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Historical Trends in Federal R&D

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The President's base budget for science and innovation reflects the tough fiscal constraints facing policymakers in FY 2015, with only limited growth proposed for R&D funding. The request proposes a $757 million increase (1.2 percent) for nondefense R&D and a $243 million increase (0.3 percent) for defense R&D, and a $1 billion increase (0.7 percent) overall. All sums are below the rate of inflation, though they would also allow R&D investments to grow at a marginally faster clip than the rest of the discretionary budget. The President has also proposed an additional $5.3 billion in R&D through his Opportunity, Growth, and Security Initiative (OGSI), though this extra funding faces tall odds in Congress. This chapter will place these proposals in historical context, but will focus primarily on the base budget and not the OGSI.[1]

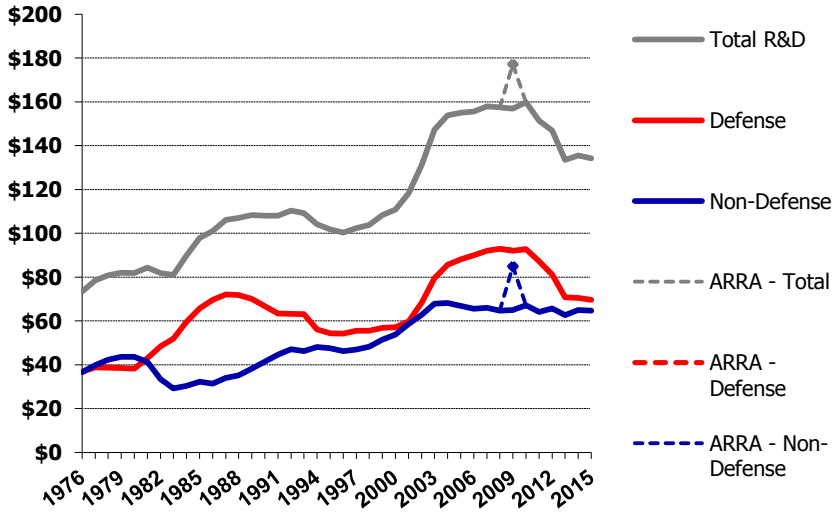
Adjusted for inflation, nondefense R&D has been inching downwards since 2004, and the President's base budget would generally continue this trend. Nondefense R&D funding over the past few decades is generally a story of real-dollar growth, but in fits and starts (see Figure 1). Nondefense R&D funding reached a low point in 1983, after being reduced by a third over the first three years of the decade. For the rest of the 1980s, though, nondefense R&D grew steadily, and it more than recovered by the end of the decade. This gradual growth continued into the 1990s, though nondefense R&D reached a plateau in the decade's middle years, likely due in part to the spending caps put in place by the Budget Enforcement Act of 1990. Growth returned and accelerated with the end of these caps late in the decade. The primary driver was the campaign, led by members of Congress, to double the National Institutes of Health (NIH) budget,

[1] See Tables I-10 and III-1-6 for historical data. More historical data are available on the AAAS R&D web site, at http://www.aaas.org/program/rd-budget-and-policy-program.

though other civilian R&D agencies also fared well in these years. In real dollars, nondefense R&D grew by 134 percent – more than doubling – between 1983 and its all-time peak in 2004, and by 45 percent between 1997 and 2003, during the NIH doubling.

But since the 2004 peak, nondefense R&D has generally either ticked downward or remained flat, save for the one-time contribution of the American Recovery and Reinvestment Act of 2009 (the stimulus bill), which contributed $20.2 billion to R&D (in inflation-adjusted dollars) in FY 2009. Recent years have seen particularly sharp reductions, with nearly five percent declines each in FY 2011 and FY 2013, the latter under sequestration. These cuts were partially undone in FY 2014 appropriations, which were relatively positive for R&D, but nondefense R&D remains 4.7 percent below the FY 2004 peak. The President's base budget, by granting a sub-inflation increase for nondefense R&D, would allow this shortfall to widen.

Figure 1. Defense and Nondefense R&D, billions of constant 2014 dollars

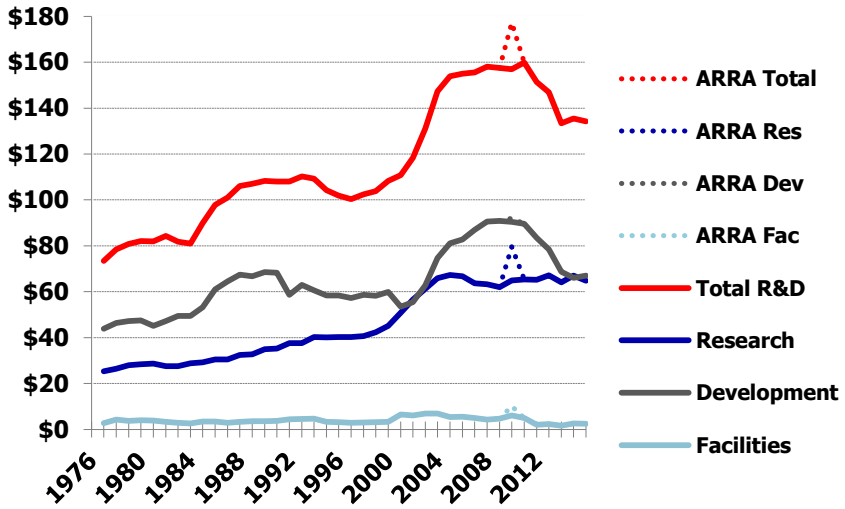


Source: AAAS *Research and Development* reports and analyses of appropriations. FY 2014-15 are current estimates. R&D includes conduct and facilities. © 2014 AAAS

Though nondefense R&D overall has ticked downwards, research trends have been somewhat more uneven. The Administration's budget would push the research trend downward. Historically, development activities, which are dominated by weapons development at

the Department of Defense (DOD), have tended to receive the greater share of federal funding (see Figure 2). But the difference between research and development funding has varied. At times, development activities have received twice the funding devoted to research, as was the case during President Reagan's defense buildup. At other times, research has managed to catch up to development, as was the case in 2000 and 2001, after a few years of increased NIH budgets but before the defense R&D spending surge driven by September 11, 2001 attacks.

Figure 2. R&D Trends by Character, billions of constant 2014 dollars



Source: AAAS *Research and Development* reports and analyses of appropriations. FY 2014-15 are current estimates. R&D includes conduct and facilities. © 2014 AAAS

Between FY 2008 and FY 2014, development activities fell by 27.4 percent, driven by cuts to DOD development. This drop in technology development has in turn served to pull down the overall R&D figure. Over the same time period, however, total research – including basic and applied research – saw some modest growth, allowing research funding to recover from earlier declines. Sequestration and other cuts eroded these gains, but research funding again recovered in FY 2014. The Administration's budget, however, would leave research spending roughly midway between the FY 2004 peak and the FY 2008 trough. It should be noted, some of this uneven growth and decline in research funding is likely due in part to reclassifications of research activities at NASA, and not necessarily due to changes in the underlying work.

Defense R&D, after declines in recent years, has plateaued of late. The President's request would keep defense R&D at this plateau, though inflation would mean a small decline. Defense R&D is composed of two sources: DOD – which has been roughly $66 billion on R&D the past two years, 25 percent below the FY 2010 peak – and the Department of Energy's (DOE) atomic defense activities, primarily the National Nuclear Security Administration. DOE defense R&D stands at roughly $4.4 billion in FY 2014. There have been two periods of defense R&D buildup followed by relative declines over the past 35 years: the aforementioned Reagan defense buildup in the 1980s and the immediate aftermath of September 11. In both instances, DOD and DOE defense R&D followed similar trajectories of growth and decline, though they have begun to diverge recently.

For DOD R&D, nearly all increases between 2000 and 2008 were in weapons systems development, "6.4" or higher in the DOD R&D classification system (see Chapter 5 for details). DOD's science and technology investments – in basic research ("6.1"), applied research ("6.2"), and early technology development and testing ("6.3") – peaked in 2005, and have been on a downward trend since then. However, the relative reductions have been much greater for weapons development. The most recent budget year, however, saw a slowing of this trend, with Congress choosing to maintain DOD R&D at post-sequestration levels in FY 2014 rather than continuing to cut. The President's budget would sustain defense R&D at this level, though the details are somewhat different. Rather than proposing increases for DOD scientific research and cuts to weapons development, the budget takes the opposite tack, levying deep cuts on most science and technology accounts save DARPA. Overall DOD R&D would decrease only slightly, adjusting for inflation

Lastly, in recent years DOE atomic defense R&D has exhibited clear growth, related to the political situation surrounding the New START nuclear arms reduction treaty. The President's request would continue this growth, saving some of the largest R&D increases anywhere in the budget for the NNSA.

At the agency level, there is no clear story. Most R&D budgets would decline due to inflation, but the "winners" and "losers" don't perfectly align with recent trends. As mentioned above, NIH funding increased substantially in real dollars between 1998 and 2003. Since

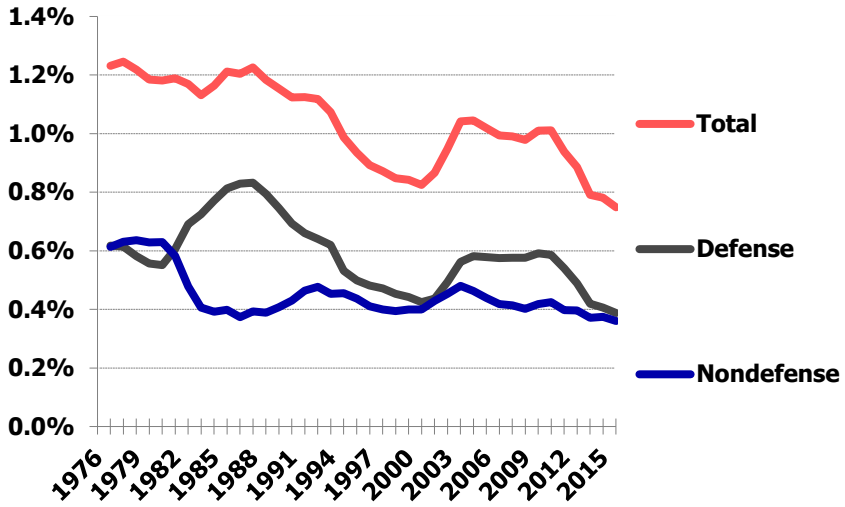
then, funding has either remained flat or slightly declined in most years (excepting the Recovery Act boost), and the Administration's budget would again hold NIH funding below inflation, representing a real-dollar decline. The Environmental Protection Agency would also continue its downward R&D trajectory. Conversely, National Science Foundation (NSF) funding did see some steady increases for a number of years, growing by 21.4 percent between FY 2005 and FY 2012. But sequestration rolled back some of these gains, and the President's budget would keep NSF R&D funding below FY 2010 levels. The long-term trend at DOE's Office of Science has followed a similar trajectory.

Some of the agencies that would gain in the request – like the Department of Transportation or the U.S. Geological Survey – have experienced cuts in recent years, while others – like the National Institute of Standards and Technology – have been on a growth trajectory, even amid sequestration. And R&D funding for efficiency and renewables at DOE has been volatile.

Perhaps the clearest statement that can be made is that most agency R&D budgets would continue to grow ahead of the overall discretionary budget, as has been the case in recent years, even as few major R&D agencies would reach pre-sequestration levels under the base budget. Equally clear is that OGSI funding would almost completely counteract any of these negative trends, but again, the possibility of obtaining additional fiscal room from Congress seems unlikely.

The Administration's budget would not counteract the long-term decline in federal R&D investments as a share of U.S. gross domestic product (GDP). In spite of the real-dollar growth described above, federal research investments are shrinking as a share of the U.S. economy, as shown in Figure 3. Gains in the NIH budget and defense R&D increased the ratio briefly in the first years of the 21st century, but the long-term trend is clearly downward. The Administration's base budget would continue this decline, with federal R&D as a share of GDP dropping to 0.75 percent, a 50-year low.

Figure 3. Trends in Federal R&D as Percent of GDP



Source: Up to 1994: National Science Foundation, *Federal Funds for Research and Development*. 1995 to Present: AAAS *Research and Development* series and agency budget documents and data. © 2014 AAAS

It is true that some of this decline has been offset by increasing R&D investment from the private sector, but it is also true that private sector R&D tends to be more focused on development activities with short-term returns, and thus does not offer the same potential for breakthrough discoveries as the more radical research the government is able to pursue. Lastly, it is also important to remember that even as U.S. investments in public R&D have declined as a share of the broader economy, other nations have accelerated their own investments in research over the past few decades. As a result, R&D growth as a share of GDP has been far more rapid elsewhere, particularly in Asia.[2]

[2] See NSF's *Science and Engineering Indicators* for additional information.