Measuring Virginia's Share of Research and Development Funding

House Appropriations Committee Retreat

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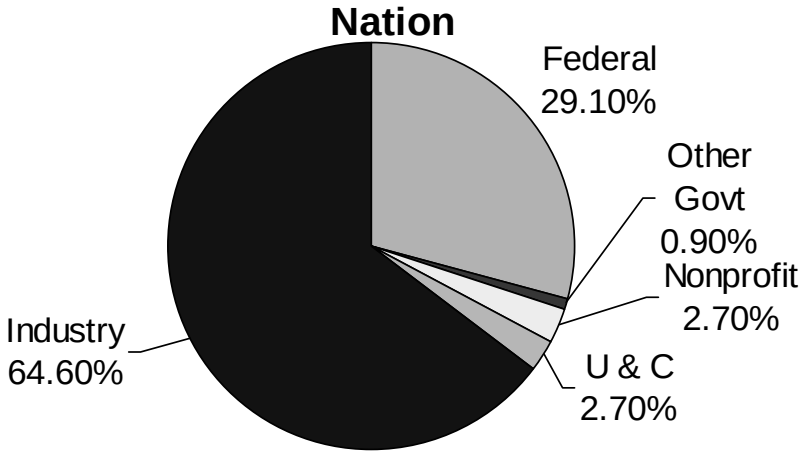
General Terms

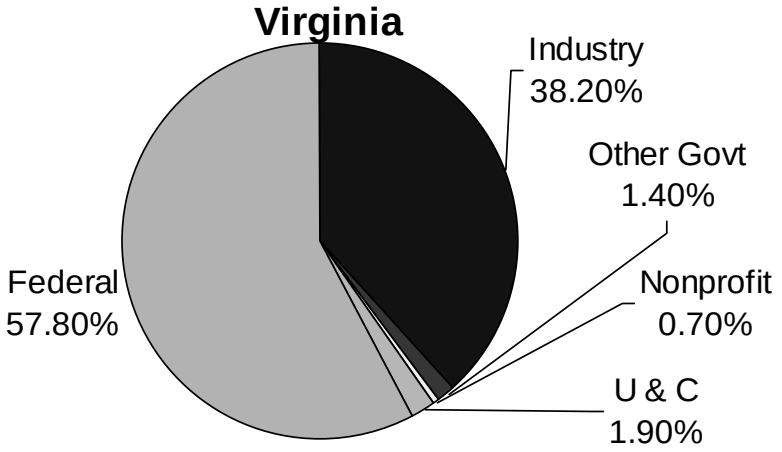
- Basic Research
  - Research conducted to gain or advance knowledge of the subject without specific applications or commercial objectives
- Applied Research
  - Research conducted to gain or increase knowledge to meet a specific, recognized need or commercial application
- Development
  - Systematic use of knowledge gained from research toward the production of useful materials, devices, systems or methods
  - Bringing it to market

Who Funds R & D?

Nation vs. Virginia

- 2002 Total R & D per National Science Foundation (NSF)
  - Nation – about $276 billion
  - Virginia – about $5.9 billion
- Total R & D since 1987 -
  - Nation – have more than doubled (119 percent increase)
  - Virginia – total R & D expenditures have increased by about 130 percent
- Nationally most research is funded by the Industry sector
- In Virginia most research is funded by the federal government



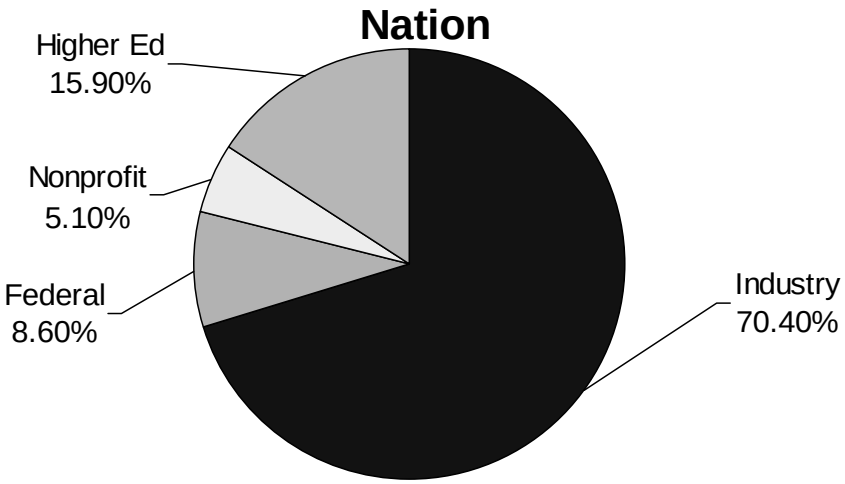


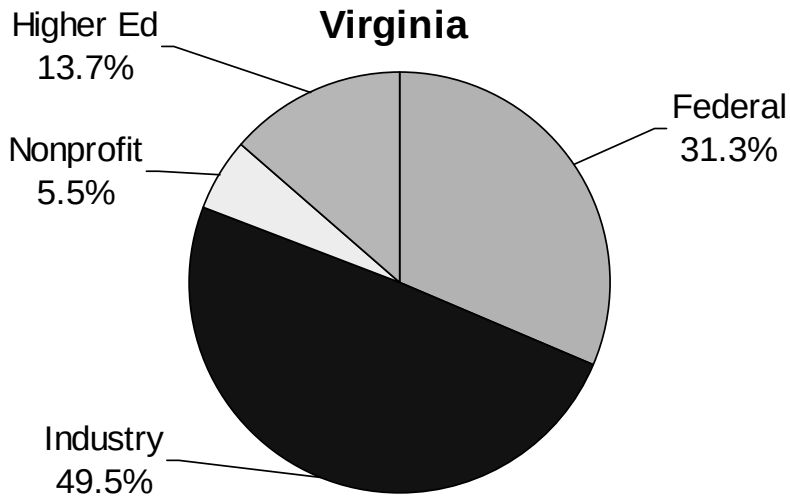
Amounts above include funds from federal labs

Who Performs R & D?

Nation vs. Virginia

- Nationally most research is performed by the Industry sector
  - Mainly applied and development
- Industry also performs the majority of the research in Virginia, however research in the state conducted by the federal government is nearly four times the national average
- Since 1987 Virginia has exceeded the nation in the growth of R & D expenditures in each of the major sectors that perform research
  - Industry R & D
    - Nation grew 111 percent
    - Virginia grew 118 percent
  - Federal R & D
    - Nation grew 75 percent
    - Virginia grew 109 percent
  - Higher Education R & D
    - Nation grew 157 percent
    - Virginia grew over 230 percent





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Virginia R & D Trends

- Virginia's relative rankings among states has not changed significantly compared to 1987
  - Virginia ranked 13th in total R & D in both 1987 and 2002
  - Virginia ranked 19th in research conducted by industry in 1987 and ranked 18th in 2002
  - Virginia ranked 18th in research conducted by higher education in 1987 and ranked 16th in 2002
- The leading R & D states also grew significantly since 1987
  - 100 percent growth rate for the top 14 states
- Virginia was further behind the top research states in 1987
  - For example, in 1987 total R & D in Virginia was about half that of Maryland, the 10th ranked state. In 2002, Virginia is about 65 percent of Maryland's R & D level

Industry R & D

- Research and development activities in the industry sector are focused on applied research and development
  - About 2/3 of all applied research activity is conducted by industry
  - About 90 percent of all development activity is conducted by industry
- Among the top ten states, industrial R & D reflects the industry clusters that exist in that state
  - Michigan ranks 2nd in terms of industry R & D mainly on the strength of transportation equipment manufacturing
  - California and Washington rank 1st and 7th respectively mainly on the strength of the software industry (over half in these two states)
  - Texas and Massachusetts (4th and 5th), along with California, perform over 40 percent of the research in computers and electronic products
  - New Jersey, New York and Pa. (3rd, 6th and 9th) have chemical and pharmaceutical niche
- Industries tend to perform research near universities that conduct the same type of research
  - Benefit from local academic research

Federal R & D

- Federal government was once main source of all R & D funds
  - Federal share began to decrease in the 1960s going from about 65% to a low of 25% in 2000
  - Federal R & D has grown recently and is estimated to now comprise about 30 percent of total research funding
- Reason for recent growth in federal R & D is the post-9/11 spending in the areas of defense, health and counter-terrorism
  - Activities to develop technologies to deter, prevent or mitigate terrorist acts grew from about $500 million in FY 2000 to $1.2 billion in FY 2002
    - The FY 2003 budget includes about $2.7 billion for counterterrorism with a third requested by HHS specifically for bioterrorism R & D at NIH
  - While these categories grew, other areas such as general science have seen little growth

Major Federal R & D Agencies

- Dept. of Defense (DOD)
  - Majority of federal R & D
  - **Most of these funds (85 percent) are spent on development**
  - Industry is the primary recipient of these funds
- Health and Human Services (HHS)
  - Federal government continues to be the primary source of basic research funding
  - About 60 percent of all basic research is funded by federal government most of which is health related (NIH)
  - Universities and colleges are the primary recipients of NIH funding
- NASA
  - Much of NASA work performed by industry or federal labs

Impact of Federal R & D in Virginia

- Virginia has consistently been among the top 10 states in terms of federal research support, ranking 6th nationally in 2002 in federal R & D expenditures
  - The majority of federal R & D in Virginia is supported by the DOD (about 76 percent)
    - DOD research obligations in Virginia are exceeded only by California
    - **However, many of these dollars do not remain in the state as firms subcontract outside of Virginia**
  - NASA, HHS and NSF are the next three major federal agencies and the largest supporters of universities and colleges in Virginia
- The profile of the top 10 research states is somewhat different
  - Most top research states are not overly reliant on a single federal agency as a R & D funding source
  - Top states receive a larger proportion of federal funds from HHS[9]

Academic Research

- Research at universities and colleges is focused on basic research activities
  - Universities and colleges account for over 60 percent of all basic research
  - Top ten academic research states are CA, NY, TX, PA, MD, MA, IL, NC, MI, OH
- The top ten states in academic research have some common characteristics. Typically, they are among the leaders in:
  - Doctoral scientists and engineers
  - Science and engineering postdoctoral students, graduate students and doctorate degrees awarded
  - Public higher education expenditures
  - Patents issued to state residents
  - Total R & D, Industry R & D, and Federal R & D

How Does Virginia Compare to the Top 10?

State (Rank) / Characteristic	**VA (16)**	CA (1)	NY (2)	TX (3)	PA (4)	MD (5)	MA (6)	IL (7)	NC (8)	MI (9)	OH (10)
Doctoral Scientists	**10**	1	2	3	5	6	4	7	11	13	9
Doctoral Engineers	**11**	1	3	2	7	10	4	9	14	8	5
Sci. & Eng. Deg	**13**	1	2	3	6	11	4	5	10	8	7
S&E Postdocs	**20**	1	3	4	5	6	2	10	7	8	13
S&E Graduate	**10**	1	2	3	7	12	5	4	11	9	8
Public HE Exp	**10**	1	2	3	5	18	27	7	9	4	6
Patents Issued	**23**	1	2	3	8	19	6	7	16	4	9
Total R & D	**13**	1	5	4	9	10	3	8	16	2	11
Industry R & D	**18**	1	6	4	9	13	5	8	16	2	10
Fed R & D Oblig	**3**	1	5	6	7	2	4	18	20	21	12
Population	**12**	1	3	2	6	19	13	5	11	8	7
Gross State Prod	**13**	1	2	3	6	15	11	5	12	9	7

Why Does Virginia Lag in Academic Research Dollars?

- If Virginia seems to compare favorable to other states, why does it trail in attracting academic research dollars?
- Industry R & D a key
  - States that are among leaders in academic research also lead in industry R & D
    - Washington (14th in academic research) and New Jersey (17th) are also top 10 in industry research
    - Maryland (Johns Hopkins) & North Carolina (Research Triangle) are exceptions
  - Synergy of academic and industry generates more federal research
- Higher education factors
  - States among academic research leaders also are among the leading states in terms of graduate and doctoral students and public spending

Another Reason Virginia Trails in Academic Research

- There is remarkable consistency in the academic rankings since 1989
  - Composition of the top tiers is fairly consistent over time with only a handful of institutions dropping out of the top 40
  - Relative proportion of spending by each tier of ten institutions is consistent over time
    - Since 1989 the Top 40 institutions spend 50 percent
- Johns Hopkins University has been ranked # 1 since 1989
  - They account for slightly more than 3 percent of all research expenditures (over $1.2 billion) driving Maryland's ranking
  - Virginia's three top-100 research institutions (VT, UVA, VCU) combined are about 1.5 percent (about $580 million)
- NC Research Triangle
  - UNC, NC State & Duke have each been in the top 40 since 1989
  - Combined they total about $1.2 billion

Institutional Variety – Strength and Weakness

- Only Michigan has a higher percentage of institutions classified as doctoral / research than Virginia
- Washington
  - Similar state to Virginia (size, GSP, higher ed structure)
  - Univ. of Washington has been in the top 10 since 1989 (top 5 since mid-90s) and drives their statewide success
  - Home to Microsoft
- Georgia
  - Governing Board state
  - Established the Georgia Research Alliance in 1990
    - $400 million invested since 1990 (about $26 million annually)
  - Partnership among six research institutions (public and private)
    - Emory U (private) made significant research gains moving from 76th to 34th

Recent Actions to Promote Research

- Generally focused in higher education
  - $250 million of the 2002 capital program was provided to increase research space
  - $8.3 million of seed funding for research at selected institutions
  - Eliminated the requirement for indirect cost recoveries into E & G
  - $1.5 million for modeling and simulation
  - $6.1 million over the 04-06 biennium to fund the Institute for Advanced Learning and Research
  - $0.4 million for Jefferson Labs
  - $1.2 million for graduate financial aid
- Not all the efforts were higher education related
  - $3.2 million for land purchase at the biotech park for Philip Morris research facility

Philip Morris Research Facility

- A number of factors were in place that influenced the location of the new research facility
  - Relocation of Philip Morris headquarters to Richmond
  - Proximity to VCU
  - Co-location of a biotechnology park
  - Funds provided for land acquisition
  - Favorable cost-of-living and quality of life in Virginia compared to the Northeast
- This project will have a significant economic impact on the Richmond area
  - No one factor but the synergy of all the factors is key

Potential Strategies to Increase R & D in Virginia

- Target investments that support national research focus such as health, counter-terrorism, defense
  - Other states have been successful using this approach
    - Michigan life science corridor
  - Three possible areas: Modeling & Simulation, Nanotechnology, Biotechnology
    - Competitive areas
    - Requires sustained investment with accountability and assessment
- Focus efforts at certain disciplines and institutions
- Expand the research capacity of our institutions
  - Add new and renovate existing space
  - Update equipment
  - Faculty recruitment
- Public-Private Partnerships
  - Look for more collaborative opportunities with industry and other institutions
- Shift focus of higher education toward graduate programs
  - Johns Hopkins is 58 percent graduate students compared to UVA at 32 percent
- Intellectual Property Issues