

## Research and Development Contributions and Stocks in the Total Economy: 1987-2016

Table 1 shows the year-to-year contributions of private, public, and total research and development (R&D) to productivity growth in the total economy. Table 2 reports the long-term R&D contributions to the total economy. Table 3 reports private, public, and total R&D stocks and Table 4 further breaks down into private and public basic and applied R&D stocks in the total economy.

Research is divided into two categories – applied and basic research. Applied research refers to the research performed in any organization with an objective of understanding or gaining knowledge in order to fulfill a specified need. Applied research involves explorations to discover new scientific knowledge that has specified objectives with respect to products or processes. Basic research refers to the research performed in any organization with the objective of gaining knowledge or understanding of a subject. Development refers to the application of the knowledge obtained from research performed with an objective of producing materials, devices, systems, or methods.

Private and public R&D contributions and stocks are measured for the total economy from 1987 to 2015. R&D stocks in the total economy are obtained by cumulating constant dollar measures of research and development expenditures and allowing for depreciation. The same lags and depreciation used in determining R&D stocks in the private nonfarm business sector are also used in calculations for the total economy. The rate of return for public R&D tends to be lower than that of private R&D because some of the public research is either not relevant to commercial matters or has very low returns. Because some of the university or government research is not oriented towards economic growth or does not appear in measures of growth,<sup>1</sup> a ten percent rate of return is assumed for public R&D even though a thirty percent rate of return is assumed for private R&D. “Public R&D and Productivity Growth” by Leo Sveikauskas at <http://www.bls.gov/mfp/publicrd.pdf> includes more information on how these rates are determined. Current dollar expenditures for publicly and privately financed research and development for the years 1987-2016 are obtained from annual issues of Research and Development in Industry published by the National Science Foundation. Price deflators for the total economy are based upon the hourly compensation and implicit price deflators for the private nonfarm business sector prepared by the Division of Major Sector Productivity.

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<sup>1</sup> For example research done by the National Institute of Health (NIH).

The main difference between R&D stocks for the total economy and the R&D stocks published by the Bureau of Economic Analysis (BEA) is as follows: the stocks calculated in this document are designed to measure the benefits of R&D, which spill over from the original investors to other firms, while the R&D measures published by the BEA are the value of R&D stocks as an asset to the owners; the private firms, government, colleges and universities which finance and conduct research. The BEA measures do not include spillover effects. R&D estimates for the total economy, including those reported here and their counterparts at the BEA, include R&D financed by private firms, government, colleges and universities and nonprofit institutions.

Because of the above discussed differences in concepts and coverage the BEA and BLS R&D stocks use different lags<sup>2</sup> and rates of depreciation, and report different magnitudes for the U.S. national R&D stock. BLS stocks are larger as spillovers, associated with the diffusion of knowledge, typically take more time to take place, and therefore depreciate more slowly.<sup>3</sup> Conceptual differences between BLS and BEA are discussed in section I of BLS working paper 408, at <http://www.bls.gov/ore/pdf/ec070070.pdf>.

The R&D contributions and stocks<sup>4</sup> to the productivity growth in the total economy are greater than those of the private nonfarm business sector. The differences in the R&D stocks between the total economy and the private nonfarm business sector are to be expected since the former includes public R&D expenditure data.

Further description of these data and methods can be found in the BLS Bulletin 2331, *The Impact of Research and Development on Productivity Growth* (September 1989). Copies can be obtained by sending an email or calling:

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<sup>2</sup> Lags refer to the period of time between an investment in R&D and its ability to contribute to production. R&D stocks often incorporate a lag before R&D is assumed to affect production.

<sup>3</sup> In addition, differences in the R&D deflator also have an important influence upon differences between the BLS and BEA R&D stocks. The BEA discusses the R&D deflator in “BEA’s 2006 Research and Development Satellite Account” in the December 2006 Survey of Current Business.

<sup>4</sup> Reflect the Total Economy Production Accounts data as of March 21, 2018.

Table 1. Contribution of Private and Public R&D to Productivity Growth in the Total Economy: 1987-2016  
 (in percent)  
 ((1) plus (2) equals (3))

	Private R&D	Public R&D	Total R&D
	(1)	(2)	(3)
1987	0.16	0.06	0.22
1988	0.14	0.06	0.20
1989	0.13	0.06	0.18
1990	0.13	0.05	0.19
1991	0.15	0.05	0.20
1992	0.16	0.05	0.21
1993	0.16	0.04	0.21
1994	0.15	0.04	0.19
1995	0.13	0.03	0.16
1996	0.13	0.03	0.16
1997	0.15	0.03	0.19
1998	0.17	0.03	0.20
1999	0.17	0.03	0.21
2000	0.19	0.03	0.22
2001	0.21	0.03	0.24
2002	0.23	0.03	0.26
2003	0.19	0.04	0.22
2004	0.14	0.04	0.18
2005	0.13	0.04	0.17
2006	0.12	0.04	0.16
2007	0.12	0.05	0.17
2008	0.14	0.05	0.19
2009	0.15	0.05	0.21
2010	0.10	0.08	0.17
2011	0.07	0.07	0.14
2012	0.05	0.07	0.12
2013	0.07	0.06	0.14
2014	0.07	0.06	0.13
2015	0.09	0.05	0.14
2016	0.09	0.05	0.14

Table 2. Long-term Contribution of Private and Public R&D to Productivity Growth in the Total Economy: 1987-2016  
(average annual percent change)

((1) plus (2) equals (3))

Period	Private R&D	Public <sup>1</sup> R&D	Total R&D
	(1)	(2)	(3)
1987-2016	0.14	0.05	0.18
1987-1990	0.13	0.06	0.19
1990-1995	0.15	0.04	0.19
1995-2000	0.16	0.03	0.19
2000-2007	0.16	0.04	0.20
2007-2016	0.14	0.06	0.20

<sup>1</sup> Based on a ten percent rate of return.

Table 3. Private and Public R&D Stocks in the Total Economy: 1987-2016  
(in Billions of 2009 dollars)  
((1) plus (2) equals (3))

Year	Private R&D Stocks	Public R&D Stocks	Total R&D Stocks
	(1)	(2)	(3)
1987	715.6	1090.1	1805.7
1988	757.0	1138.3	1895.3
1989	795.4	1190.1	1985.5
1990	836.5	1240.0	2076.5
1991	883.7	1287.0	2170.6
1992	935.6	1332.0	2267.7
1993	988.9	1372.5	2361.4
1994	1040.2	1411.2	2451.4
1995	1084.8	1447.9	2532.7
1996	1130.8	1485.1	2615.9
1997	1187.9	1524.1	2712.1
1998	1253.4	1563.2	2816.5
1999	1324.9	1602.5	2927.4
2000	1405.2	1641.7	3047.0
2001	1495.9	1681.6	3177.5
2002	1598.7	1721.3	3320.1
2003	1684.4	1770.2	3454.5
2004	1752.4	1827.5	3579.9
2005	1816.9	1892.1	3709.0
2006	1877.6	1961.8	3839.4
2007	1943.1	2036.8	3979.9
2008	2018.2	2115.7	4133.8
2009	2098.3	2196.4	4294.7
2010	2147.8	2316.4	4464.2
2011	2182.6	2430.7	4613.3
2012	2209.8	2543.1	4752.9
2013	2251.4	2649.2	4900.6
2014	2293.4	2747.2	5040.7
2015	2343.0	2843.0	5186.0
2016	2397.6	2934.05	5331.7

Table 4. Basic and Applied Private and Public R&D Stocks in the Total Economy: 1987-2016  
(in Billions of 2009 dollars)

Year	Private R&D Stocks		Public R&D Stocks	
	Basic R&D Stocks	Applied R&D Stocks	Basic R&D Stocks	Applied R&D Stocks
1987	79.4	636.2	331.6	758.5
1988	83.5	673.4	350.5	787.8
1989	88.4	707.0	370.8	819.4
1990	93.7	742.8	392.4	847.6
1991	101.0	782.6	415.5	871.5
1992	108.5	827.2	440.0	892.0
1993	115.6	873.3	466.0	906.5
1994	123.2	917.0	493.9	917.3
1995	130.6	954.2	522.6	925.4
1996	141.4	989.4	552.8	932.3
1997	151.6	1036.4	583.1	941.0
1998	161.9	1091.5	614.3	948.9
1999	172.3	1152.7	646.0	956.4
2000	181.7	1223.6	678.1	963.6
2001	193.1	1302.8	711.9	969.8
2002	207.2	1391.6	747.5	973.8
2003	215.9	1468.5	784.8	985.4
2004	225.4	1527.0	824.4	1003.2
2005	235.5	1581.4	866.1	1026.0
2006	246.7	1630.9	911.4	1050.4
2007	257.1	1686.0	961.7	1075.1
2008	267.5	1750.6	1015.4	1100.3
2009	277.6	1820.7	1069.5	1126.9
2010	288.4	1859.5	1124.8	1191.6
2011	298.4	1884.2	1180.7	1249.9
2012	310.0	1899.8	1236.4	1306.7
2013	322.8	1928.7	1293.2	1356.0
2014	337.5	1956.0	1351.2	1396.1
2015	352.9	1990.0	1410.6	1432.4
2016	365.6	2032.1	1468.4	1465.6

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