Innovation in the U.S. Federal Government

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Short Outline

- Summary
- The Federal Government
- Classification of Innovation in the Federal Government
- Technological Innovation Inputs
- Technological Innovation Outputs
- Diffusion of Innovation

Government Innovation: Summary

- Innovation in the Government is split into two parts
  - Hard science/engineering type of innovations (technological)
    - These outputs are easier to measure
  - Social science type of innovations (organizational, regulatory, policy)
    - These outputs are harder to measure
- Scientists
  - Hard scientists/engineers dominate the Department of Defense (DOD)
  - Social and other scientists are more equally represented in non-DOD agencies
- Budgets (Mainly Hard Science)
  - ~50% of Federal R&D budget goes to DOD; Non-DOD R&D budget goes mostly to Health and Space research
  - ~75% of Federal R&D budget directed externally to Higher Ed, FFRDCs, & Business
    - ~25% of Federal R&D budget directed internally (intramural)

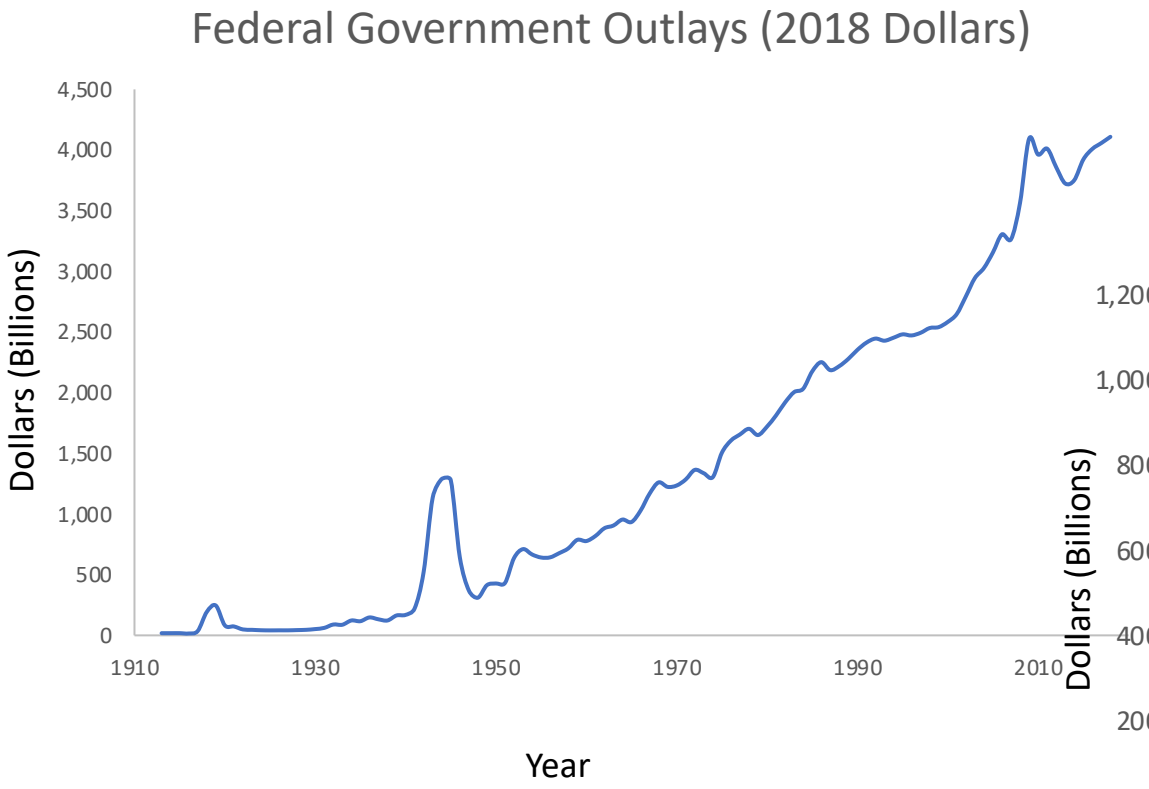
Government Innovation: Summary

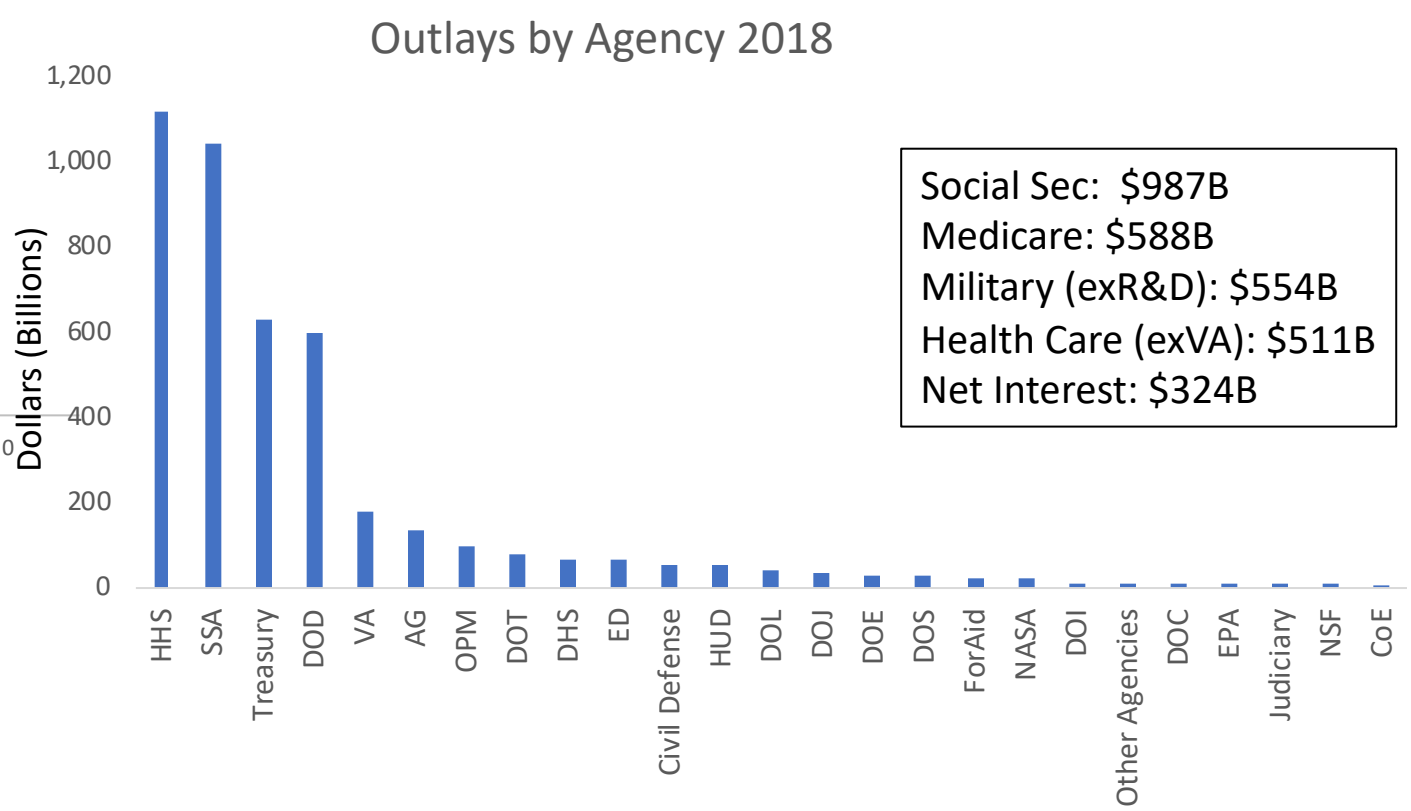
- Government-Assigned Patent Output (Hard Science/Engineering)
  - The quantity of government-assigned patents looks like a large firm (TI, DuPont)
  - The areas in which the government patents
    - Biggest areas: Medical Science; Biochemistry; Measuring and Testing; Calculating and Counting
    - Biggest market share of patents: Defense-Related (Manufacturing Explosives; Ammunition Fuses; Explosive Charges; Radio-Based Navigation; Materials Analysis)
  - Government-assigned patents, relative to corporate-assigned patents in a technology class, are:
    - Slightly more original (novel); Slightly more general; Less cited
- Diffusion of Innovation (very, very preliminary)
  - Technical innovations start in an agency and tend to follow one of three paths
    - Stay in the agency
    - Diffuse across technical agencies
    - Diffuse across the government
- To understand innovation in the federal government, measuring the scope and impact of non-technological innovations is important

Brief Literature Review

- Taxonomy of Government Innovation: Hartley (2005); Hartley et al (2013); Chen et al (2019); de Vries et al (2016); Bommert (2010); Edquist (2012);
- Methods for Measuring Government Innovation and Patents: Arundel et al (2019); Jaffe et al (1993); Jaffe and Trajtenberg (1996); Trajtenberg et al (1997); Valero and Van Reenen (2019)
- External Government R&D Spending Programs and Outputs: Bloom et al (2019)
- Defense/FFRDCs R&D: Trajtenberg (2006); Mowery (2012); Moretti et al (2019); Chen (2014); Bonvillian (2018); Jaffe and Lerner (1999)
- Diffusion: de Vries et al (2018); De Francesco (2012)

Federal Government Budget





Social Sec: $987B
Medicare: $588B
Military (exR&D): $554B
Health Care (exVA): $511B
Net Interest: $324B

Source: FY2020 Historical Tables, Budget of the United States, OMB; BLS CPI

Federal Government Employees

2018 FTE Employees	
Executive Branch Civilian	2,061,248
Postal Workers:	585,530
Uniformed Military	1,401,715
Judicial Branch	32,711
Legislative Branch	30,010
Total Federal Employees	4,111,307

Source: FY2020 President's Budget of the United States, OMB; OPM CPDF-EHRI

Federal Government Employees

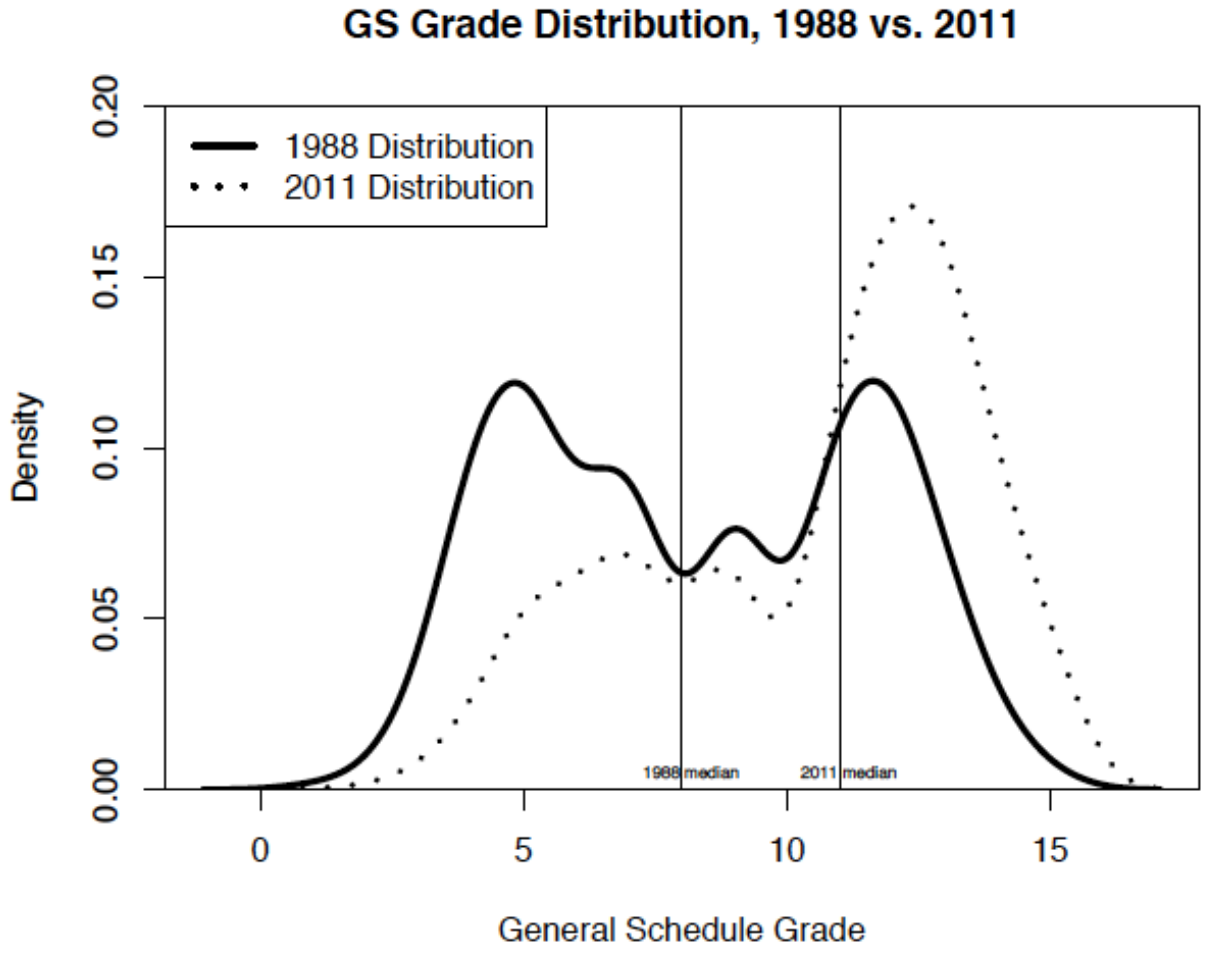


Figure 2: Distribution of GS Grades Over Time.

Source: FY2020 President's Budget of the United States, OMB; OPM CPDF-EHRI

Federal Government Employees

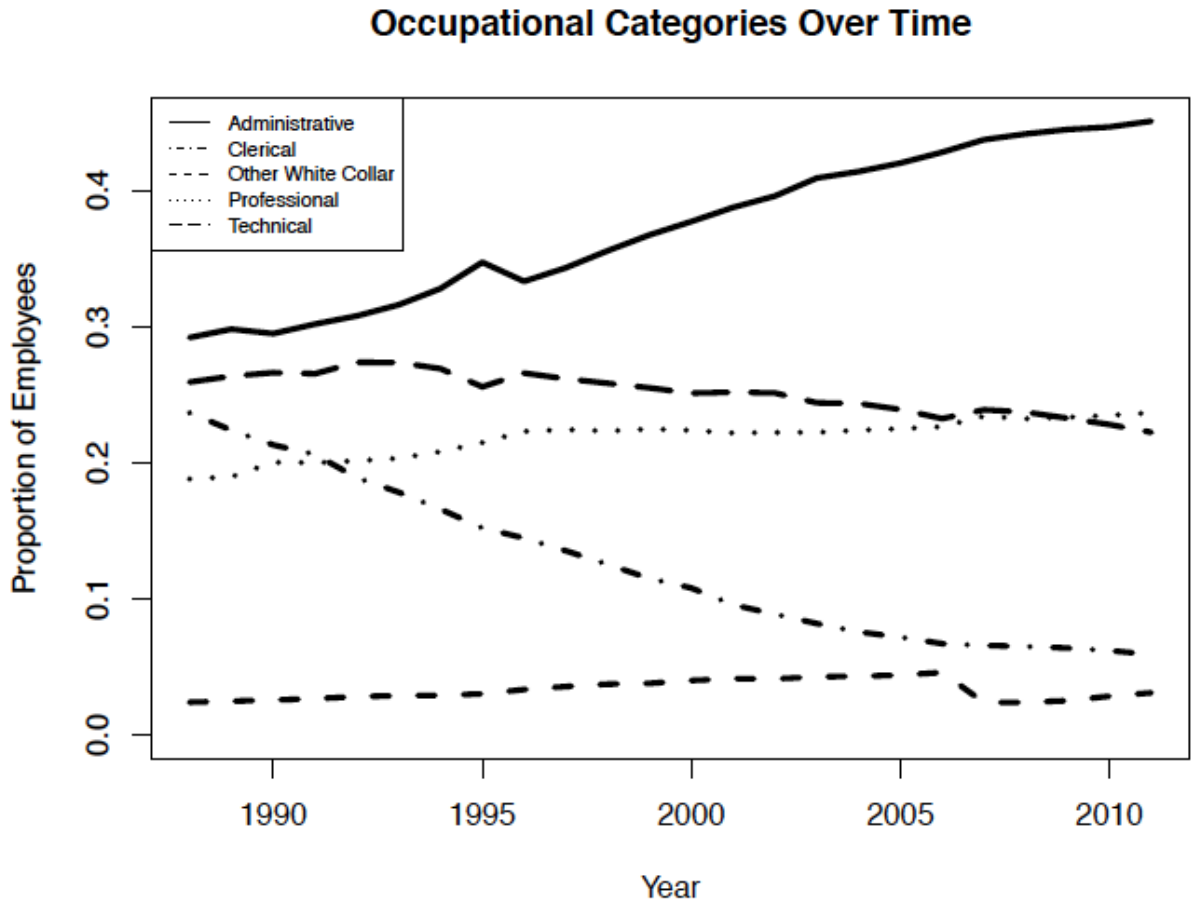


Figure 7: Changing Nature of Federal Work.

Source: FY2020 President's Budget of the United States, OMB; OPM CPDF-EHRI

Classification of Innovation in the Federal Government

Innovation	Concept	Example
Technological	Technically or technologically new or novel inventions	Snake repellant identification Inhibitors of integrase in HIV Hybrid vehicle control methods
Organizational	Advances in the way government is organized	SSA and DHS Outsourcing Crowdsourcing citizen science
Regulatory	Changes in the process of making regulations, enforcement, and adjudication	Negotiated rulemaking E-rulemaking
Policy	New types of regulatory policies to achieve social welfare or desired policy objectives	Cap and Trade Spectrum Auctions

Organizational, Regulatory and Policy Types of Innovations

Medicaid Prescription Drug Dispute Resolution	Health Care Finance Administration
Internet Rulemaking for Organic Food Standards	Department of Agriculture
PulseNet	Centers for Disease Control
Continuum of Care	Housing and Urban Development
Best Manufacturing Practices Program	Department of Defense
Fast-Track Product Recall Program	Consumer Product Safety Commission
Northern New Mexico Collaborative Stewardship	U.S. Forest Service
Secure Electronic Network for Travelers Rapid Inspection	Inter-Agency Task Force
Control of Asphalt Fume during Paving	Department of Transportation
National New Hire Reporting	Department of Health and Human Services
Reform of the U.S. Drug Approval Process	Food and Drug Administration
Disarming the Criminal	Bureau of Alcohol, Tobacco, and Firearms
33/50 Program	Environmental Protection Agency
TeleFile	Internal Revenue Service
Consequence Assessment Tool Set and Operations Concept	Federal Emergency Management Agency
No Sweat: Eradicating Sweatshops	Department of Labor
U.S. Export Assistance Centers	Department of Commerce
Evaluating Oral Proposals in Major Government Procurements	Federal Aviation Administration
Ozone Depleting Chemical Elimination	U.S. Air Force
Early Warning Program	Pension Benefit Guaranty Corporation
Multimedia Medical Language Translator	U.S. Navy

Source: Innovation in Government Awards; Ash Center at the Kennedy School, Harvard

Innovation in the Federal Government

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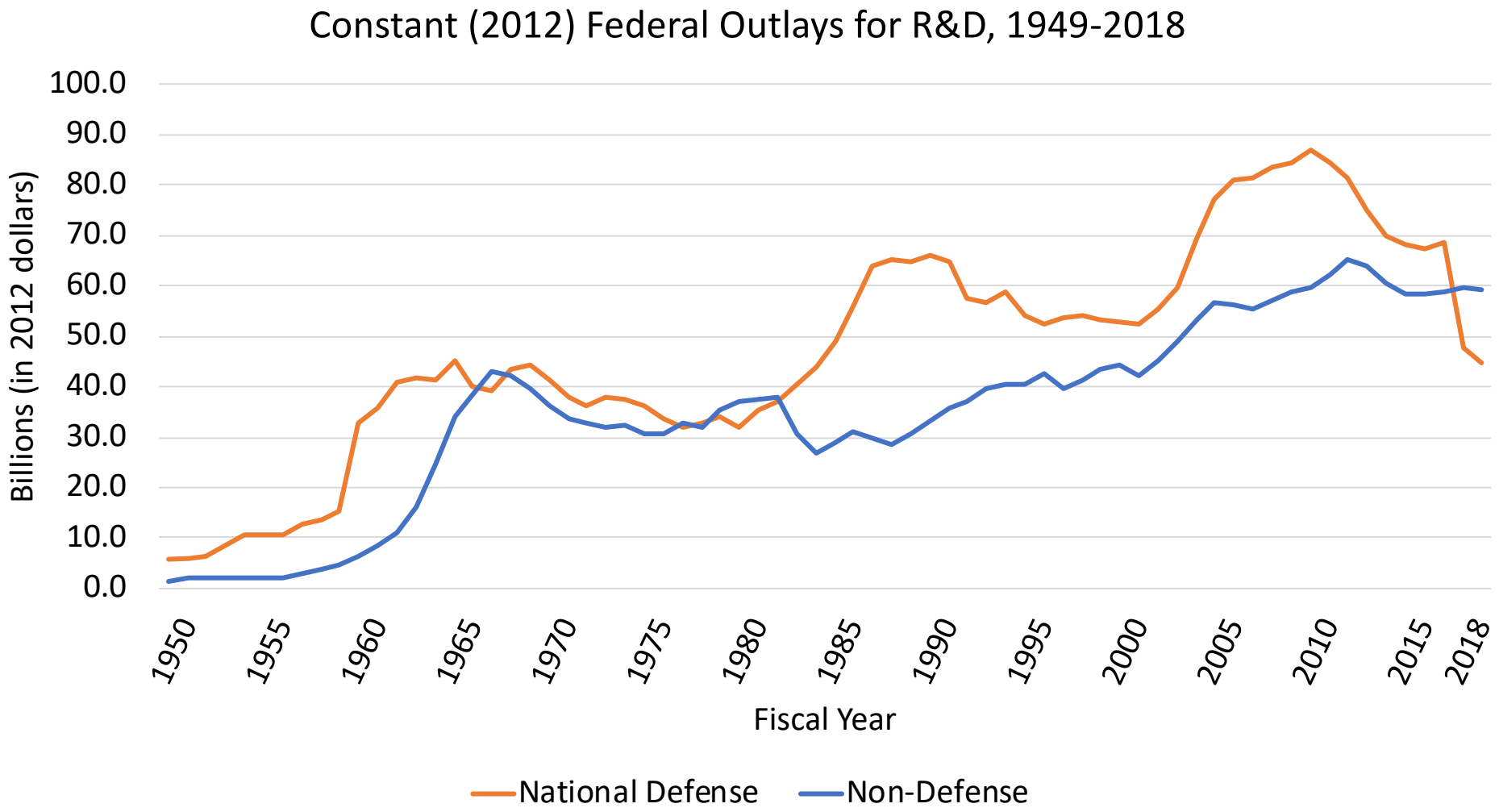
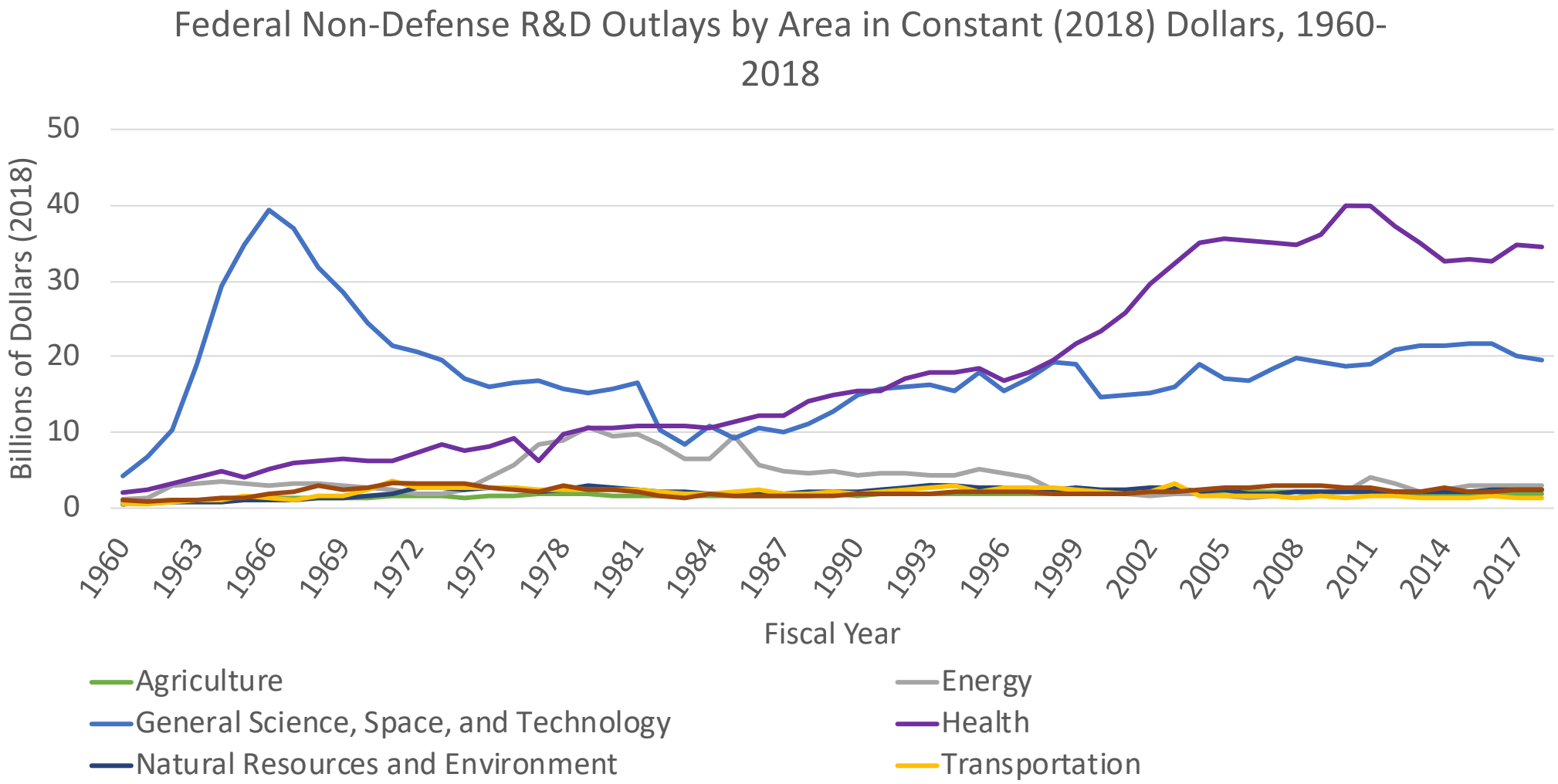
Federal Spending on R&D



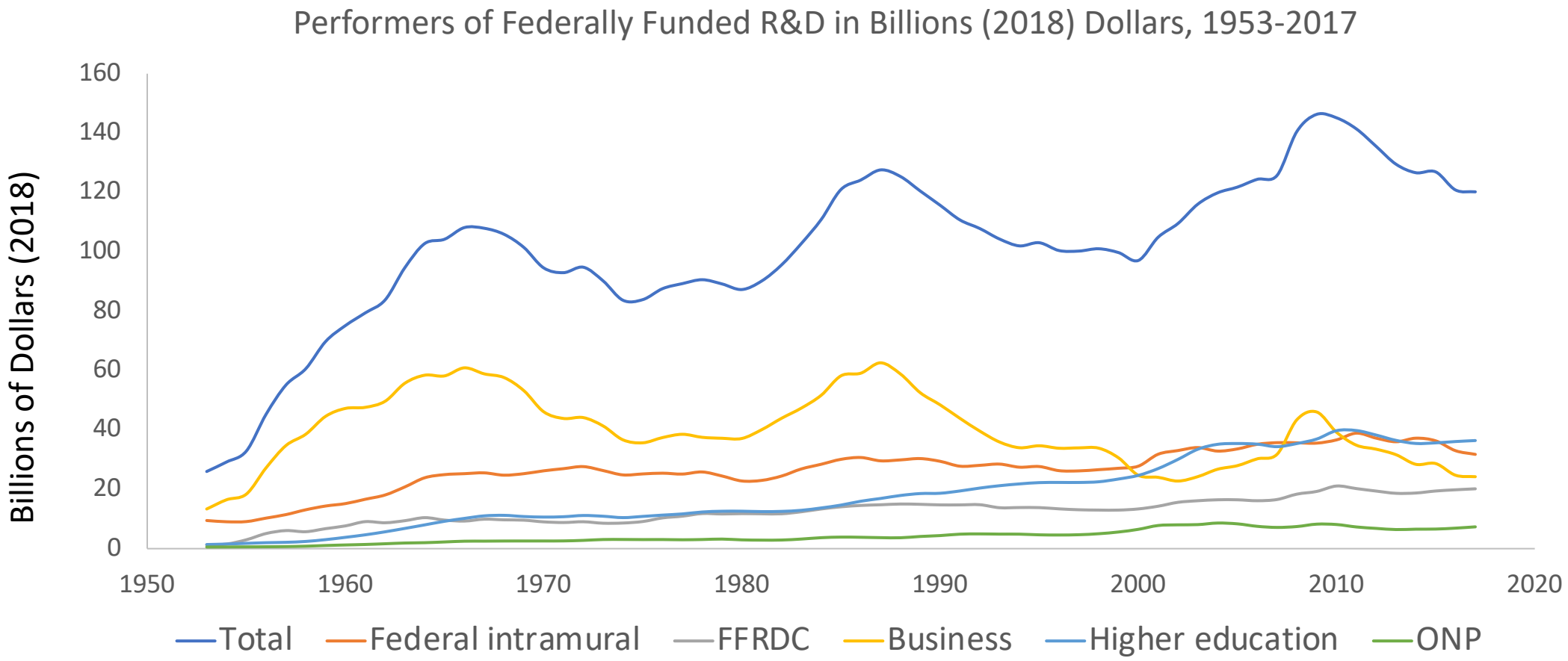
Source: Office of Management and Budget, Historical Table 9.7

Federal Spending on R&D



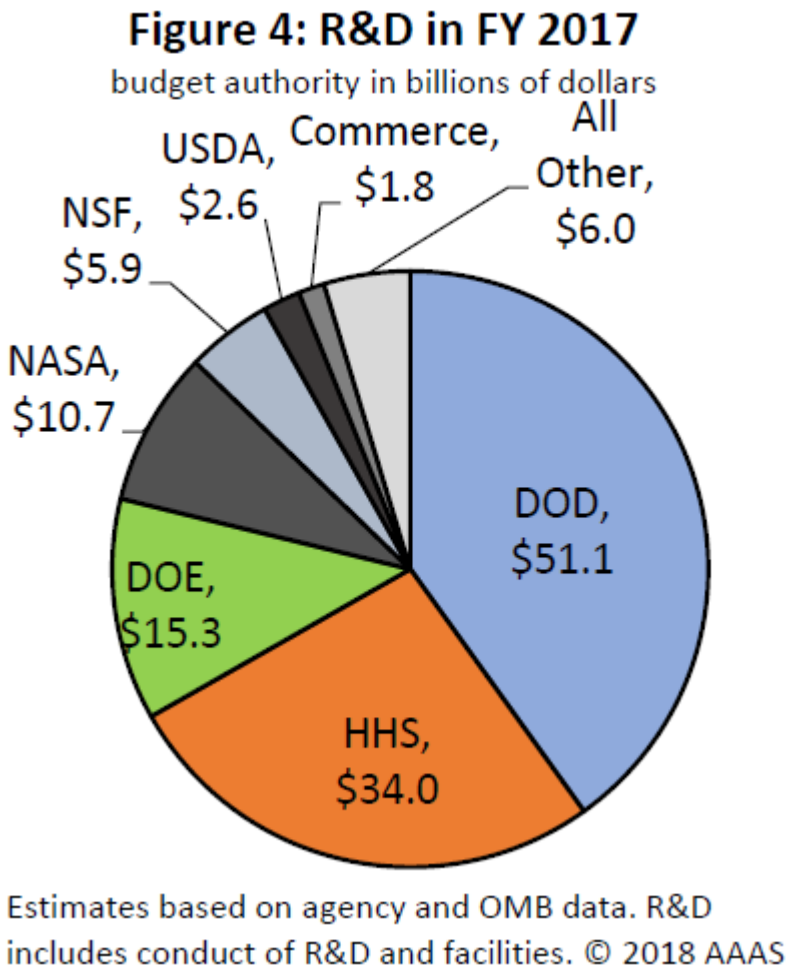
Source: Office of Management and Budget, Historical Table 9.8

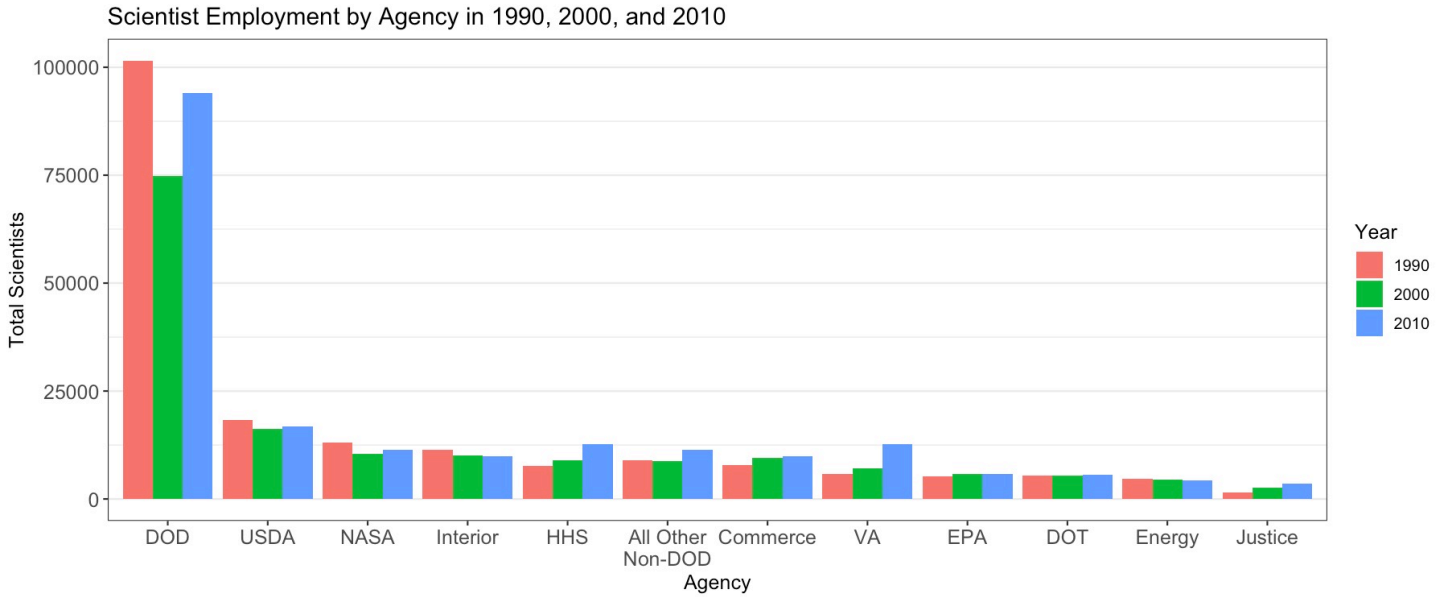
Federal Spending on R&D

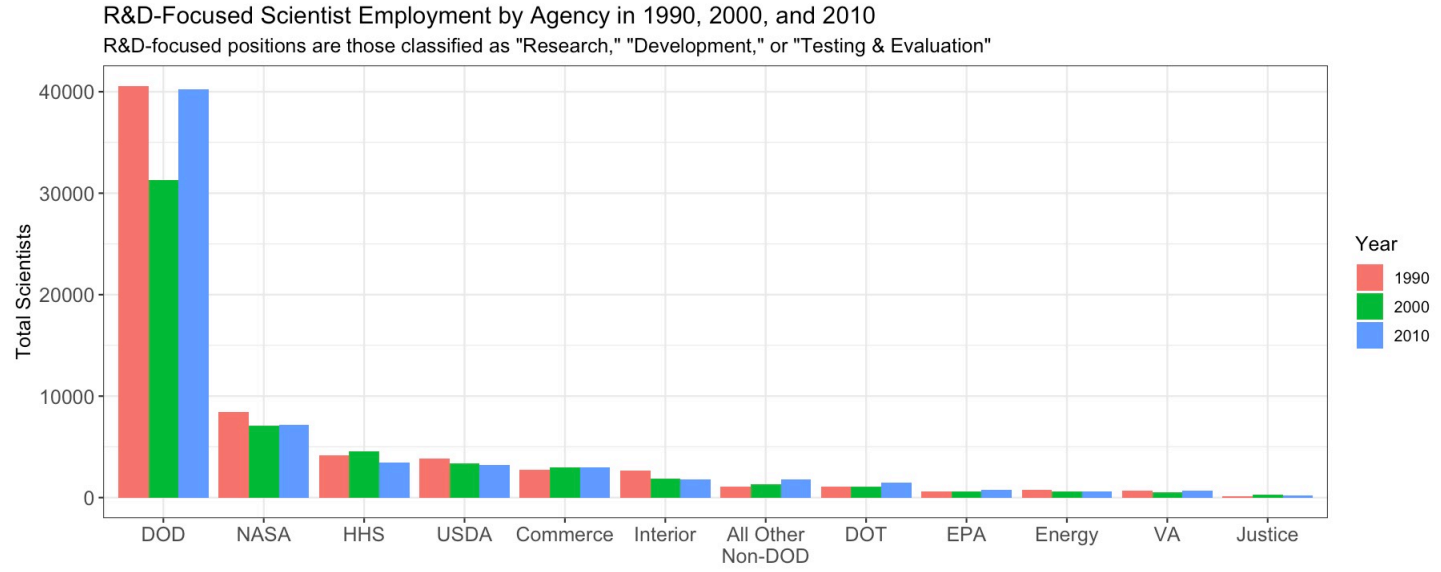


Source: NSF National Patterns of R&D Data, 2016-2017.

R&D Inputs by Agency

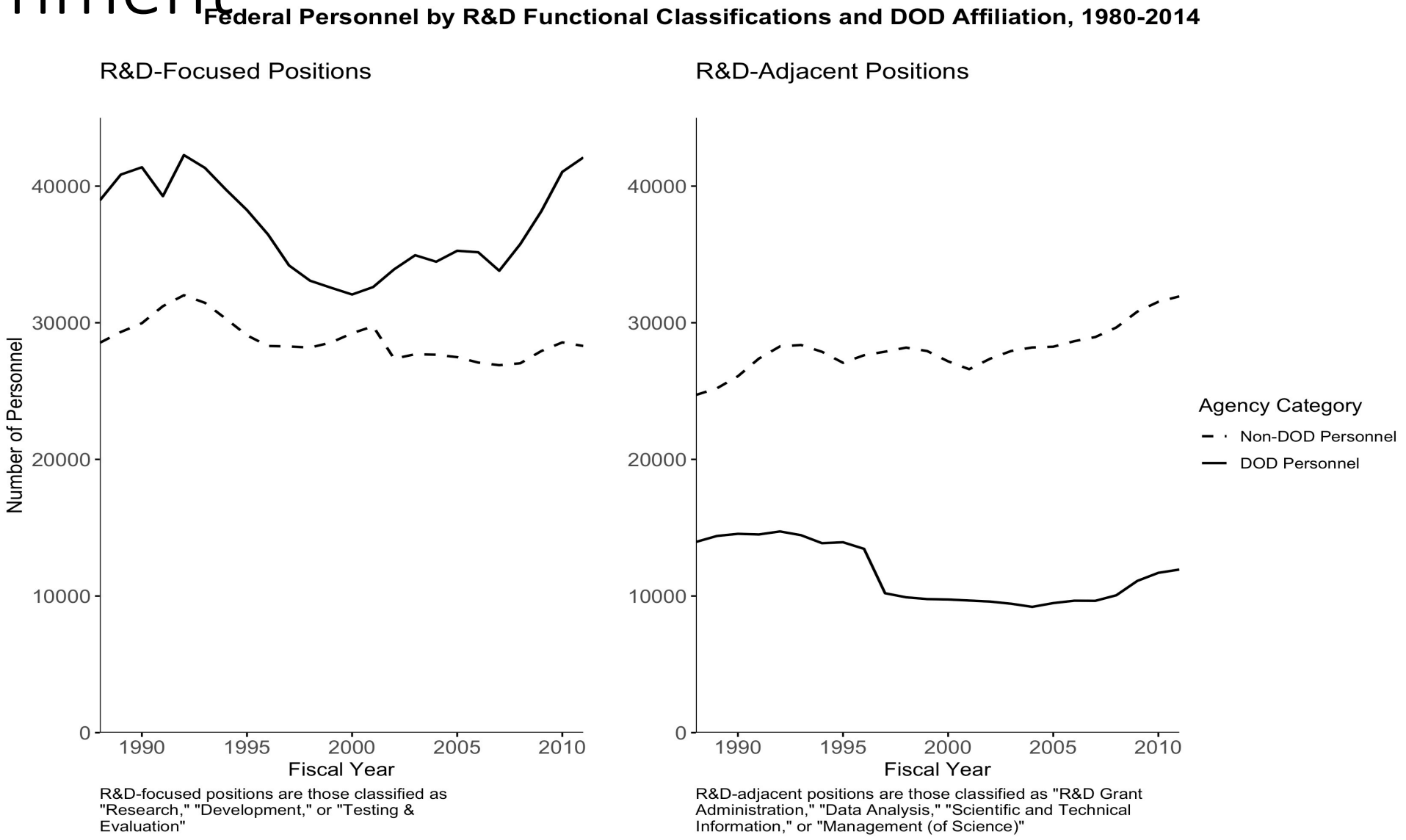




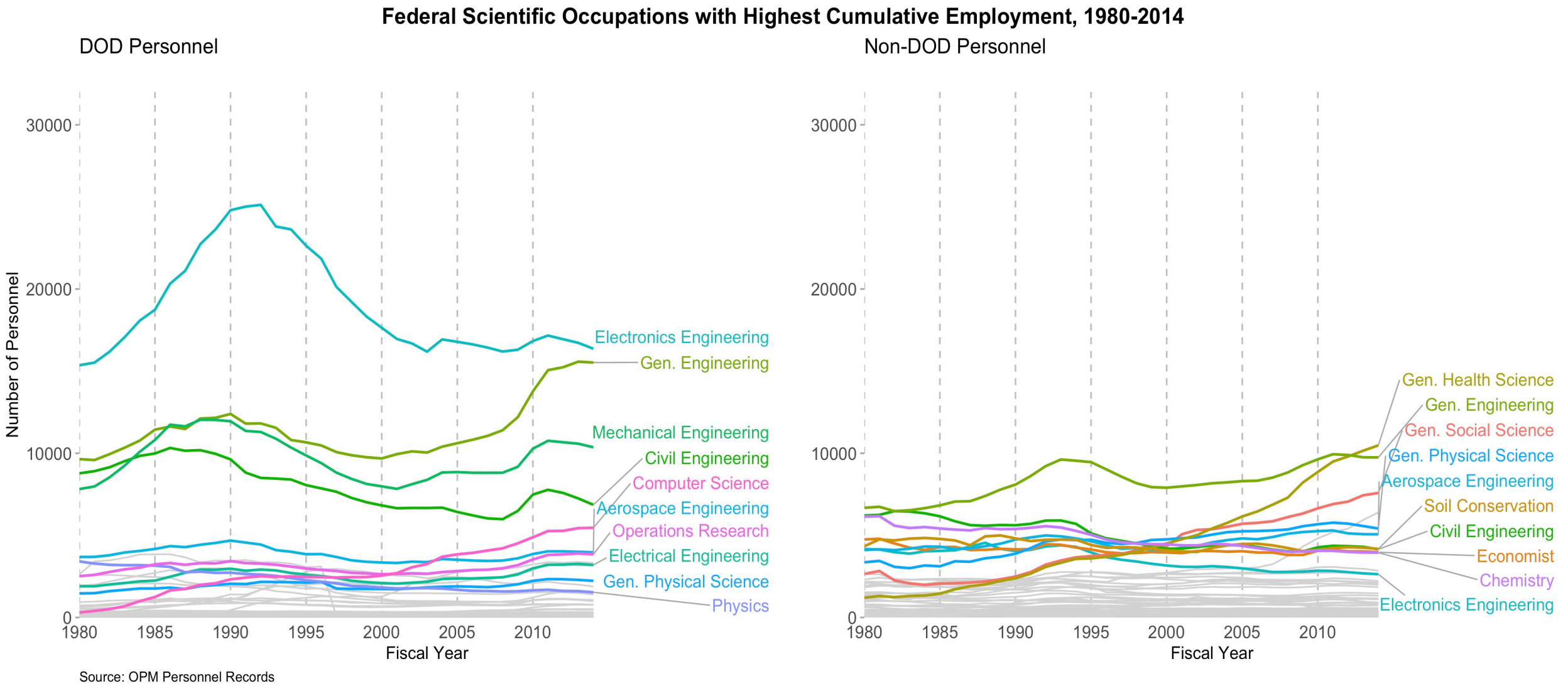


Source: AAAS 2019, Federal R&D Budget Trends: A Short Summary

Positions Engaged in R&D in the Federal Government

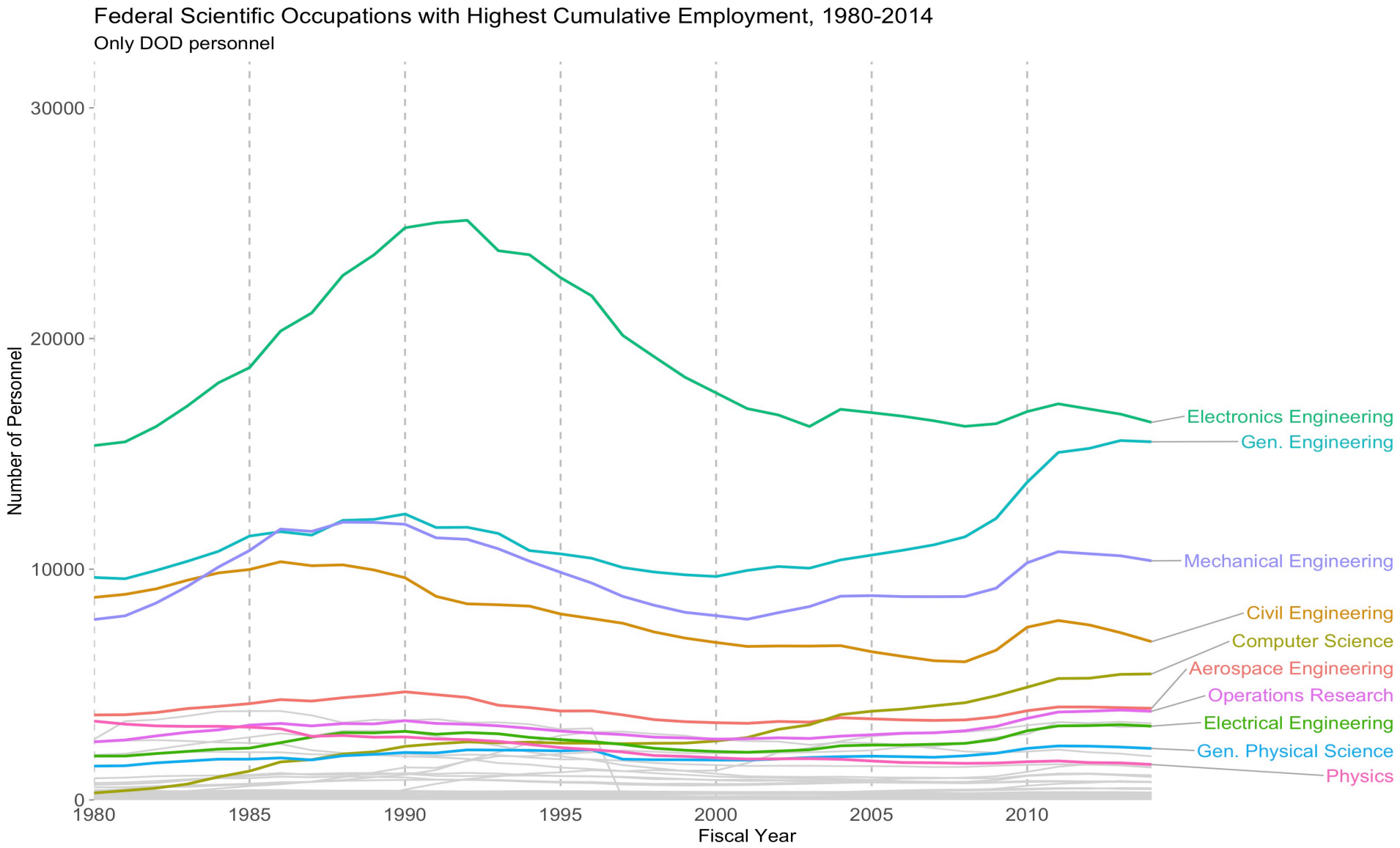


Scientists in the Federal Government

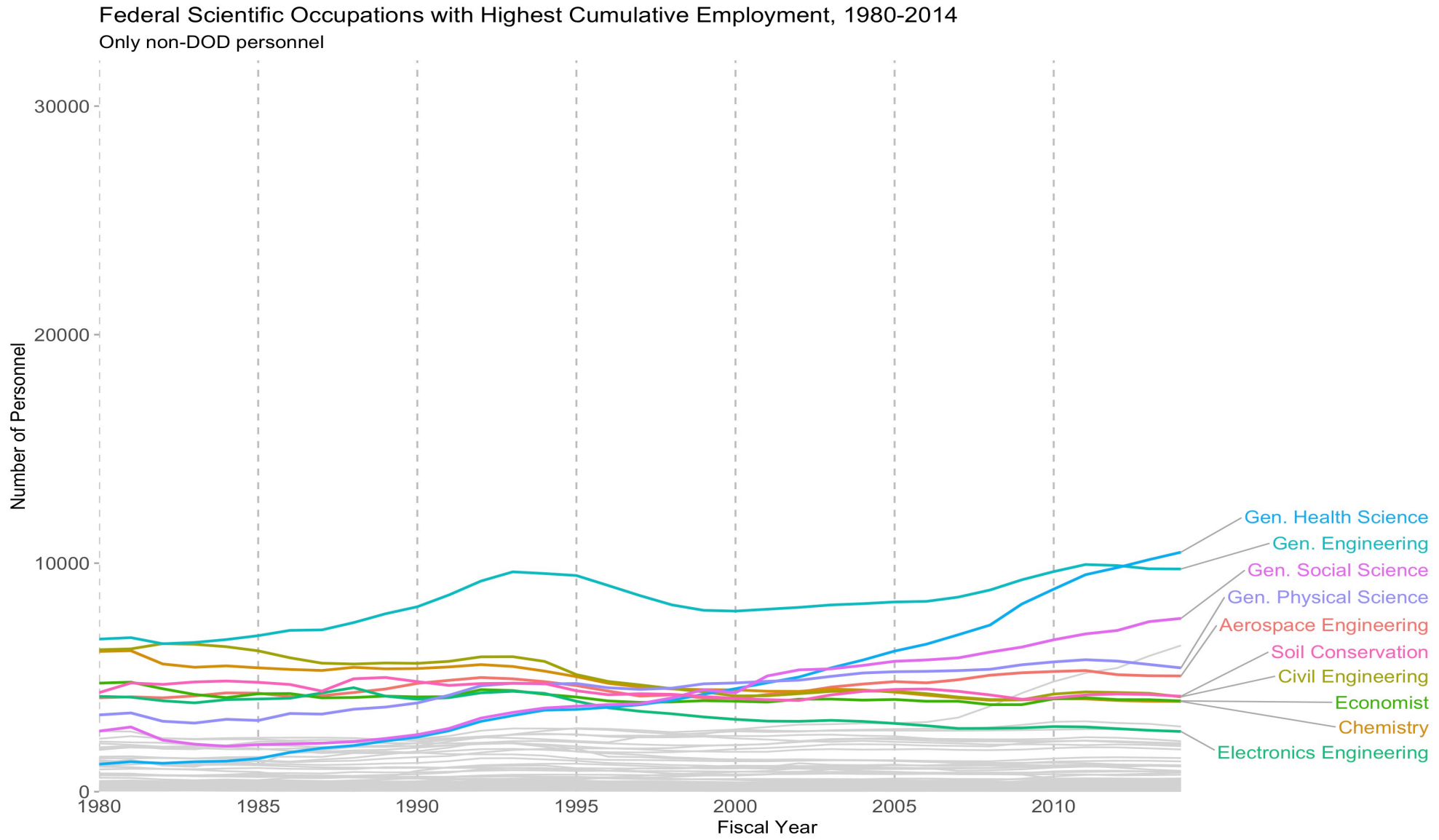


Source: OPM Personnel Records

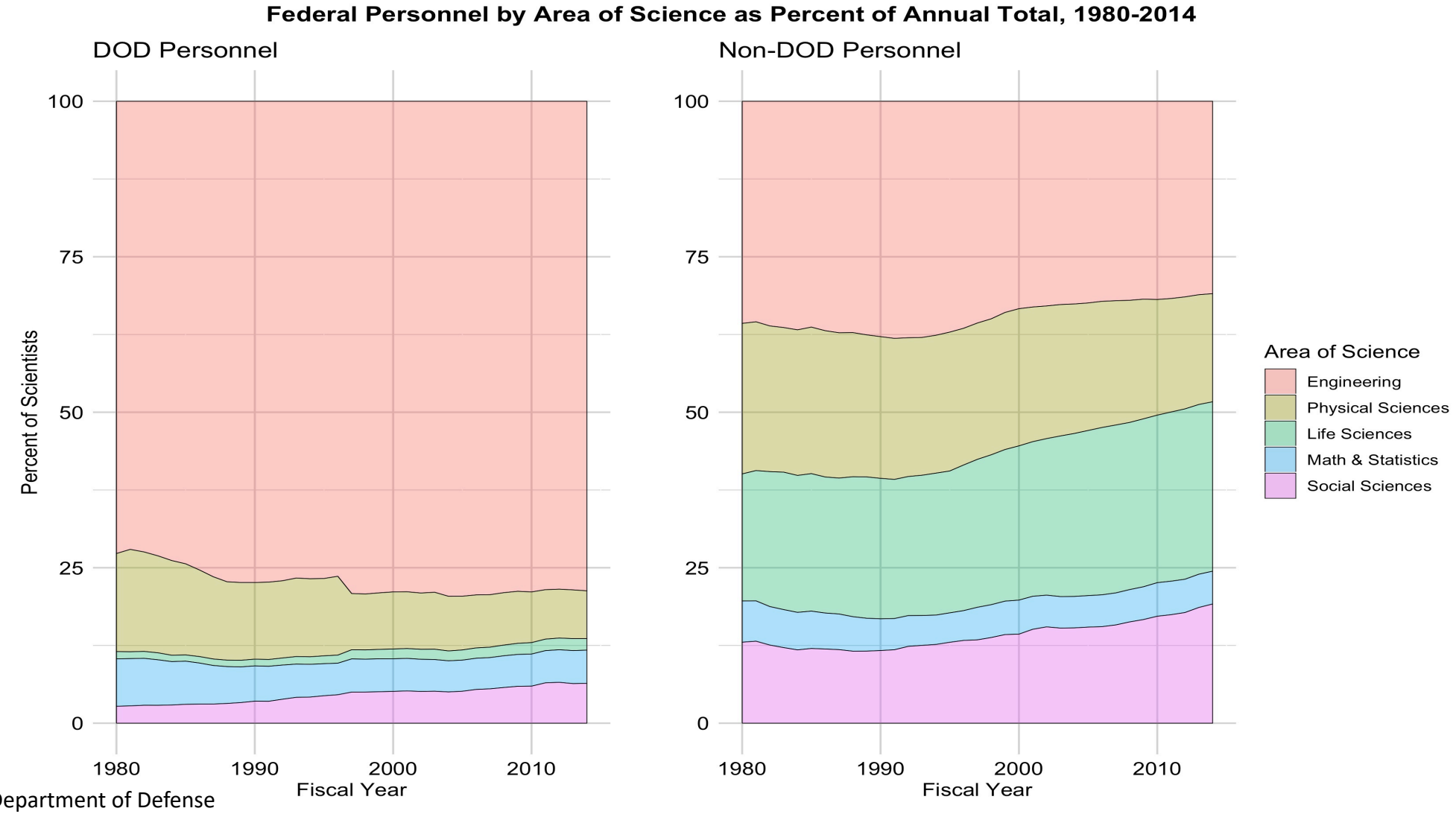
Scientists in the DOD



Scientists Outside the DOD



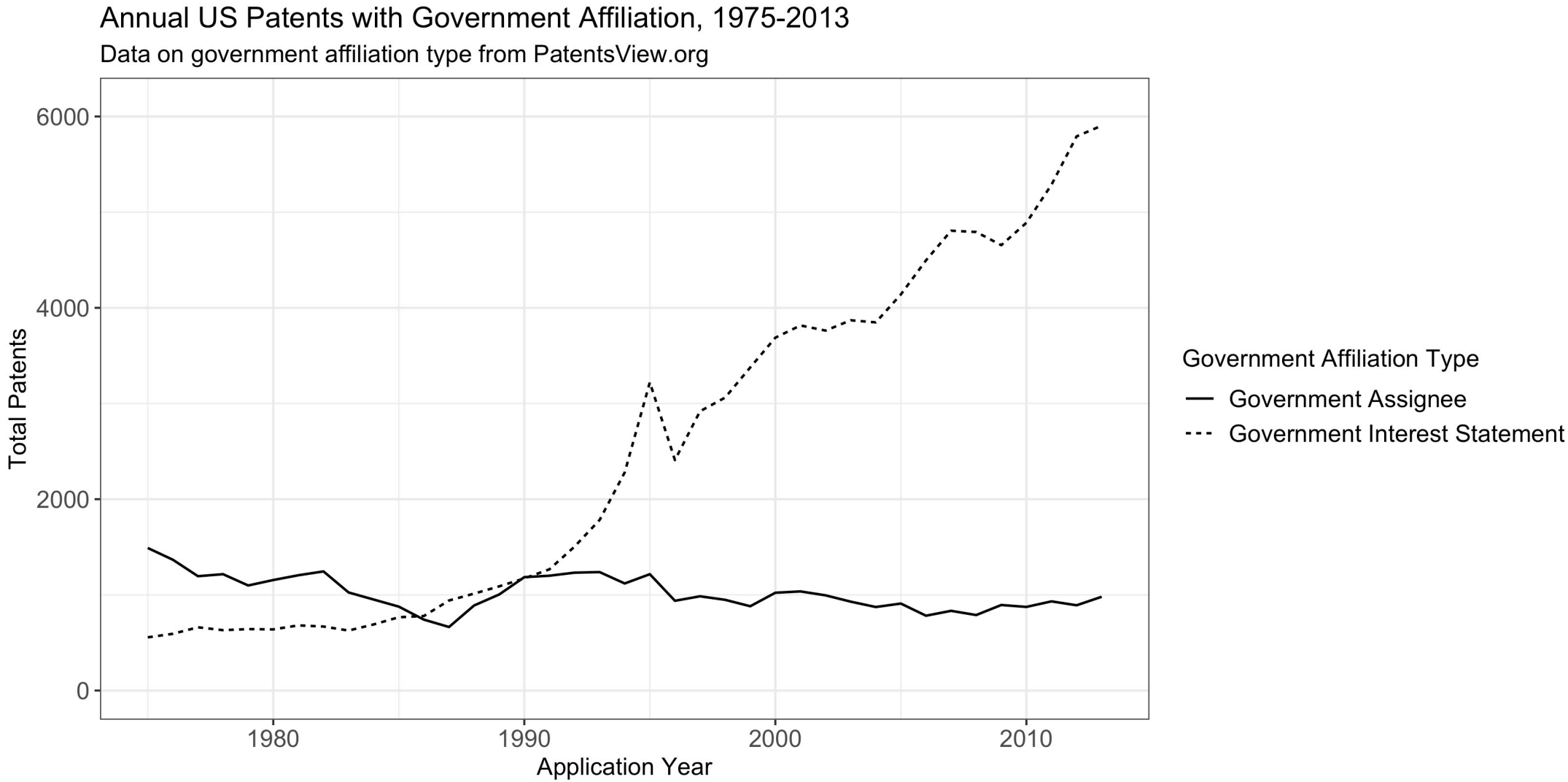
Scientists Differ Between the DOD and the Rest of Government



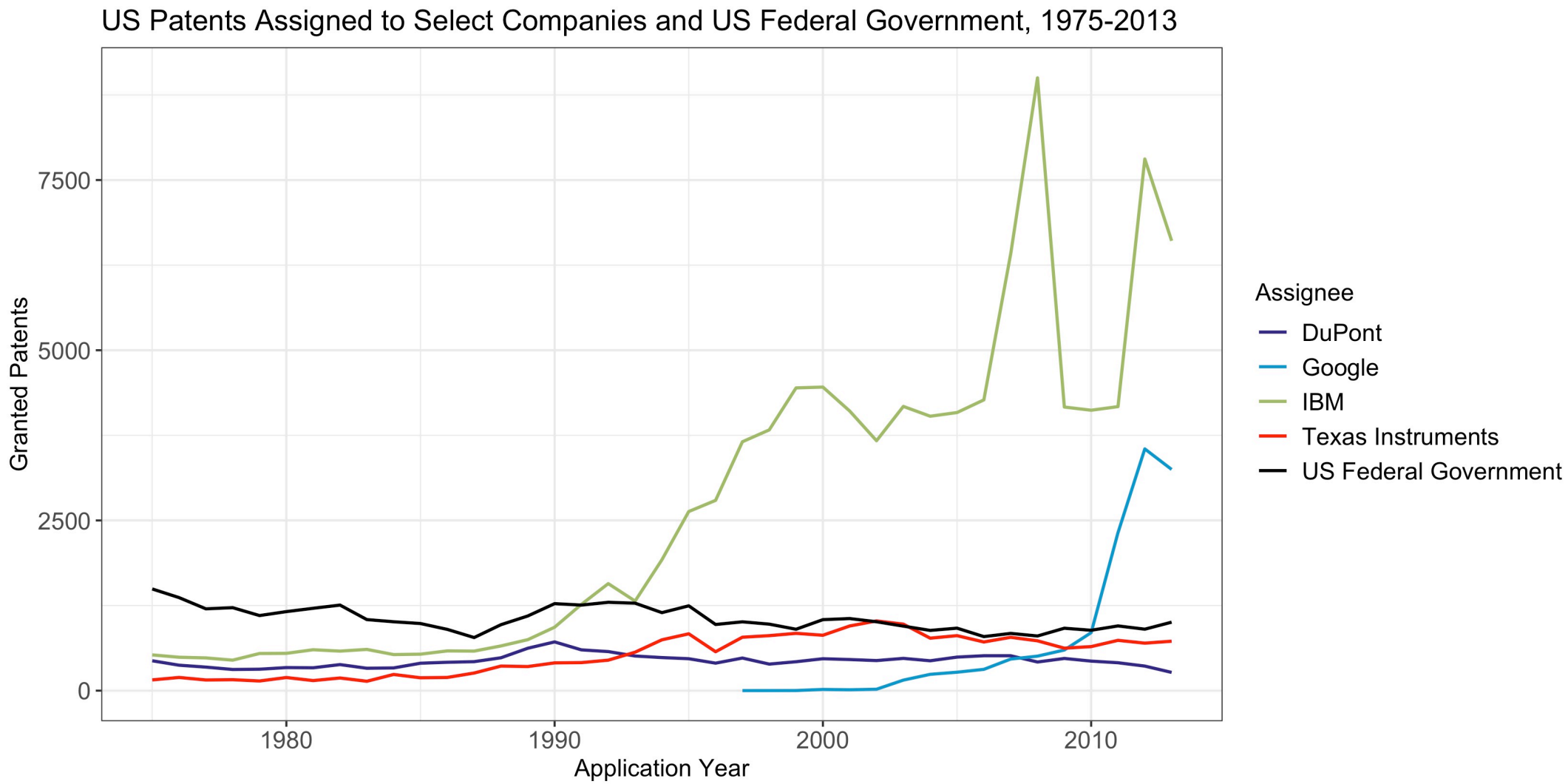
Note: DOD = Department of Defense

Source: Statistical Analysis of OPM CDPF-EHRI

Federal Government Patent Output



Federal Government Patent Output



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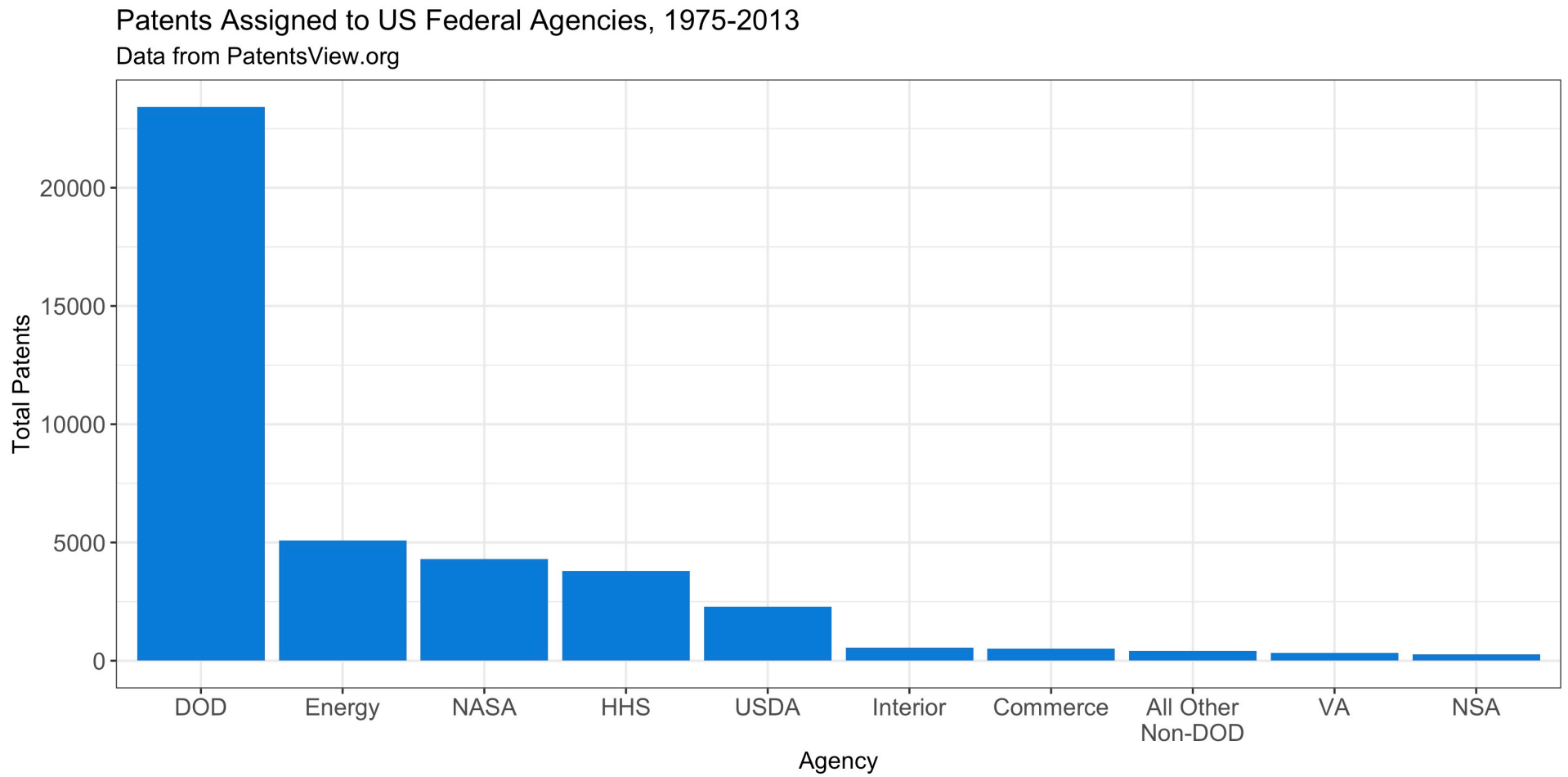

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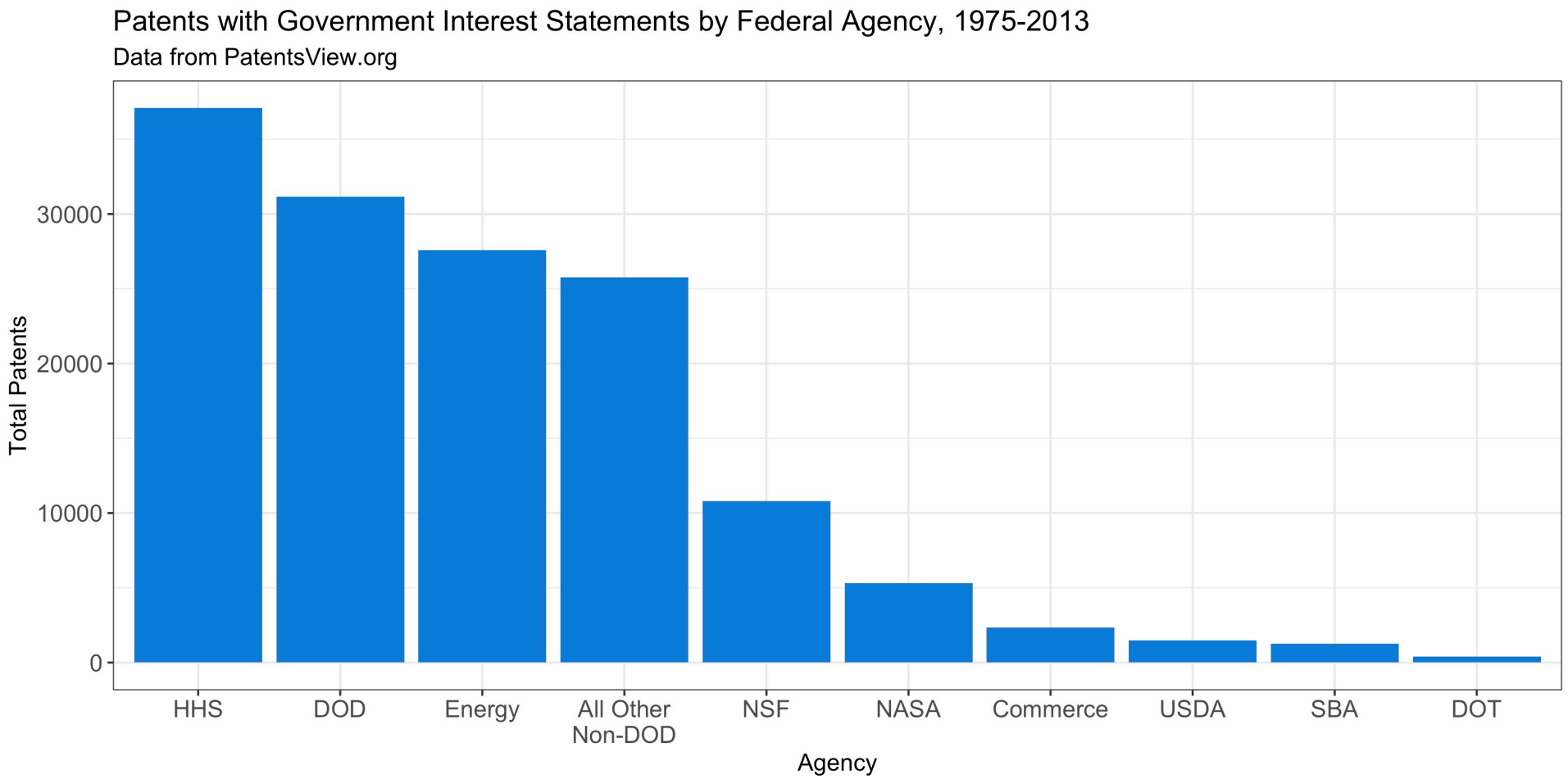
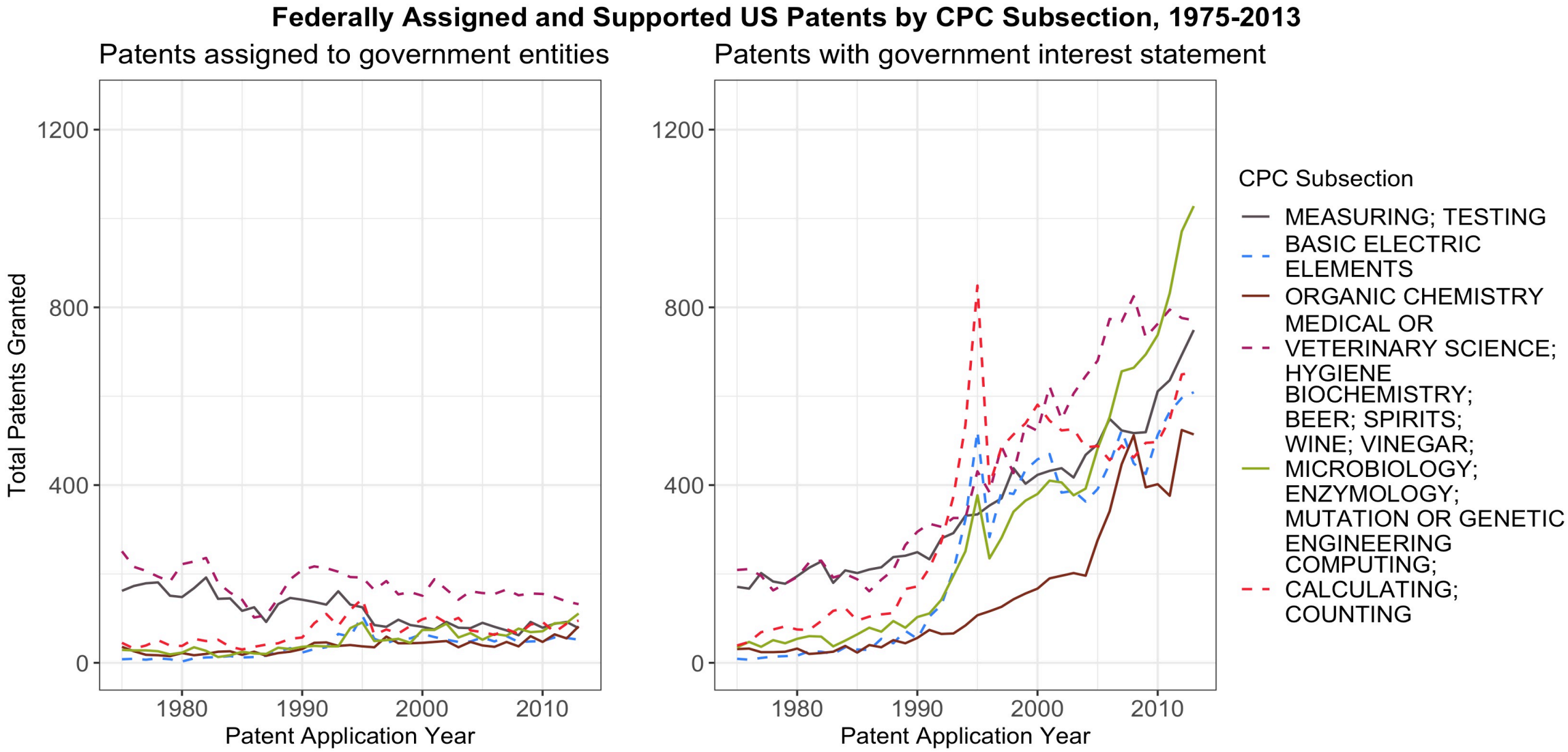
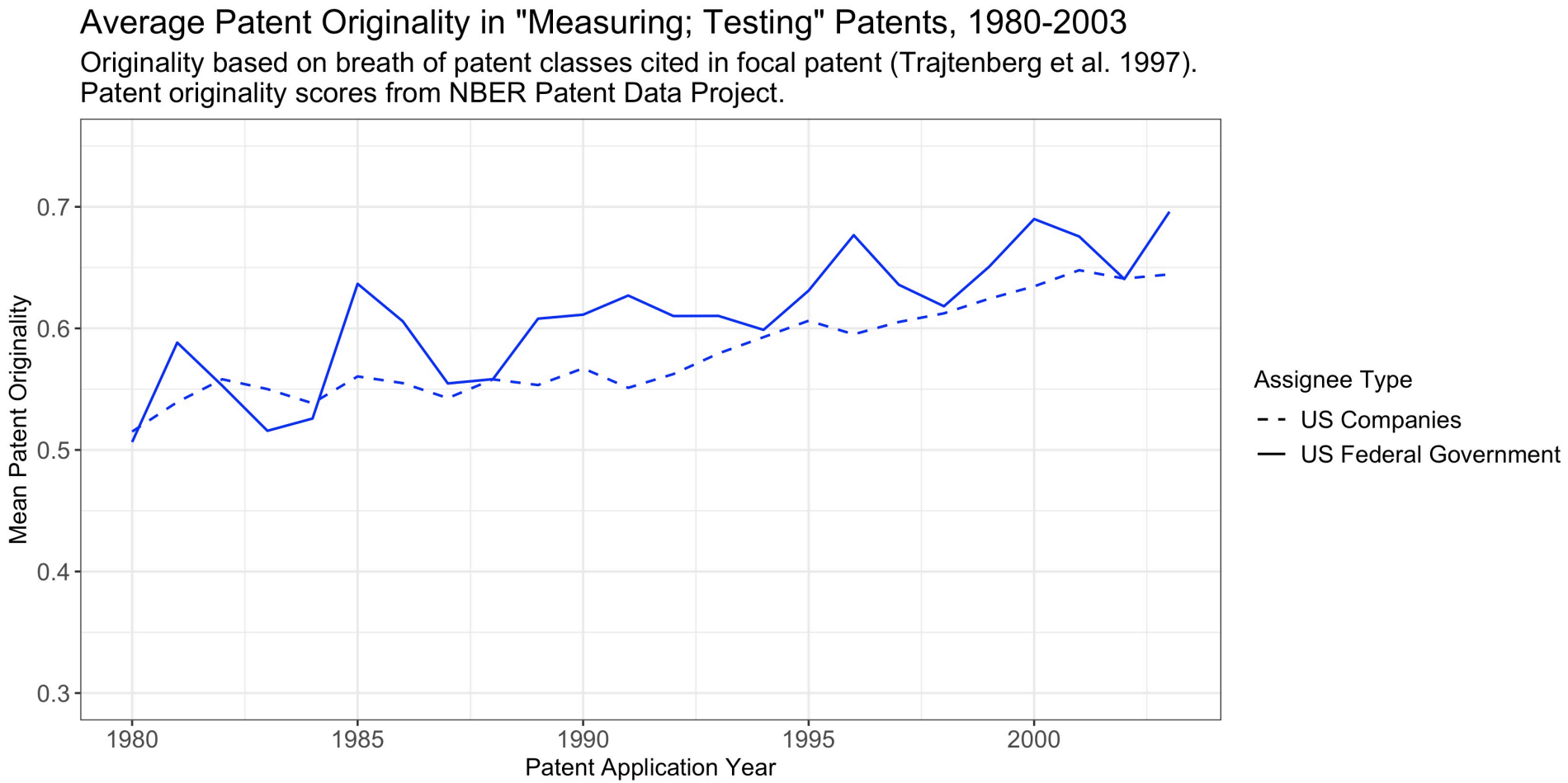


Government Patent Technologies



Government Patent Novelty



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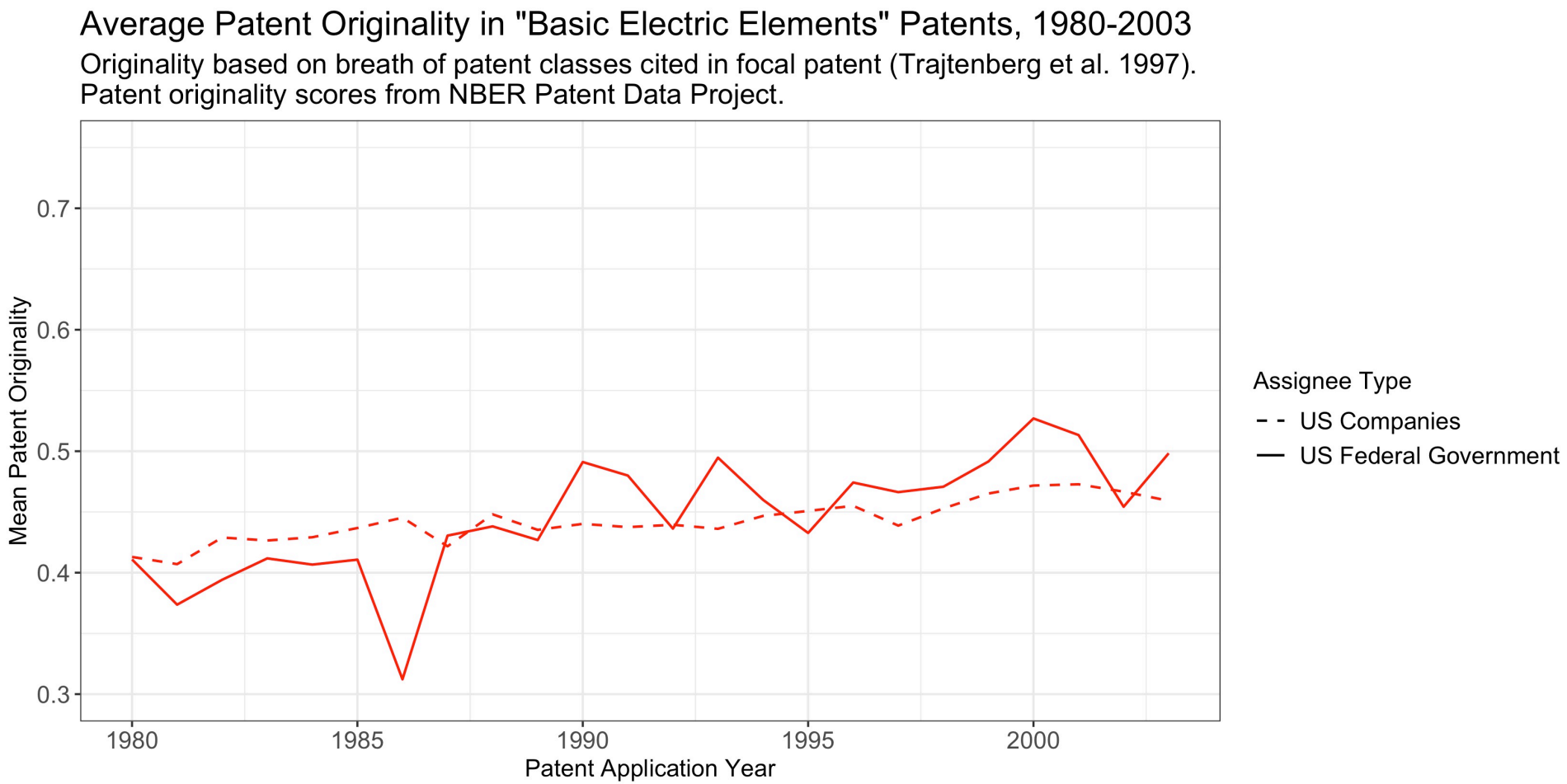

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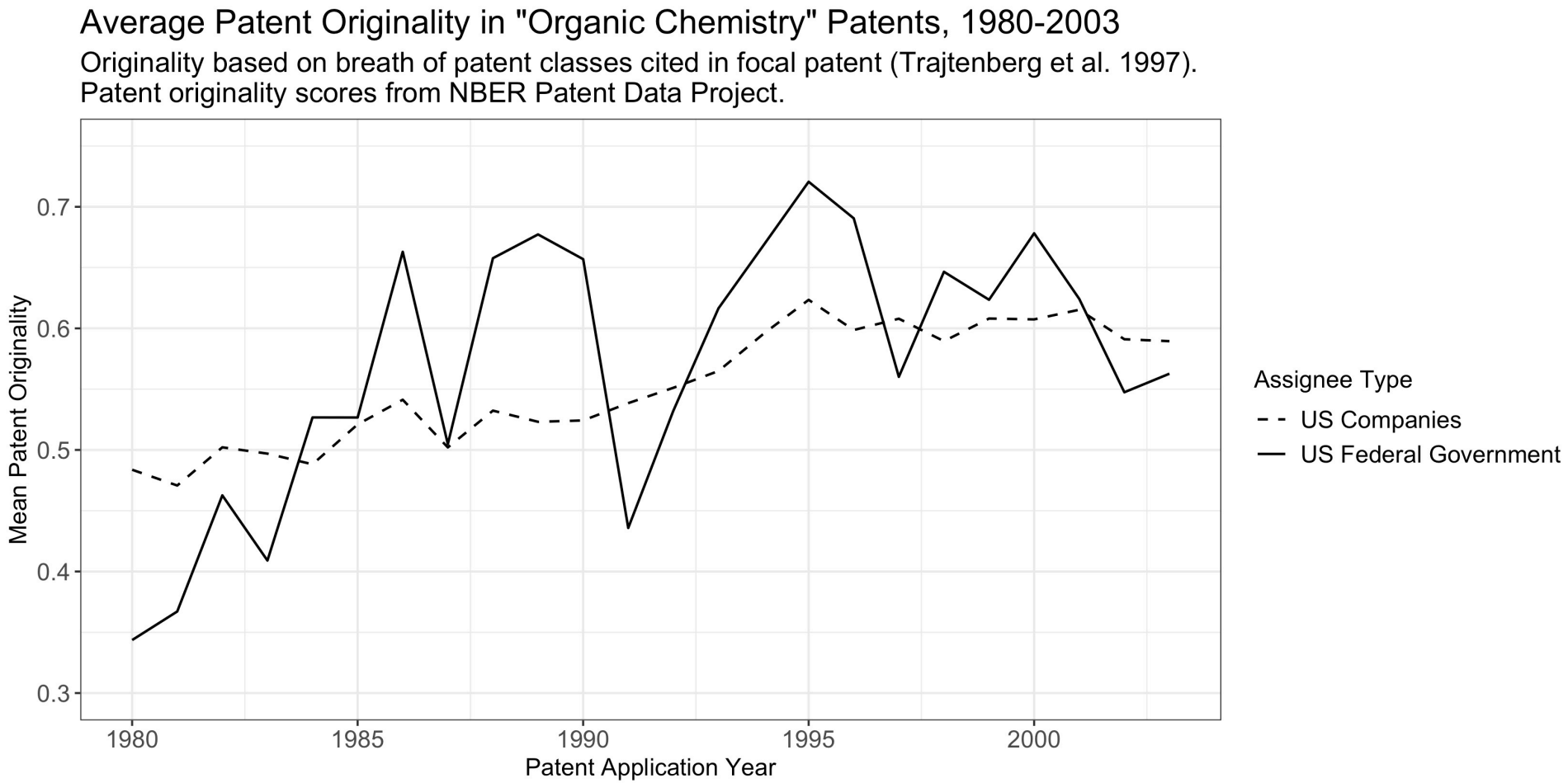
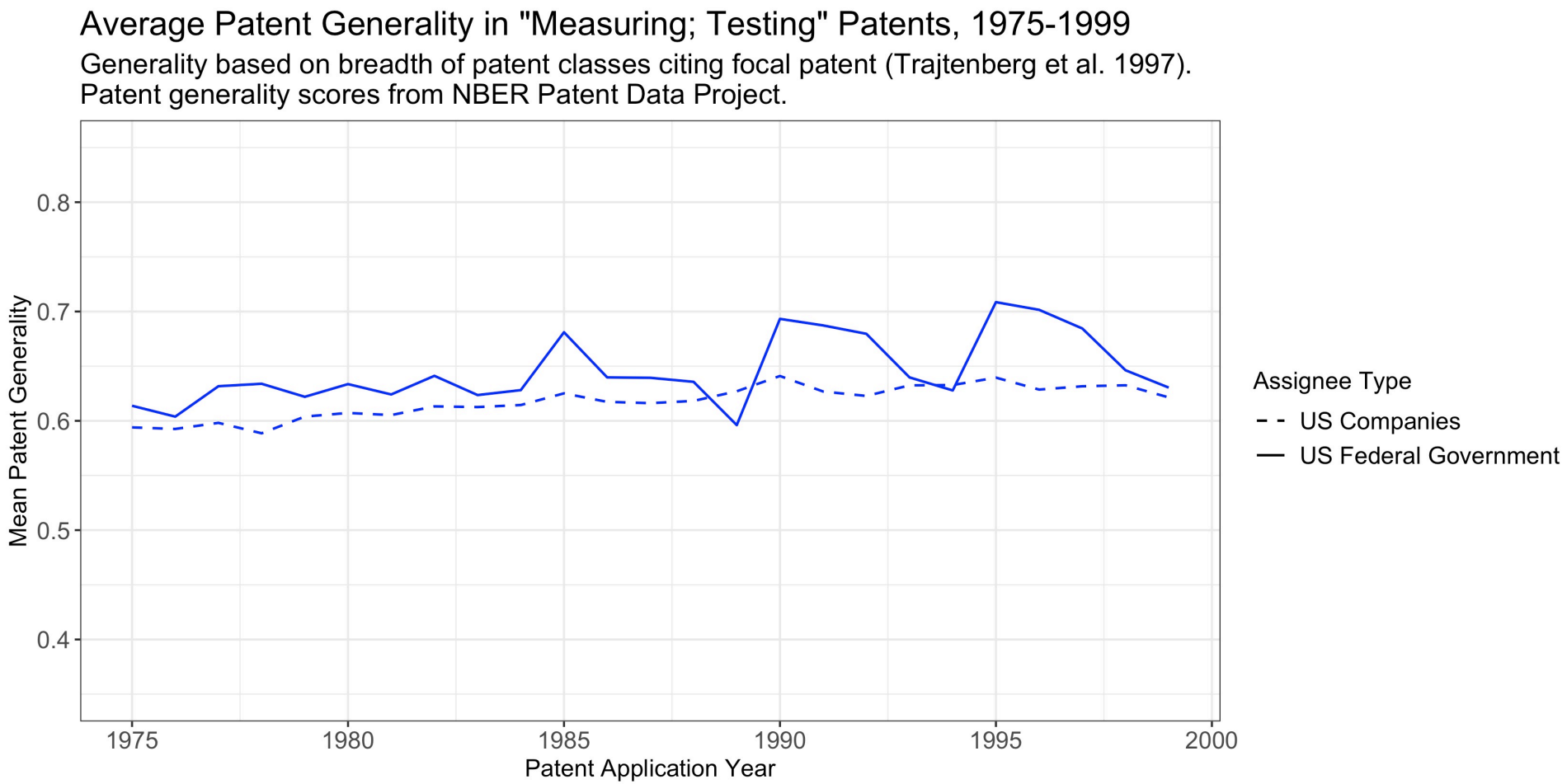


Government Patents Generality



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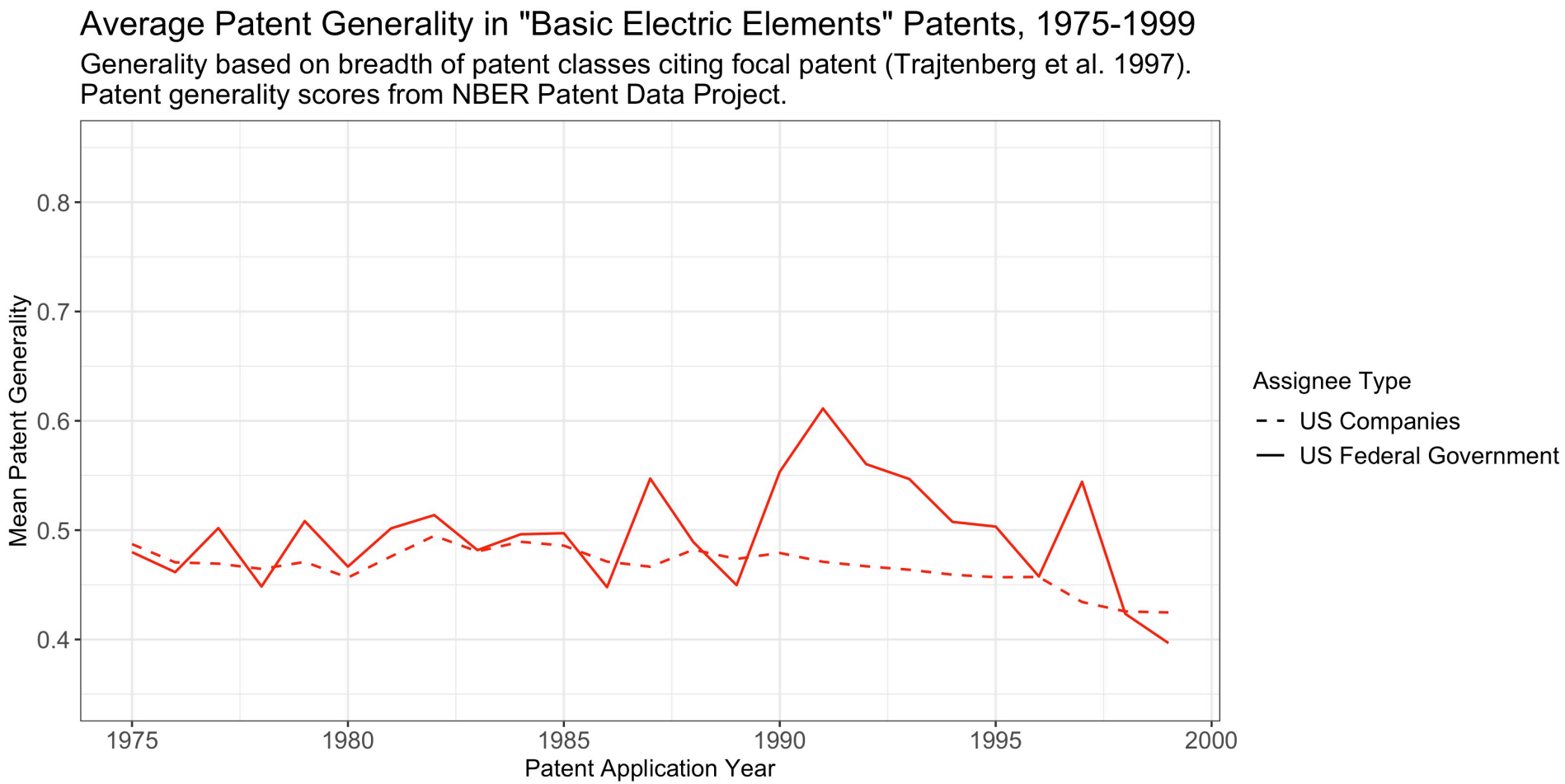

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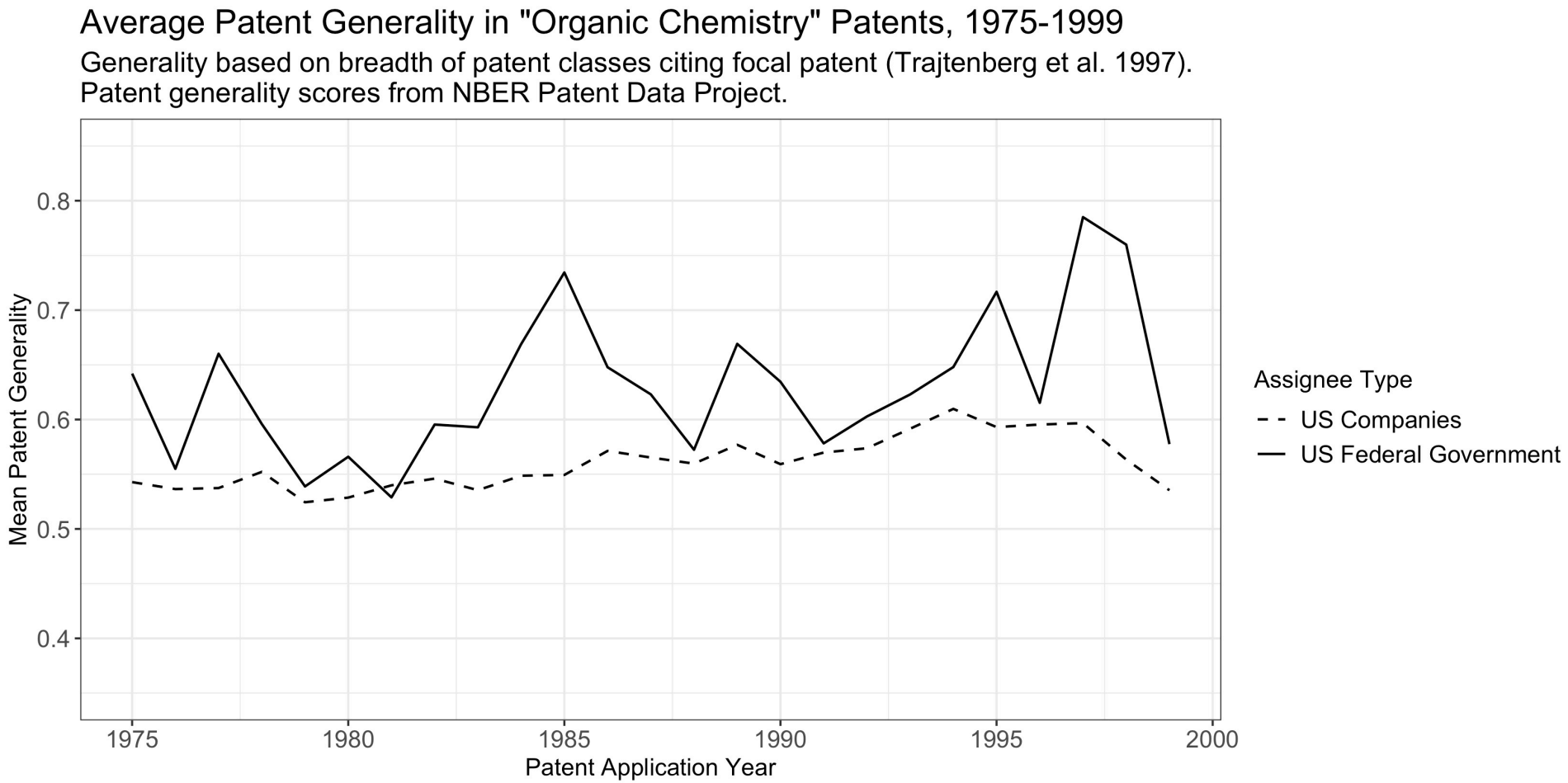
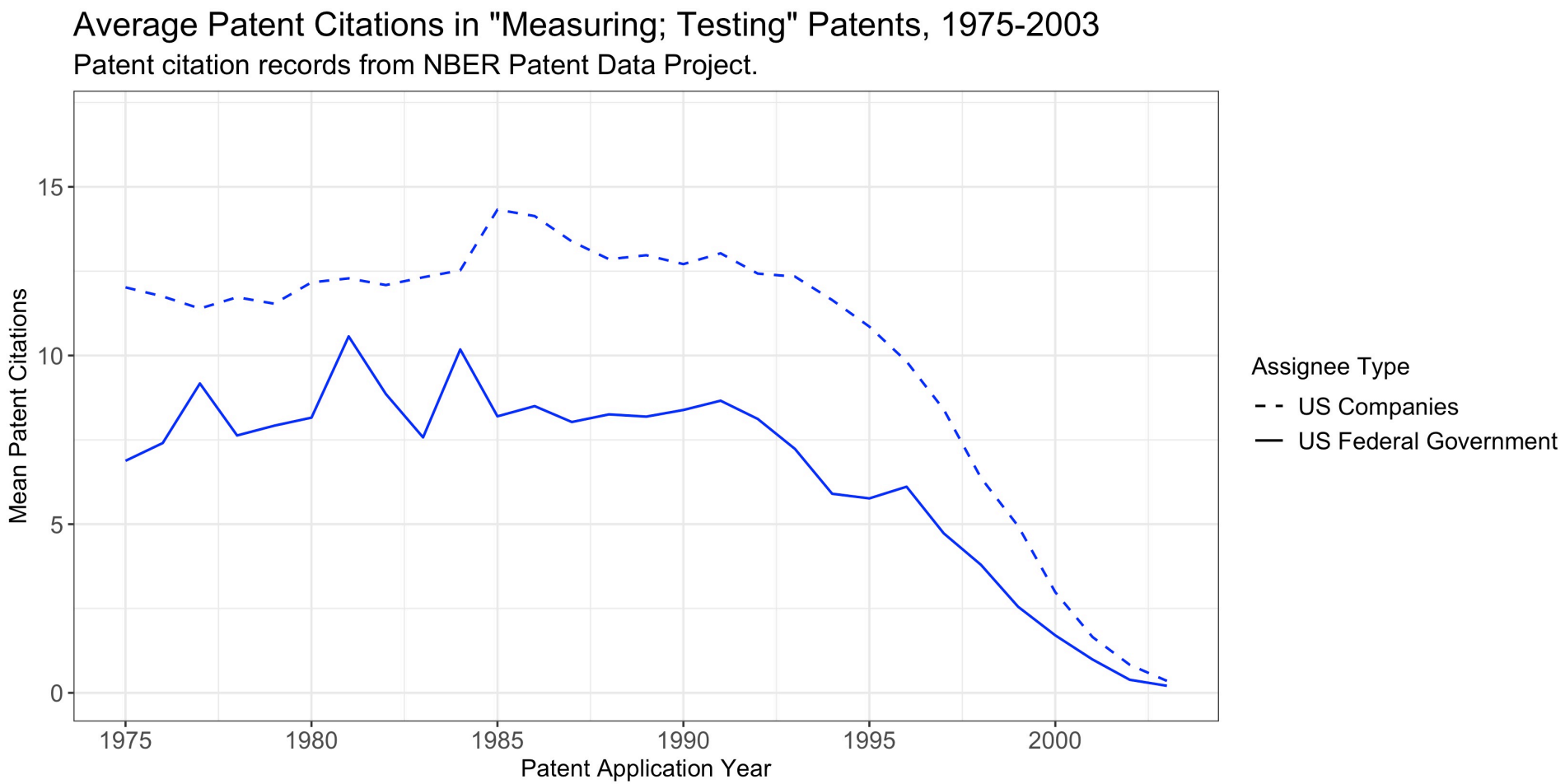
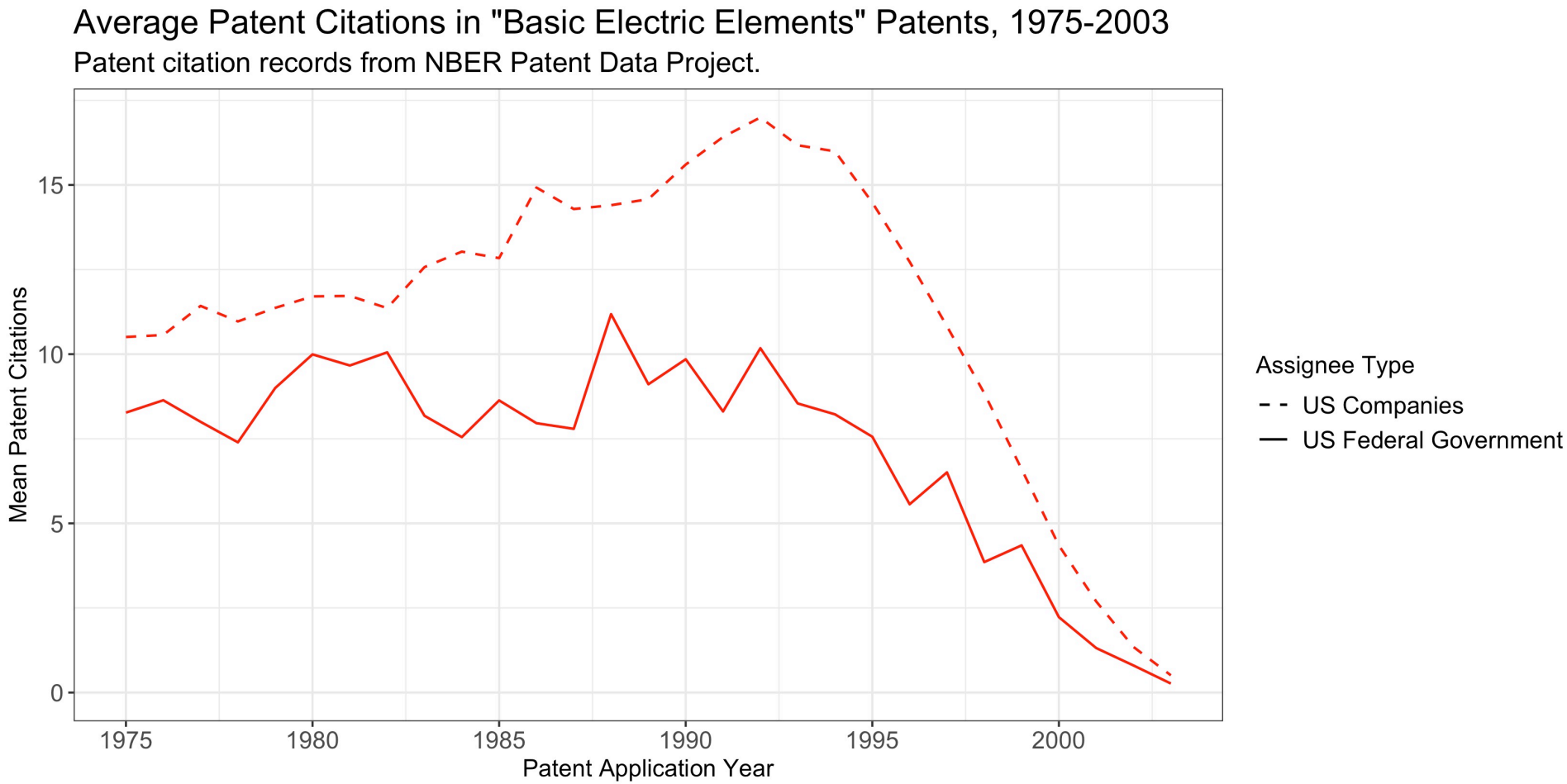


Government Patent Quality



Government Patent Quality



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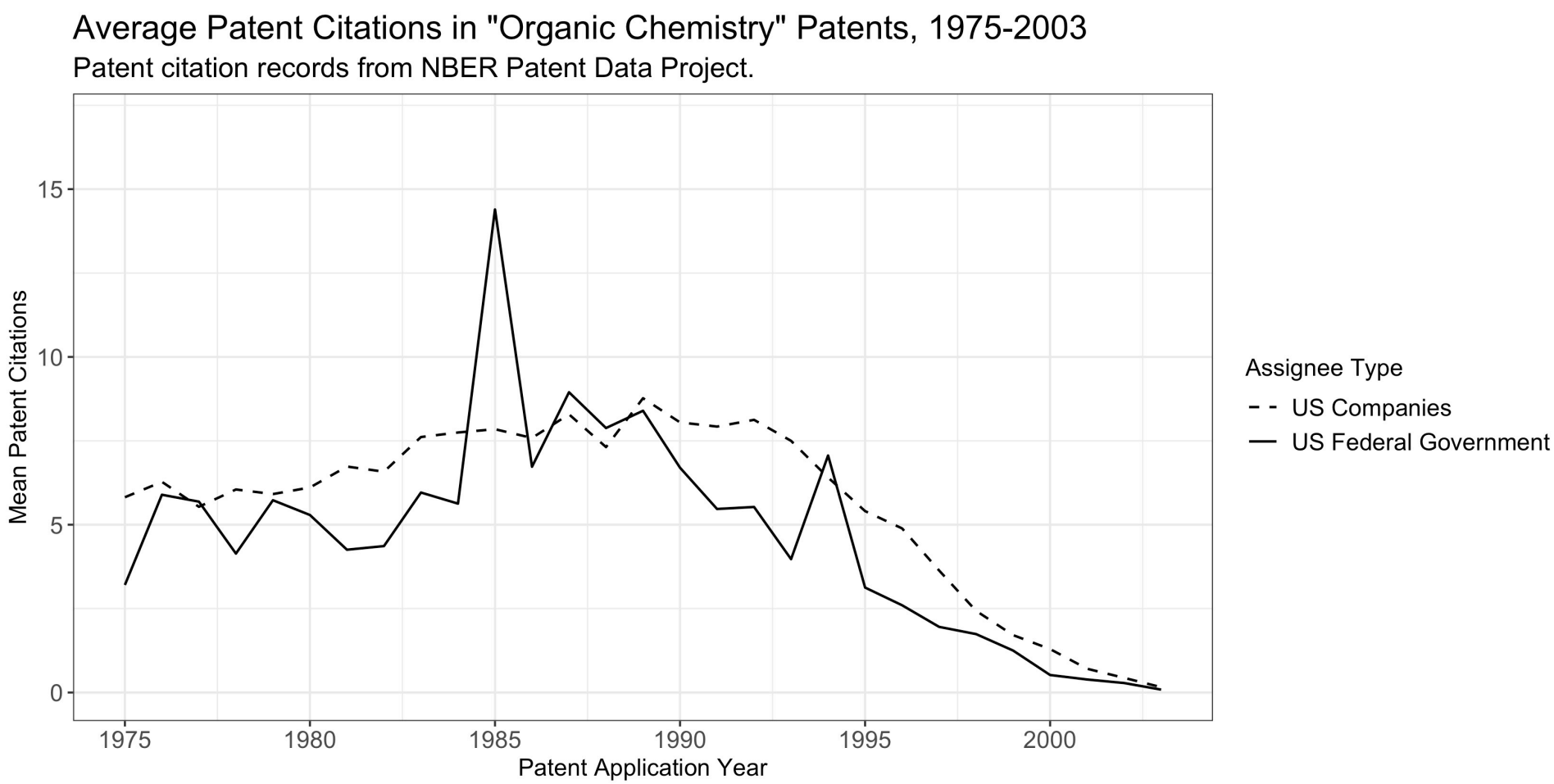
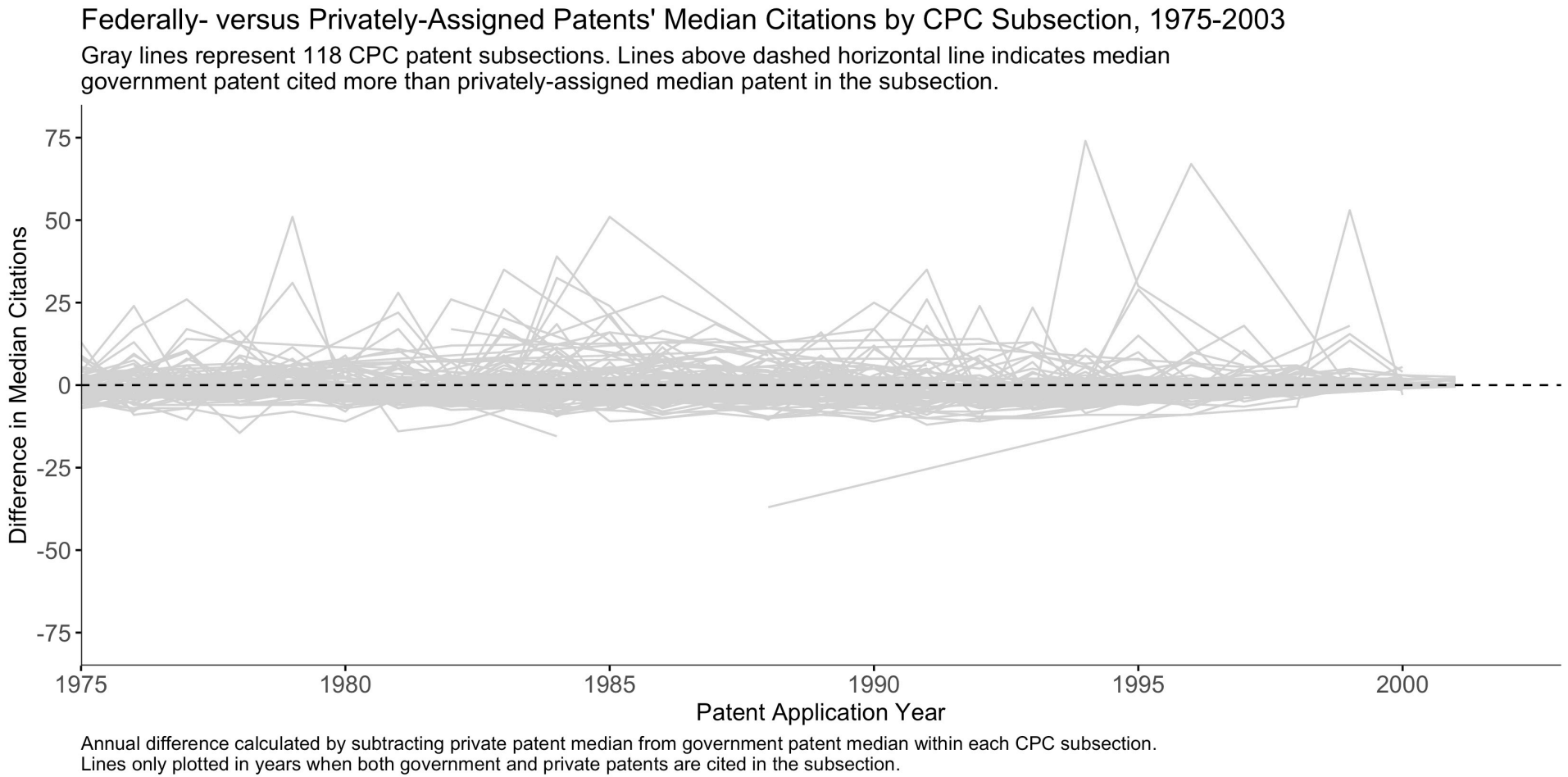
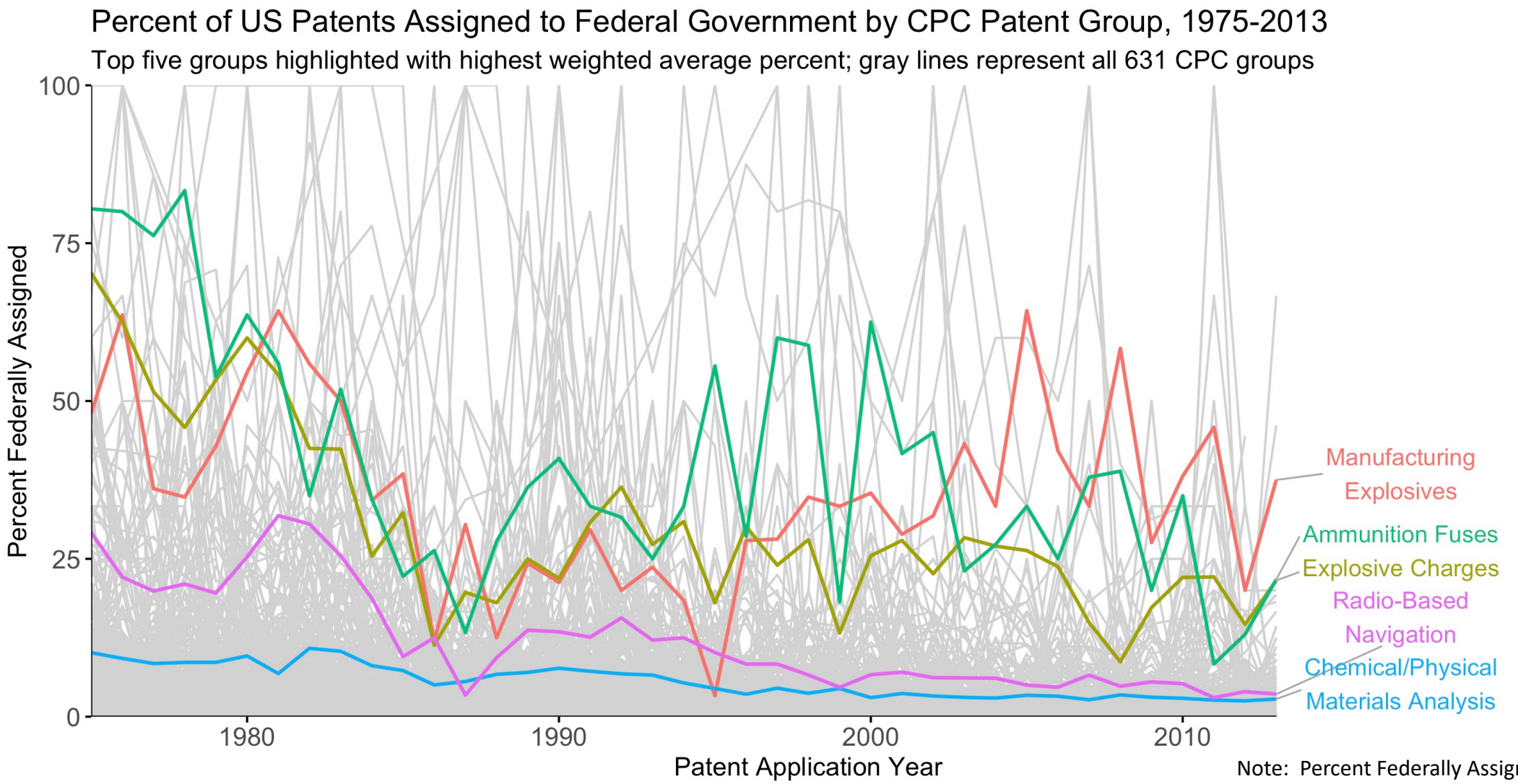


Government Patent Quality



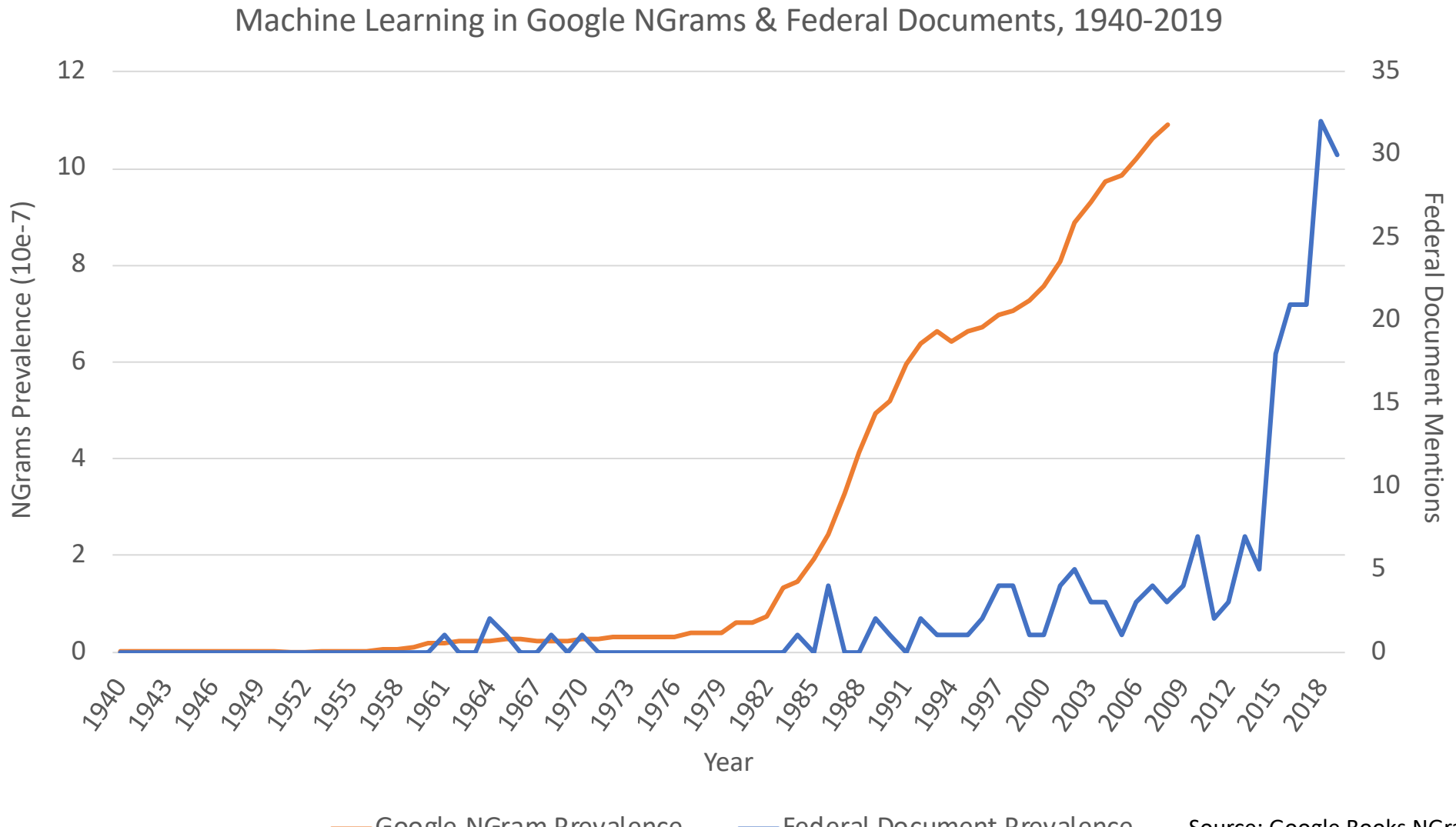
Government Patent Share by Technology



Denominator is combined patents assigned to US companies and federal government.
Annual average weighted by number of federally-assigned patents.

Note: Percent Federally Assigned weighted by number of patents in CPC Group
Source: PatentsView.org

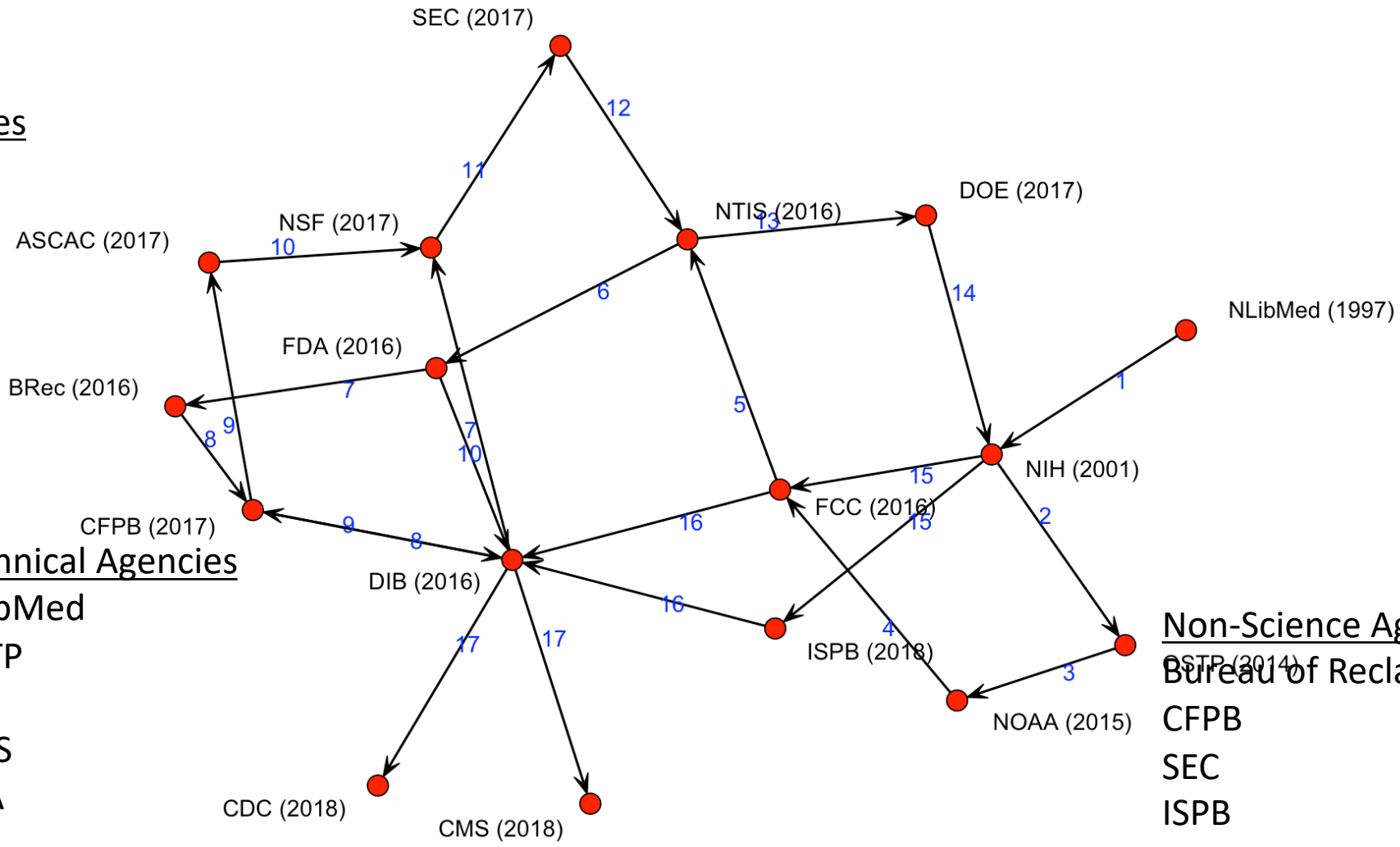
Diffusion Across Time: Example of Machine Learning



Source: Google Books NGram Viewer; Govinfo.gov

Diffusion Across Agencies: Machine Learning

<u>Science Agencies</u>
NIH
NOAA
NSF
DOE
NIH
CDC



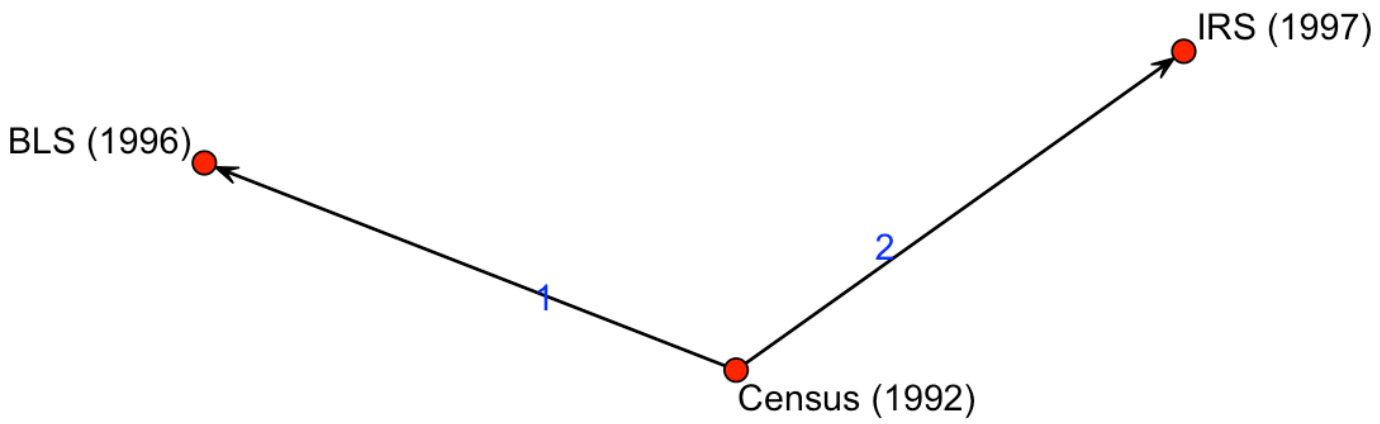
<u>Technical Agencies</u>
NLibMed
OSTP
FCC
NTIS
FDA
DIB
ASAC

<u>Non-Science Agencies</u>
Bureau of Reclamation (BRec)
CFPB
SEC
ISPB
CMS

Note: Acronyms are agencies; year is year that
"machine learning" first appears in the Federal Register for a given agency;

Diffusion Across Agencies: Touchtone Data Entry

<u>Technical Agencies</u>
Census
BLS
IRS



Note: Acronyms are agencies; year is year that
"machine learning" first appears in the Federal Register for a given agency;
arrows indicate sequence of appearance. Source: FederalRegister.gov

Government Innovation: Summary

- Classification of Innovation in the Government
- Inputs
  - Scientists
  - Budgets
- Outputs: Government-Assigned Patents (Hard Science/Engineering)
- Diffusion of Innovation
- To understand innovation in the federal government, measuring the scope and impact of non-technological innovations is important