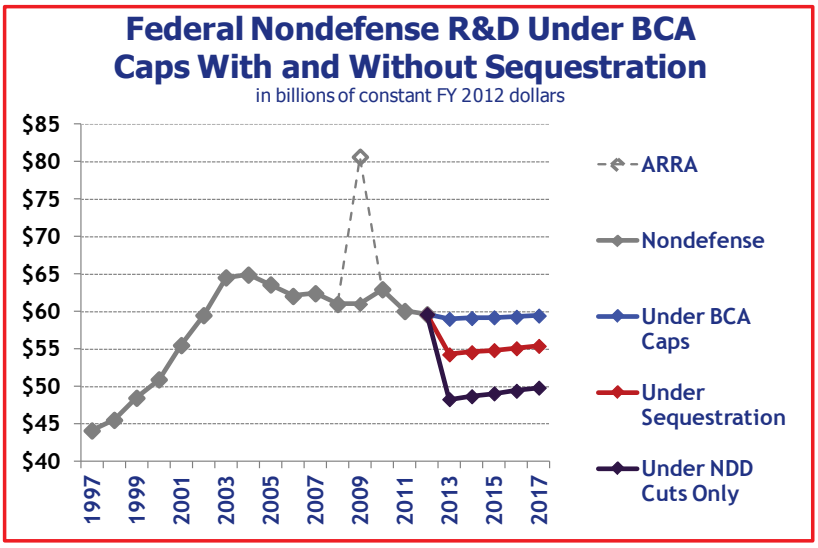
Summary: Federal R&D and Sequestration In The First Five Years

Sequestration – the large, automatic, across-the-board reductions in federal funding set to begin in January of 2013 – remains a major concern for many inside and outside Washington. The cuts, established in the Budget Control Act (BCA) of 2011, amount to $55 billion less in defense discretionary spending and up to $38 billion less in nondefense discretionary spending. Cuts of this magnitude could no doubt have significant impacts on federal funding of science, research, and innovation. They also come at a time when federal R&D has already declined by 10 percent in real dollars since FY 2010. This brief attempts to illuminate the size of these potential cuts by estimating budget impacts for most key R&D agencies, and the funding ramifications by state, over the next five years.[1] A summary version follows, with tables appended.



Sequestration Again Is…?

Sequestration was put in place by the BCA in August 2011. This law was meant to reduce discretionary spending, which accounts for about a third of the federal budget, and includes almost all federal R&D. As far as mandatory spending – which makes up the remainder of the budget, and consists mostly of entitlements like Social Security – the BCA leaves it largely untouched, and nor does it affect the tax code, though it's difficult to envision a real deficit-reduction plan that ignores these latter elements.

In terms of spending, the BCA basically did two things. First, it established caps that will keep federal discretionary spending mostly flat (when accounting for inflation) over the next decade. Alone, these caps amount to about $1 trillion less than had been projected prior to the law's passage. But it also established additional automatic reductions – the sequestration – which would reduce this spending even further: by about 9.4 percent for defense spending and 8.2 percent for nondefense spending.

[1] Note: sequestration extends through 2021, but we only cover the first five years to allow for adjustment for inflation, based on OMB's price deflators through 2017.

The irony is that it was originally intended only as a contingency plan. The BCA established a special Congressional committee to produce what would have been a sweeping deficit reduction plan of well more than $1 trillion. The cuts now known as sequestration were simply meant as a "gun to the head" for this committee. Policymakers expected this committee to succeed, and thus avoid the doomsday sequestration scenario; it didn't, and so sequestration looms in the absence of a bipartisan plan to avoid it.

What We Did

Read the full brief[i] for the more detailed explanation, but here are the basics. We started out by developing an R&D funding baseline through 2017, under the assumption that federal R&D spending would grow at the rate allowed by the BCA caps mentioned above. This is a pretty safe expectation, as the ratio of federal R&D to discretionary spending has been pretty static over the past few decades. Then, we estimated potential cuts under a couple different scenarios. The first scenario assumes sequestration goes forth in a balanced fashion: equal cuts to defense and nondefense, as the law is currently written. We drew on previous analyses of the BCA by the Congressional Budget Office (CBO) and the White House's Office of Management and Budget (OMB) to develop these estimates.[ii]

However, many have proposed alternative plans that would shift at least some of the spending-reduction burden onto nondefense and away from defense (and given the tenor of the debate, there are many who would shift the entire burden).[iii] So, in the second scenario we looked at what might happen should this shift happen in its entirety, with the defense cuts redirected onto nondefense spending. The aforementioned analyses by OMB and CBO were helpful here too.

Lastly, we used state-by-state funding data from the National Science Foundation (NSF) to determine how a balanced sequestration may impact individual states.

What We Found

Again, see the full brief for more details, but here are the basic results. In both scenarios, total R&D could be cut by at least $50 billion below the baseline over five years. If sequestration is balanced (see graph at right), the total cuts over five years would be somewhat higher but more evenly distributed. R&D programs on the defense side could be cut by 9.1 percent over five years, while nondefense programs would receive 7.6 percent cuts (they would be larger in the first year and decline thereafter). At the agency level, the National Institutes of Health (NIH) could receive a cut of $11.3 billion over five years, averaging $2.3 billion less per year for research. The Department of Defense (DOD) could average $6.7 billion less for R&D per year, while NSF could receive $2.1 billion less over five years. Total cuts through 2017 would amount to $57.5 billion. The resulting R&D budgets at most agencies would be lower than they've been in several years.

Estimated R&D Cuts Under Balanced Sequestration, FY 2013-2017
(budget authority in millions of constant 2012 dollars)

	2013	2014	2015	2016	2017	Total Cut	5-Year Percent
Dept of Defense	-6,928	-6,818	-6,696	-6,585	-6,495	-33,524	-9.1%
HHS	-2,528	-2,429	-2,333	-2,241	-2,155	-11,685	-7.6%
NIH	*-2,439*	*-2,343*	*-2,251*	*-2,162*	*-2,079*	*-11,274*	*-7.6%*
Dept of Energy	-972	-944	-916	-889	-865	-4,585	-8.2%
Natl Sci Foundation	-456	-438	-421	-404	-388	-2,106	-7.6%
NASA	-763	-733	-704	-676	-650	-3,527	-7.6%
Dept of Agr	-189	-182	-175	-168	-161	-875	-7.6%
Dept of Commerce	*-103*	*-98*	*-95*	*-91*	*-87*	-474	-7.6%
Dept of the Interior	*-65*	*-62*	*-60*	*-57*	*-55*	-299	-7.6%
EPA	-46	-44	-43	-41	-39	-213	-7.6%
Homeland Security	-50	-48	-46	-44	-43	-232	-7.6%
Total R&D Cut	**-12,099**	**-11,796**	**-11,488**	**-11,196**	**-10,939**	**-57,519**	**-8.4%**

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act.
Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.

The nondefense-only scenario would be far tougher for most science agencies, with $50.8 billion in cuts to nondefense R&D funding over five years (see table). This is more than twice the cuts we might expect under a balanced sequestration. Should larger cuts take place, it would mean a cut of 17.5 percent per agency over the next five years, except for Veterans Affairs, which is exempt. For NIH, this could amount to $26.1 billion less for research, or an average of $5.2 billion less per year. The Department of Energy's (DOE) Office of Science could lose $3.9 billion total for research, or $775.9 million per year; NSF could lose $4.9 billion, or $976.0 million per year. For many agencies, cuts of this magnitude would reduce their R&D budgets to levels not seen in over a decade. NASA, for one, hasn't seen its budget at these potential levels since the 1980s.

One of the frustrating things about these cuts is that we won't really know *how* the agencies will adapt to them until they make their plans known. No doubt, agencies will likely cut the numbers of available research grants; for instance, NIH expects to lose over 2,000 grants.[iv] Agencies may also modify grant terms to reduce individual grants values but maintain award numbers. Agencies may also reduce or terminate select programs, capital projects, or overhead, or withdraw from current partnerships. Each of these choices will have diverse effects on researchers and contractors depending on the nature of the project. These effects will likely ripple through the broader economy, but the actual impacts are difficult to predict.

Estimated R&D Cuts Under Nondefense Sequestration, FY 2013-2017
(budget authority in millions of constant 2012 dollars)

	2013	2014	2015	2016	2017	Total Cut	5-Year Percent
Dept of Defense	0	0	0	0	0	0	0.0%
HHS	-5,711	-5,561	-5,411	-5,264	-5,124	-27,070	-17.5%
NIH	*-5,509*	*-5,365*	*-5,220*	*-5,078*	*-4,944*	*-26,116*	*-17.5%*
Dept of Energy	-1,236	-1,203	-1,171	-1,139	-1,109	-5,857	-10.4%
Natl Sci Foundation	-1,029	-1,002	-975	-949	-924	-4,880	-17.5%
NASA	-1,723	-1,678	-1,633	-1,589	-1,546	-8,170	-17.5%
Dept of Agr	-427	-416	-405	-394	-384	-2,026	-17.5%
Dept of Commerce	*-232*	*-226*	*-219*	*-213*	*-208*	-1,098	-17.5%
Dept of the Interior	*-146*	*-142*	*-138*	*-135*	*-131*	-692	-17.5%
EPA	-104	-101	-99	-96	-93	-494	-17.5%
Homeland Security	-113	-110	-107	-104	-102	-536	-17.5%
Total R&D Cut	**-10,721**	**-10,440**	**-10,158**	**-9,882**	**-9,620**	**-50,822**	**-7.4%**

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act. Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.

What we do know, in any event, is that agencies will have much less to work with when it comes to R&D. We also know that the impacts on researchers will be spread far and wide, geographically speaking. The table at right ranks the impacted states by the size of the potential cut under the balanced scenario. California tops the list, given its enormous size and its large university system, with several prominent federal research centers in energy, space technology, and defense. Some states, like Virginia, are particularly heavy in defense R&D, but many, like Maryland, New York, Massachusetts, and Pennsylvania, receive more balanced federal research funding. New Mexico is somewhat unique given the presence of a pair of major labs, Sandia and Los Alamos, making DOE R&D particularly important there. Illinois' profile is also somewhat unique, given low levels of DOD funding relative to other nondefense agencies like NSF and the presence of Argonne National Laboratory and Fermilab.

Top 20 States by Lost Federal R&D
Five-year total reductions due to sequestration, in millions of constant 2012 dollars.

State	Total	Percent Below Baseline
California	-11,315	-8.5%
Maryland	-5,440	-8.1%
Virginia	-4,256	-8.8%
Massachusetts	-3,140	-8.4%
District of Columbia	-2,877	-8.6%
Texas	-2,822	-8.6%
New York	-2,401	-8.2%
New Mexico	-1,880	-8.4%
Pennsylvania	-1,754	-8.2%
Washington	-1,661	-8.5%
Florida	-1,566	-8.7%
Alabama	-1,439	-8.7%
Ohio	-1,434	-8.5%
Arizona	-1,337	-8.8%
Colorado	-1,157	-8.1%
New Jersey	-1,142	-8.7%
Connecticut	-1,054	-8.7%
Missouri	-1,039	-8.6%
Illinois	-1,015	-8.0%
Georgia	-907	-8.4%

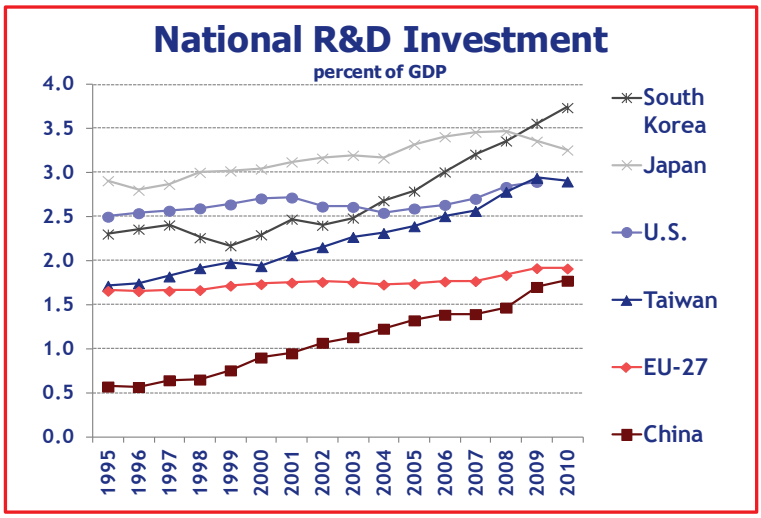
WHAT IT MEANS IN CONTEXT

It would be strange to call this a bad time for cuts of this magnitude, because that would imply that there's a *good* time. Nevertheless, there are some negative trends we need to keep in mind as we look at the current situation. As we don't quite know yet how agencies might adapt, keeping this context in mind is important.

First, federal funding for R&D has been largely flat over the past decade in regular appropriations, and more recently has been on the downswing. In just the past two years, federal nondefense R&D has declined by 5 percent, after a largely stagnant decade. The big exception to the trend, of course, was the infusion of research dollars from the Recovery Act in 2009. While quite large and no doubt helpful, a one-time injection is not a substitute for steady, predictable investment over time, and that stimulus funding has long since dried up. Even the Bowles-Simpson commission has said public investment in R&D is important.[v]

Second, as appropriators have been restrained, federal R&D as a share of the economy has declined. This trend is much more long-term, as federal research investments have generally not kept up with economic growth since the 1970s; if it had, it would be closer to $200 billion, rather than its current level of $140 billion. As public R&D funding has declined in relative scale, private R&D funding has increased. The growth of industrial R&D should be welcomed by those who would have an innovative economy, but it's also not a perfect substitute for public R&D, which tends to be more long-term, higher-risk, and focused on more fundamental knowledge areas that can have big long-term benefits.

Lastly, while the U.S. prepares to scale back, other nations are ramping up. When measuring by research intensity, or research investment as a percentage of GDP, Asian tigers like South Korea, Taiwan, and China, and select European economies like Sweden and Finland, have managed to increase their research intensities substantially – and at a far faster pace than the U.S., albeit from a less research-intensive base. Simply put, sequestration would set the U.S. on a path that runs counter to global research investment trends.



[i] http://www.aaas.org/spp/rd/fy2013/SeqBrief.shtml

[ii] Congressional Budget Office, "Estimated Impact of Automatic Budget Enforcement Procedures Specified in the Budget Control Act," September 12, 2011, http://www.cbo.gov/sites/default/files/cbofiles/attachments/09-12-BudgetControlAct.pdf; OMB's September 14 sequestration report, http://www.whitehouse.gov/sites/default/files/omb/assets/legislative_reports/stareport.pdf

[iii] See http://www.aaas.org/spp/rd/fy2013/HouseBudgetBrief.shtml; see also, "Paul Ryan's Fiscal Year 2013 Budget: The Details," Bipartisan Policy Center, March 21, 2012. http://bipartisanpolicy.org/blog/2012/03/paul-ryan%E2%80%99s-fiscal-year-2013-budget-details

[iv] See http://markey.house.gov/sites/markey.house.gov/files/documents/HHS%20response%20on%20sequester%20cuts.pdf

[v] National Commission on Fiscal Responsibility and Reform, http://www.fiscalcommission.gov/news/moment-truth-report-national-commission-fiscal-responsibility-and-reform

APPENDIX

Table 1: Estimated R&D Funding Under the BCA Caps, FY 2013-2017
(budget authority in millions of constant 2012 dollars)

	2013	2014	2015	2016	2017	Total	Average Annual Growth
Dept. of Defense	73,704	73,862	73,869	73,974	74,298	369,707	0.2%
HHS	30,825	30,881	30,933	30,971	31,052	154,661	0.2%
National Institutes of Health	*29,739*	*29,793*	*29,843*	*29,880*	*29,959*	*149,213*	*0.2%*
DOE	11,191	11,213	11,224	11,239	11,276	56,143	0.2%
Energy Programs	*2,252*	*2,256*	*2,260*	*2,262*	*2,268*	*11,298*	*0.2%*
Office of Science	*4,417*	*4,425*	*4,433*	*4,438*	*4,450*	*22,164*	*0.2%*
Atomic Defense	*4,522*	*4,531*	*4,532*	*4,538*	*4,558*	*22,681*	*0.2%*
NSF	5,557	5,567	5,576	5,583	5,598	27,880	0.2%
NASA	9,303	9,320	9,336	9,347	9,372	46,677	0.2%
Science	*3,252*	*3,258*	*3,264*	*3,268*	*3,276*	*16,319*	*0.2%*
Aeronautics	*468*	*469*	*470*	*470*	*472*	*2,349*	*0.2%*
Space Ops	*1,686*	*1,689*	*1,692*	*1,694*	*1,698*	*8,457*	*0.2%*
Exploration Systems	*3,386*	*3,392*	*3,398*	*3,402*	*3,411*	*16,989*	*0.2%*
Space Technology	*382*	*383*	*383*	*384*	*385*	*1,917*	*0.2%*
USDA	2,307	2,311	2,315	2,318	2,324	11,576	0.2%
Agr Research Service	*1,115*	*1,117*	*1,118*	*1,120*	*1,123*	*5,592*	*0.2%*
National Inst of Food and Agr	*703*	*704*	*705*	*706*	*708*	*3,526*	*0.2%*
Forest Service	*331*	*331*	*332*	*332*	*333*	*1,659*	*0.2%*
Commerce	*1,250*	*1,252*	*1,254*	*1,256*	*1,259*	6,272	0.2%
NIST	*549*	*550*	*551*	*552*	*553*	*2,756*	*0.2%*
NOAA	*575*	*576*	*577*	*578*	*579*	*2,885*	*0.2%*
Interior	*788*	*789*	*791*	*792*	*794*	3,953	0.2%
US Geological Survey	*668*	*669*	*670*	*671*	*673*	*3,352*	*0.2%*
EPA	562	563	564	565	566	2,821	0.2%
Veterans	1,152	1,154	1,156	1,158	1,161	5,781	0.2%
DHS	611	612	613	614	615	3,064	0.2%
Total R&D	**137,250**	**137,524**	**137,631**	**137,815**	**138,316**	**688,536**	**0.2%**
Defense	78,225	78,393	78,401	78,513	78,857	392,388	0.2%
Nondefense	59,024	59,130	59,230	59,303	59,459	296,147	0.2%

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act. Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.

Table 2: Estimated R&D Cuts Under the Sequestration, FY 2013-2017
(budget authority in millions of constant 2012 dollars)

	2013	2014	2015	2016	2017	Total Cut	5-Year Percent Cut
Dept. of Defense	-6,928	-6,818	-6,696	-6,585	-6,495	-33,524	-9.1%
HHS	-2,528	-2,429	-2,333	-2,241	-2,155	-11,685	-7.6%
National Institutes of Health	*-2,439*	*-2,343*	*-2,251*	*-2,162*	*-2,079*	*-11,274*	*-7.6%*
DOE	-972	-944	-916	-889	-865	-4,585	-8.2%
Energy Programs	*-185*	*-177*	*-170*	*-164*	*-157*	*-854*	*-7.6%*
Office of Science	*-362*	*-348*	*-334*	*-321*	*-309*	*-1,675*	*-7.6%*
Atomic Defense	*-425*	*-418*	*-411*	*-404*	*-398*	*-2,057*	*-9.1%*
NSF	-456	-438	-421	-404	-388	-2,106	-7.6%
NASA	-763	-733	-704	-676	-650	-3,527	-7.6%
Science	*-267*	*-256*	*-246*	*-236*	*-227*	*-1,233*	*-7.6%*
Aeronautics	*-38*	*-37*	*-35*	*-34*	*-33*	*-177*	*-7.6%*
Space Ops	*-138*	*-133*	*-128*	*-123*	*-118*	*-639*	*-7.6%*
Exploration Systems	*-278*	*-267*	*-256*	*-246*	*-237*	*-1,284*	*-7.6%*
Space Technology	*-31*	*-30*	*-29*	*-28*	*-27*	*-145*	*-7.6%*
USDA	-189	-182	-175	-168	-161	-874.6	-7.6%
Agr Research Service	*-91*	*-88*	*-84*	*-81*	*-78*	*-422.5*	*-7.6%*
Nat Institute of Food and Agr	*-58*	*-55*	*-53*	*-51*	*-49*	*-266.4*	*-7.6%*
Forest Service	*-27*	*-26*	*-25*	*-24*	*-23*	*-125.3*	*-7.6%*
Commerce	*-103*	*-98*	*-95*	*-91*	*-87*	-474	-7.6%
NIST	*-45*	*-43*	*-42*	*-40*	*-38*	*-208*	*-7.6%*
NOAA	*-47*	*-45*	*-44*	*-42*	*-40*	*-218*	*-7.6%*
Interior	*-65*	*-62*	*-60*	*-57*	*-55*	-299	-7.6%
US Geological Survey	*-55*	*-53*	*-51*	*-49*	*-47*	*-253*	*-7.6%*
EPA	-46	-44	-43	-41	-39	-213	-7.6%
Veterans	0	0	0	0	0	0	0.0%
DHS	-50	-48	-46	-44	-43	-232	-7.6%
Total R&D Cut	**-12,099**	**-11,796**	**-11,488**	**-11,196**	**-10,939**	**-57,519**	**-8.4%**
Defense	-7,353	-7,237	-7,107	-6,989	-6,894	-35,580	-9.1%
Nondefense	-4,746	-4,560	-4,381	-4,207	-4,046	-21,938	-7.4%

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act.
Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.

Table 3: Estimated R&D Cuts Under Nondefense-Only Sequestration, FY 2013-2017
(budget authority in millions of constant 2012 dollars)

	2013	2014	2015	2016	2017	Total Cut	5-Year Percent Cut
Dept. of Defense	0	0	0	0	0	0	0.0%
HHS	-5,711	-5,561	-5,411	-5,264	-5,124	-27,070	-17.5%
National Institutes of Health	*-5,509*	*-5,365*	*-5,220*	*-5,078*	*-4,944*	*-26,116*	*-17.5%*
DOE	-1,236	-1,203	-1,171	-1,139	-1,109	-5,857	-10.4%
Energy Programs	*-417*	*-406*	*-395*	*-385*	*-374*	*-1,977*	*-17.5%*
Office of Science	*-818*	*-797*	*-775*	*-754*	*-734*	*-3,879*	*-17.5%*
Atomic Defense	*0*	*0*	*0*	*0*	*0*	*0*	*0.0%*
NSF	-1,029	-1,002	-975	-949	-924	-4,880	-17.5%
NASA	-1,723	-1,678	-1,633	-1,589	-1,546	-8,170	-17.5%
Science	*-603*	*-587*	*-571*	*-555*	*-541*	*-2,856*	*-17.5%*
Aeronautics	*-87*	*-84*	*-82*	*-80*	*-78*	*-411*	*-17.5%*
Space Ops	*-312*	*-304*	*-296*	*-288*	*-280*	*-1,480*	*-17.5%*
Exploration Systems	*-627*	*-611*	*-594*	*-578*	*-563*	*-2,974*	*-17.5%*
Space Technology	*-71*	*-69*	*-67*	*-65*	*-64*	*-336*	*-17.5%*
USDA	-427	-416	-405	-394	-384	-2,026	-17.5%
Agr Research Service	*-206*	*-201*	*-196*	*-190*	*-185*	*-979*	*-17.5%*
Nat Institute of Food and Agr	*-130*	*-127*	*-123*	*-120*	*-117*	*-617*	*-17.5%*
Forest Service	*-61*	*-60*	*-58*	*-56*	*-55*	*-290*	*-17.5%*
Commerce	*-232*	*-226*	*-219*	*-213*	*-208*	-1,098	-17.5%
NIST	*-102*	*-99*	*-96*	*-94*	*-91*	*-482*	*-17.5%*
NOAA	*-107*	*-104*	*-101*	*-98*	*-96*	*-505*	*-17.5%*
Interior	*-146*	*-142*	*-138*	*-135*	*-131*	-692	-17.5%
US Geological Survey	*-124*	*-121*	*-117*	*-114*	*-111*	*-587*	*-17.5%*
EPA	-104	-101	-99	-96	-93	-494	-17.5%
Veterans	0	0	0	0	0	0	0.0%
DHS	-113	-110	-107	-104	-102	-536	-17.5%
Total R&D Cut	**-10,721**	**-10,440**	**-10,158**	**-9,882**	**-9,620**	**-50,822**	**-7.4%**
Defense	0	0	0	0	0	0	0.0%
Nondefense	-10,721	-10,440	-10,158	-9,882	-9,620	-50,822	-17.2%

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act.
Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.

Table 4: Estimated State R&D Cuts Under Sequestration, FY 2013-2017

(Five-year totals expressed as budget authority in millions of constant 2012 dollars)

	DOD	DOE	HHS	DHS	NASA	NSF	DOI	USDA	DOC	EPA	Total	Percent
Alabama	-1,168	-7	-125	-2	-112	-11	-1	-10	-2	0	-1,439	-8.7%
Alaska	-116	-4	-6	0	-4	-15	-12	-10	-10	0	-178	-8.5%
Arizona	-1,114	-5	-73	-5	-47	-73	-6	-12	-1	0	-1,337	-8.8%
Arkansas	-10	-1	-35	0	-1	-5	-1	-15	0	0	-68	-7.8%
California	-7,313	-920	-1,381	-40	-1,205	-339	-39	-51	-22	-5	-11,315	-8.5%
Colorado	-453	-85	-147	-1	-246	-104	-39	-17	-63	-2	-1,157	-8.1%
Connecticut	-803	-16	-191	-5	-9	-22	-1	-4	-3	-1	-1,054	-8.7%
Delaware	-17	-3	-13	0	-5	-10	0	-3	-1	0	-53	-8.0%
District of Columbia	-1,996	-218	-108	-15	-342	-63	-2	-106	-2	-25	-2,877	-8.6%
Florida	-1,216	-10	-158	-2	-59	-58	-14	-24	-18	-6	-1,566	-8.7%
Georgia	-548	-24	-238	-4	-15	-41	-5	-29	-1	-3	-907	-8.4%
Hawaii	-142	-2	-28	0	-9	-15	-4	-12	-7	0	-220	-8.5%
Idaho	-19	-110	-6	-2	-2	-5	-4	-10	-1	0	-158	-8.1%
Illinois	-174	-371	-314	-6	-11	-107	-2	-25	-4	-2	-1,015	-8.0%
Indiana	-127	-12	-88	-1	-6	-43	-2	-8	-1	0	-287	-8.2%
Iowa	-97	-24	-88	0	-5	-17	-1	-27	0	0	-260	-8.1%
Kansas	-77	-6	-36	0	-3	-15	-2	-8	0	0	-147	-8.3%
Kentucky	-27	-3	-61	-1	-2	-9	-1	-7	0	0	-113	-7.9%
Louisiana	-76	-3	-66	0	-7	-13	-8	-20	-1	0	-195	-8.1%
Maine	-68	-1	-32	0	-2	-7	-1	-3	-1	0	-115	-8.4%
Maryland	-2,071	-16	-2,531	-31	-463	-52	-7	-70	-196	-3	-5,440	-8.1%
Massachusetts	-1,843	-60	-956	-11	-90	-143	-6	-11	-15	-4	-3,140	-8.4%
Michigan	-372	-20	-246	0	-10	-67	-3	-11	-7	-3	-739	-8.3%
Minnesota	-238	-6	-191	-1	-6	-32	-2	-16	-1	-7	-500	-8.2%
Mississippi	-329	-2	-19	-1	-15	-6	-3	-37	-5	0	-417	-8.7%
Missouri	-769	-5	-214	0	-9	-24	-5	-14	0	0	-1,039	-8.6%
Montana	-17	-3	-58	0	-5	-9	-4	-11	0	0	-108	-7.8%
Nebraska	-29	-1	-33	0	-1	-10	-1	-14	0	0	-90	-8.0%
Nevada	-58	-145	-10	-1	-6	-7	-2	-1	-1	-7	-239	-8.3%
New Hampshire	-127	-1	-40	-4	-10	-9	0	-4	-8	0	-204	-8.4%
New Jersey	-885	-45	-118	-6	-22	-48	-1	-4	-12	-2	-1,142	-8.7%
New Mexico	-611	-1,150	-50	-20	-23	-14	-4	-5	-2	-1	-1,880	-8.4%
New York	-932	-390	-835	-4	-40	-167	-2	-18	-9	-3	-2,401	-8.2%
North Carolina	-100	-12	-485	-2	-7	-49	-3	-18	-7	-66	-750	-7.7%
North Dakota	-14	-8	-8	0	-2	-3	-2	-14	0	0	-52	-8.0%
Ohio	-919	-20	-304	-6	-91	-40	-1	-11	-2	-38	-1,434	-8.5%
Oklahoma	-103	-6	-36	0	-7	-10	-1	-9	-8	-5	-185	-8.4%
Oregon	-42	-10	-121	0	-5	-26	-7	-21	-3	-8	-244	-7.8%
Pennsylvania	-758	-244	-603	-1	-20	-96	-3	-25	-3	-1	-1,754	-8.2%
Rhode Island	-245	-2	-58	-1	-3	-15	-1	-1	-1	-6	-333	-8.6%
South Carolina	-99	-17	-57	-1	-3	-15	-1	-8	-8	0	-209	-8.3%
South Dakota	-5	0	-8	0	-4	-3	-6	-4	0	0	-31	-7.8%
Tennessee	-150	-290	-180	-14	-90	-18	-3	-11	-1	0	-757	-8.1%
Texas	-2,025	-28	-483	-2	-165	-67	-6	-39	-5	-1	-2,822	-8.6%
Utah	-324	-6	-67	0	-54	-17	-3	-12	0	0	-484	-8.5%
Vermont	-61	-1	-29	0	-1	-4	0	-4	-1	0	-102	-8.4%
Virginia	-3,590	-63	-178	-30	-247	-74	-57	-7	-6	-4	-4,256	-8.8%
Washington	-1,056	-118	-353	-10	-15	-50	-6	-20	-30	-2	-1,661	-8.5%
West Virginia	-83	-64	-18	0	-11	-3	-2	-14	-1	0	-196	-8.3%
Wisconsin	-35	-20	-163	0	-8	-39	-6	-21	-2	-1	-295	-7.7%
Wyoming	-3	-2	-4	0	-1	-5	-2	-4	0	0	-19	-7.8%
Other*	-70	0	-37	0	-1	-10	-1	-13	-1	0	-133	-8.3%
Total R&D Cut	**-33,524**	**-4,585**	**-11,685**	**-232**	**-3,527**	**-2,106**	**-299**	**-875**	**-474**	**-213**	**-57,519**	**-8.4%**

Source: AAAS estimates of R&D, based on CBO and OMB analyses of the Budget Control Act.
Constant dollar conversions based on OMB's GDP deflators from the FY 2013 budget.
*Includes territories, outlying areas, and offices abroad.

ITIF
The Information Technology & Innovation Foundation

Eroding Our Foundation: Sequestration, R&D, Innovation and U.S. Economic Growth

BY JUSTIN HICKS AND ROBERT D. ATKINSON | SEPTEMBER 2012

Unless changed, sequestration will result in significant cuts to federal R&D investments from 2013-2021 and lead to GDP losses of up to $860 billion.

EXECUTIVE SUMMARY

Because of the Budget Control Act, budget enforcement procedures known as *sequestration* will commence January, 2013 unless Congress and the Obama Administration act otherwise. The sequester requires cuts in discretionary spending to achieve $1.2 trillion in savings from 2013-2021. When compared to 2011 spending levels, this will lead to a cut of 8.7 percent (or $12.5 billion) of federally-funded research and development (R&D) in 2013.

Because of the key role federal R&D plays in driving U.S. innovation, productivity, and economic growth; we estimate that the projected decline in R&D will reduce GDP by between $203 billion and $860 billion over the nine year period, depending on the baseline used. At $203 billion, the loss is equivalent to taking away from U.S. consumers all the new motor vehicles purchase over six months, over two years of airline travel, or six years of attendance at professional sporting events. These R&D cuts will also result in job losses of approximately 200,000 in 2013. Reducing the budget deficit is important, but it should not and does not have to come at the expense of growth-inducing investments in areas like federal support for R&D. In fact, undermining growth capability is disruptive of a deficit control policy.

We generate these estimates by comparing sequestration to three alternative benchmarks. First, we compare sequestration to a benchmark that holds discretionary expenditures constant at their 2011 rates; just as the Office of Management and Budget (OMB) and Congressional Budget Office (CBO) did when determining how much would be sequestered from each agency starting in 2013. Under this scenario we find that sequestration of federal R&D will lead to a shortfall of $95 billion from 2013-2021. Second, we introduce a benchmark where the R&D share of GDP remains constant. It

should be noted that from 1994 through 2009, R&D expenditures have outpaced GDP growth by 20 percent, so even this benchmark would result in slower growth in R&D than in the past. Using this benchmark would result in a R&D shortfall of $330 billion. In other words, in order to increase federal R&D expenditures at a rate that simply keeps pace with the rest of the economy we would need to invest $330 billion more that sequester allows over the 2013-2021 period. Lastly, we consider what the level of R&D expenditures would need to be for federal R&D expenditures to grow at the same rate as China's relative to its economy. Sequestration will leave the United States $511 billion behind in R&D investment when compared to expected Chinese R&D expenditure growth rates.

R&D is a critical source of economic growth and therefore we estimate the implications of these cuts to the economy at large. We use the latest academic estimates which show how R&D impacts productivity to build an empirical model that analyses the impacts of R&D sequestration on GDP. To be clear, the effects to GDP do not stem from short-run reductions in government expenditures (Keynesian effects); rather the estimated effects are caused by the reduction in R&D and its impact on the underlying mechanisms of growth. Figure 1 shows the estimates of the cuts in federal R&D expenditures from sequestration and the related losses to GDP stemming from reduced innovation over the 2013-2021 period.

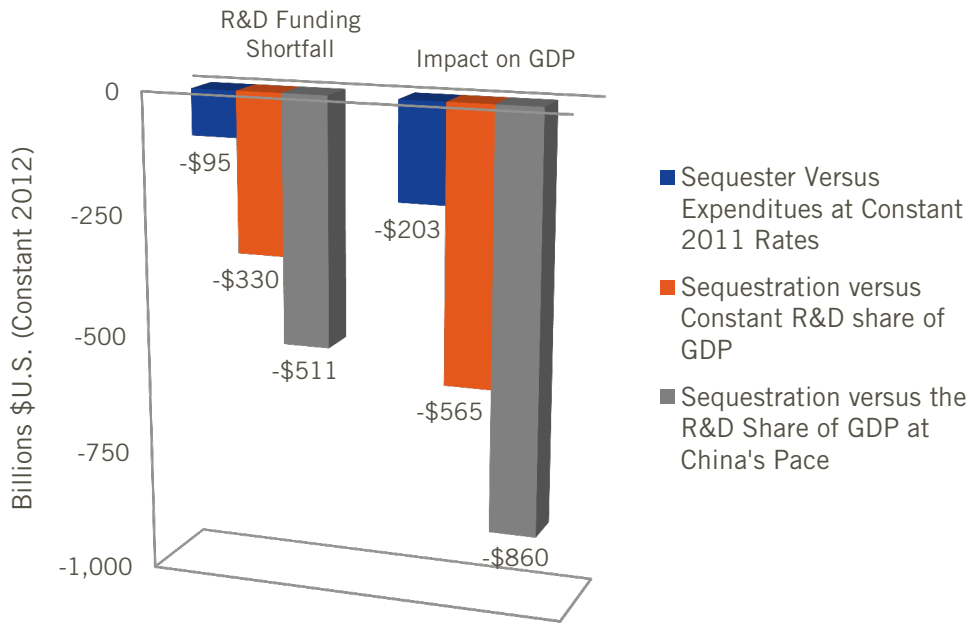


Figure 1: R&D Funding Shortfalls and the Related Losses in GDP: 2013-2021 Cumulative Effect, Sources: NSF, OMB, CBO, BEA, ITIF

In addition to the losses in productivity and GDP, we find that R&D sequestration would also reduce the knowledge base (publications and patents), U.S. international competiveness, and employment. We estimate that sequestration compared to the CBO baseline of no real growth in federal R&D budgets would result in U.S. scientific journal

publications declining almost 8 percent and patents almost 3 percent over the decade-long period.

In order to estimate the effects of sequestration on employment, we use a similar technique to the GDP model, but supplement it with more traditional measures of how changes in federal spending affect employment. The employment effect from cutting R&D comes from both the short-term job losses from current worker displacement, and the longer-term effects from less innovation as related to the formation of new firms. We estimate that if sequestration of R&D goes into effect, the U.S. economy will have approximately 200,000 fewer jobs per year between 2013 and 2016. This would result in the U.S. unemployment rate being 0.2 percentage points higher than it otherwise would be.

In summary, this report models the impact of R&D cuts from sequestration on the U.S. economy. The report first explains how sequestration will impact R&D expenditures and the U.S. innovation system. Next, the report presents the conceptual model and previous research explaining how R&D funding impacts the economy at large. Subsequently, based on the latest academic research, we estimate the effects of the R&D expenditure cuts on: productivity and GDP, the knowledge base (patents and publications), the U.S. standings in the global innovation system, and finally employment.

While ensuring that the federal budget crisis comes under control is critical, everything should not be "on the table" when doing this. Cutting federal support R&D, a key "fuel" for the U.S. innovation economy engine, would not only lead to a relatively smaller U.S. economy and higher unemployment , it would reduce U.S. global competitiveness precisely at a time when the U.S. economy is struggling to stay in the race for global innovation advantage.

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ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a Washington, D.C.-based think tank at the cutting edge of designing innovation strategies and technology policies to create economic opportunities and improve quality of life in the United States and around the world. Founded in 2006, ITIF is a 501(c) 3 nonprofit, non-partisan organization that documents the beneficial role technology plays in our lives and provides pragmatic ideas for improving technology-driven productivity, boosting competitiveness, and meeting today's global challenges through innovation.

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