*Appendix for*

**The Aftershock: Projecting the Impact of NIH Funding Reductions on Research and Innovation**

# Data Sources

We used several sources with data from 1995 to 2024 to inform our model where available.

## Workforce

Most of the data on the workforce in the model are drawn from the National Science Foundations’ (NSF) National Center for Science and Engineering Statistics. We limited the workforce to individuals located in the United States during the time of data collection.

### Graduate students

To derive data on graduate students, we used NSF’s Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS).1 We limited the total number of graduate students to those of full-time status, as a majority of the data, such as first-time enrollment, was available for full-time students only. We included all students surveyed in GSS, who are in either the science, engineering, or health fields. Note that for all values, there were often trend breaks, and we always used the new values rather than the old.

The total annual counts of current full-time graduate students were obtained from Table 1-5a. *Enrollment intensity of graduate students in science, engineering, and health, by degree program: 1975–2023*.

We derived the first-time enrollments of full-time graduate students from Table 1-5b. *First-time status among full-time graduate students in science, engineering, and health, by degree level: 1975–2023*. According to NSF, this includes all students newly enrolled for credit in a graduate degree program in the fall, including those with prior graduate enrollment or existing graduate/professional degrees.

GSS provides additional data on the characteristics of graduate students. Using Table 1-7. *Detailed primary source of federal support for full-time graduate students in science, engineering, and health: 1975–2023*, we obtained yearly counts of students whose primary source of support was through federal funding, as well as those specifically funded by NIH. Furthermore, Table 1-8. Primary mechanism of support for full-time graduate students in science, engineering, and health: 1975–2023, allowed us to derive annual percentages of all full-time graduate students whose primary mechanism of support was through research assistantships.

Using NSF’s Survey of Earned Doctorates (SED),2 we obtained the number of research doctorate recipients from U.S. academic institutions, available for selected years only, using Table 1-6. *Research doctorate recipients, by trend broad field of doctorate and citizenship status*. We included only individuals from the science and engineering fields, which includes the health sciences in this data, and excluded those in non-science or engineering fields. Additionally, the SED allowed us to obtain time series data on the outflow of doctorate recipients. Using Table 2-6. *Employment sector of research doctorate recipients with definite postgraduation commitments for non-postdoc employment in the United States, by trend broad field of doctorate: Selected years, 1993–2023*, we obtained the number of research doctorate students of science and engineering fields who secured positions in academia and in industry or business—categories we broadly interpret as representing project grant investigator and industry employment, respectively. Similarly, we obtained the students who committed to postdoctoral training plans using Table 2-3. *Postgraduation plans of research doctorate recipients with definite commitments, by trend broad field of doctorate.*

Unlike many statistics collected by the GSS, the SED surveys all graduate students without distinction of enrollment intensity. In other words, our outflow data include all doctoral students—both full- and part-time—whereas our stock data focus exclusively on full-time students. While we acknowledge the discrepancy between the two measures, we choose to disregard it, as part-time doctoral students have consistently accounted for less than 13% since 2017.1

### Postdoctoral appointees

Similar to graduate students, we noted all postdoctoral appointees among the science, engineering, or health fields from Table 1-1. *Graduate students, postdoctoral appointees, and doctorate-holding nonfaculty researchers in science, engineering, and health: 1975–2023* of GSS. Additionally, the primary source of funding for postdoctoral researchers being identified as federal, were noted based on data obtained from the GSS, with most information derived from archived reports.

### Researchers

To obtain the total number of researchers currently in either an academic or industry setting, we utilized NSF’s Survey of Doctorate Recipients (SDR)3 for the select years available. To begin, we obtained the total number of doctorate recipients residing in the U.S. whose primary or secondary work activity is any research and development (R&D) using Table 15-1. *U.S. residing employed doctoral scientists and engineers, by fine field of doctorate and primary or secondary work activity: 2023*. We obtained the breakdowns of academic researchers by identifying doctorate recipients whose primary or secondary work is R&D in a four-year institution using Table 23. *U.S. residing employed doctoral scientists and engineers in 4-year educational institutions, by broad field of doctorate, primary work activity, and secondary work activity: 2023*, and the equivalent tables for previous years, with most information derived from archived reports. We then estimate the number of industry researchers by assuming that they make up the remaining doctorate recipients whose primary or secondary work is R&D. Again, these data included only the doctorate recipients in the science, engineering, and health fields. We include limited data, as prior to 2015, the disaggregated data for doctoral scientist and engineers who are residing in the U.S. in the year of data collection and either were specified to be in the academic or industry sectors are absent.

We leveraged NIH’s RePORT (Research Portfolio Online Reporting Tools),4 NIH Data Book Report ID: 167 to identify the number of first-time and established investigators supported by research project grants funded by the NIH and NIH Data Book Report ID: 166 to derive the funding rates by career stage of investigators.

## National Institutes of Health Budget and Grants

We draw all the data related to the National Institutes of Health (NIH) budget and grants from NIH’s RePORT.

### Budget and costs

The annual budget is derived from the NIH Data Book Report ID: 226, where we noted the total annual budget amount. From this same report, we obtained a breakdown of the annual budget used for research grants and training grants. Furthermore, we noted the average costs, or size, in current dollars of research grants using the NIH Data Book Report ID: 115.

### Grants and projects

The number of applications for research project grants as well as the success rates were derived from NIH Data Book Report ID: 20.

The total number of active NIH research grants is based on data from the NIH Special Reports and Current Issues Report Archive, specifically from the report titled “*Trends in NIH-Supported Basic, Translational, and Clinical Research: FYs 2009–2022.*” From this report, we also obtained disaggregated data of the number of fundamental research projects and applied projects supported by NIH per year. We align our definition of *fundamental* research projects with NIH’s definition of *basic* researchprojects, which entails all research that involves scientific exploration and can reveal fundamental mechanisms of biology, disease or behavior.5

We used ExPORTER from RePORT to obtain the annual number of published papers funded by NIH. Further, we obtained annual numbers of published papers for basic sciences using PubMed that were also funded by NIH. Specifically, we used the following advanced search query: (cellular\* [Title/Abstract] OR cell[Title/Abstract] OR animals[Title/ Abstract] OR Biologic Markers[mh] OR mice OR Polymorphism[mh] OR pathway[Title/Abstract] OR mechanism[Title/ Abstract] OR cytokine[Title/Abstract] OR signal transduction [mh] OR animal[mh] NOT clinical trial[Publication Type] NOT editorial[Publication Type] NOT Case Reports[Publication Type] NOT Practice Guideline[Publication Type] NOT Comment[Publication Type]) AND (NIH[Grants and Funding]).6

## Biomedical Innovation

### Clinical Trials and Patents

We identified annual actively registered clinical trials from ClinicalTrials.gov by applying the following filters: "Study Start Date on or before 12/31/[year]," "Primary Completion Date on or after 01/01/[year], and location being the United States. This approach captures trials that were active during the specified year. Among these, we further filtered for trials with NIH funding and recorded the corresponding annual counts. We repeated the same process to obtain the inflow of new clinical trials annually, but rather used filters simply for the location being the United States and “Study Start Date from 01/01/[year] to 12/31/[year].”

Then, we used data from the United States Patent and Trademark Office to identify the inflow of medical- or health-related patents originating from the United States using the advanced search: @py = "[year]" AND (medical.bsum. OR health.bsum.) for every year.

### FDA New Drug Application and Device Approvals

We identified annual new drug and device application approvals from various sources of the Food Drug Administration (FDA). Primarily, we obtained the number of new drug applications, new molecular entities,7 and biological device application8 approvals from FDA. The biological approvals are medical devices involved in the collection, processing, testing, manufacture and administration of blood, blood components and cellular products, approved or cleared by the Center for Biologics Evaluation and Research.8



**Figure S1**: Model fit to historical data



**Figure S2**: Partial calibration for input time series data

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**Figure S3**: Sensitivity analysis results

**References**

1. National Center for Science and Engineering Statistics (NCSES). Survey of Graduate Students and Postdoctorates in Science and Engineering: Fall 2023. Published online 2025. https://ncses.nsf.gov/surveys/graduate-students-postdoctorates-s-e/2023

2. National Center for Science and Engineering Statistics (NCSES). Doctorate Recipients from U.S. Universities: 2023 Data Tables. Published online 2024. https://ncses.nsf.gov/surveys/earned-doctorates

3. National Center for Science and Engineering Statistics (NCSES). Survey of Doctorate Recipients: 2023. Published online 2025. https://ncses.nsf.gov/surveys/doctorate-recipients/2023

4. RePORT (Research Portfolio Online Reporting tools). National Institutes of Health. Accessed May 14, 2025. https://report.nih.gov/

5. Translational Science Spectrum. National Center for Advancing Translational Sciences. April 30, 2025. Accessed May 14, 2025. https://ncats.nih.gov/about/about-translational-science/spectrum

6. Steinberg BE, Goldenberg NM, Fairn GD, Kuebler WM, Slutsky AS, Lee WL. Is basic science disappearing from medicine? The decline of biomedical research in the medical literature. *The FASEB Journal*. 2016;30(2):515-518. doi:10.1096/fj.15-281758

7. *Summary of NDA Approvals & Receipts, 1938 to the Present*. U.S. Food & Drug Administration; 2018. Accessed May 16, 2025. https://www.fda.gov/about-fda/histories-fda-regulated-products/summary-nda-approvals-receipts-1938-present

8. *Biological Approvals by Year*. U.S. Food & Drug Administration; 2025. Accessed May 16, 2025. https://www.fda.gov/vaccines-blood-biologics/development-approval-process-cber/biological-approvals-year