill separately from the others, and each bill is usually signed into law separately, although in recent years several bills have had to be bundled into a single omnibus appropriations bill at the end of the congressional session. The FY 2005 omnibus appropriations bill, for example, contained final versions of 9 regular appropriations bills, but in FY 2006 all the appropriations bills were enacted separately. In FY 2008, only one bill (Defense) was enacted individually, and the other 11 bills were rolled into an omnibus bill.

In the congressional appropriations process, the federal R&D investment is contained in 10 of the 12 appropriations bills (see Table I-8). The large proposed increases for NSF, NASA, and NIST will have to find room in the Commerce, Justice, and Science appropriations bill, while DOD development increases would be funded in the Defense bill. The flat NIH budget would be funded in the always-contentious Labor/HHS/Education bill, which contains many health and education programs that are proposed for steep cuts or even elimination in the FY 2009 request.

The division of the budget into 12 appropriations bills limits the extent to which it is possible to coordinate or trade off increases and decreases in agency R&D budgets in the congressional process. For example, three R&D agencies—NSF, NASA, and the Department of Commerce—are under the jurisdiction of the Subcommittee on Commerce, Justice, and Science. NIH appropriations reside in the Labor, Health and Human Services, and Education subcommittee. This means, for example, that money used for the increase in the NASA budget in FY 2005 did not come from the same pot of money as NIH, although NASA's budget increase was offset with a cut in NSF's budget. But this system does mean that R&D programs compete with non-R&D programs in the same appropriations bill for limited funds.

THE “FEDERAL SCIENCE AND TECHNOLOGY (FS&T)” BUDGET

Seven years ago, the Office of Management and Budget (OMB) introduced a “Federal Science and Technology” (FS&T) budget in the

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FY 2002 budget, and continues to advance this concept in the FY 2009 budget (see Table I-7). The **FS&T budget** is successor to the Clinton Administration's "21st Century Research Fund" (see previous editions of this report) and contains most of the same programs. FS&T is a collection of selected R&D and non-R&D programs that emphasize basic and applied research and the creation of new knowledge or technologies. It also includes some S&T education and training activities but excludes most development, and is designed to be an alternative measure for the federal investment in science and technology and an alternative way to track federal S&T investments in the budget process. (This FS&T budget has a similar emphasis but different definitions from the FS&T concept proposed in 1995 by the National Academies as a subset of federal R&D; thus, the data in Table I-7 differ from NAS discussions of its version of FS&T in previous editions of this report.)

Combined funding for the ACI agencies, a subset of the FS&T budget, would be \$12.2 billion in 2009, a dramatic increase of 15.0 percent or \$1.6 billion when most other FS&T programs would decline. The cuts in other FS&T programs result in a total FS&T investment that would fall 0.3 percent to \$61.8 billion.

U.S. INVESTMENTS IN AN INTERNATIONAL CONTEXT

In absolute terms, the \$353 billion spent on R&D from all sources in the U.S. in 2007 was larger than the total R&D expenditures of the entire European Union combined. The U.S. spent 30 percent of world R&D, a share that has declined slightly over the past decade as emerging R&D powers such as South Korea and China have dramatically increased spending (see Figure 5). From tiny amounts in the last decade, China has emerged as a major R&D investor this decade. Adjusting for the much lower costs for R&D talent and equipment there, China is now the second largest R&D performer in the world, having recently overtaken third-place Japan.

When one looks at the national R&D expenditures of various countries in relation to the size of their economies, however, the picture is somewhat different. R&D represented 2.6 percent of gross domestic product (GDP) in the United States in 2004. This places the U.S. below Japan (3.3 percent) but above most other major industrialized countries—including the United Kingdom, France, and Germany. Although the EU recently set a goal of attaining an EU-wide R&D investment ratio of 3 percent of

the EU economy by 2010, currently the combined EU nations have a R&D/GDP ratio of just 1.8 percent, down significantly from previous figures because of the induction of 10 less research-intensive nations three years ago. On the other hand, a significant share of the U.S. R&D investment is on the military side, where it has relatively little impact on the civilian economy and U.S. industrial competitiveness. This is very different from the situation in Germany and Japan, which devote only a small portion of their R&D resources to defense. Recently, South Korea surpassed the U.S. in its R&D / GDP ratio, which now stands at 3 percent.

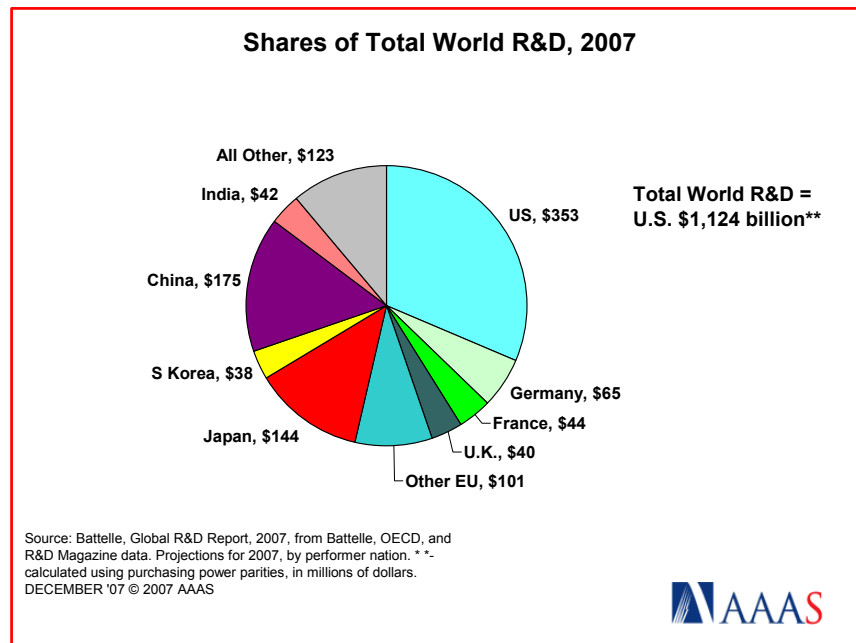


Figure 5.