

Higher Education Research and Development Survey: Fiscal Year 2017

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Technical Notes

Survey Overview

Purpose. The Higher Education Research and Development (HERD) Survey is the primary source of information on separately accounted for R&D expenditures within higher education institutions in the United States and outlying areas.

Data collection authority. The information is solicited under the authority of the National Science Foundation Act of 1950, as amended, and the America COMPETES Reauthorization Act of 2010. The Office of Management and Budget control number is 3145-0100, with an expiration date of 30 September 2019.

Survey contractor. ICF.

Survey sponsor. The HERD Survey is sponsored by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation.

Key Survey Information

Frequency. Annual.

Initial survey year. In 2010, the HERD Survey replaced a previous annual collection, the Survey of Research and Development Expenditures at Universities and Colleges (Academic R&D Expenditures Survey), which was conducted from FY 1972 through FY 2009.

Reference period. FY 2017.

Response unit. Establishment.

Sample or census. Census.

Population size. A total of 903 research-performing academic institutions.

Sample size. The survey was a census of all known eligible universities and colleges.

Survey Design

Target population. The FY 2017 HERD Survey target population consisted of public and private nonprofit postsecondary institutions in the United States, Guam, Puerto Rico, and the U.S. Virgin Islands that granted a bachelor's degree or higher in any field; expended at least \$150,000 in separately accounted for R&D in FY 2017; and were geographically separate campuses headed by a president, chancellor, or equivalent. A list of all accredited, degree-granting institutions in the United States (the *Higher Education Directory*) was obtained from Higher Education Publications (HEP). More information about HEP and its sources can be found at <https://www.hepinc.com/about/>.

The survey population was reviewed before data collection began to ensure that each institutional classification was accurate. Characteristics of the schools were reviewed before and during the survey to determine whether changes had occurred (e.g., name; highest degree granted; school openings, closings, or mergers). Table A-1 shows all institution name changes between the FY 2016 and FY 2017 surveys.

After data collection closed, institutions were reviewed to verify that only those reporting at least \$150,000 in separately accounted for R&D were included in the population. Of the 917 institutions surveyed, 14 completed the survey but reported total R&D expenditures of less than \$150,000. These institutions were excluded from the population, and their data are not included in the FY 2017 survey totals. The total and federally financed R&D expenditures for these 14 institutions are listed in table A-2.

Sample frame. The frame for the FY 2017 HERD Survey included (1) all institutions considered in scope for the FY 2016 survey, (2) institutions that granted a bachelor's degree or higher and reported an amount greater than \$0 for research on the Integrated Postsecondary Education Data System (IPEDS) 2015 Finance Survey, (3) all U.S. service institutions that granted a bachelor's degree or higher and were not already part of the HERD Survey population, and (4) institutions that granted graduate degrees but did not report to IPEDS and were not already part of the HERD Survey population. The information in the *Higher Education Directory* was used to locate institutions meeting the conditions listed in (3) and (4). When FY 2016 R&D expenditures were not known, institutions in the frame were sent a brief questionnaire asking whether the institution had R&D expenditures during FY 2016 and whether those expenditures were less than \$150,000, were \$150,000 to \$999,999, or were \$1 million or more.

The population review screener was sent to 242 institutions. A total of 32 institutions were added to the survey population during the population review. Three other institutions were added when representatives of university systems contacted data collection staff about campuses that newly qualified for the survey. During data collection, 29 institutions were removed from the population after they indicated that their R&D expenditures were less than \$150,000 for FY 2017 or that their institution had merged with another surveyed university or college. After accounting for these additions and subtractions, the number of academic institutions in the final population increased from 897 in FY 2016 to 903 in FY 2017 (table A-3).

Sample design. The FY 1997 survey was the last one conducted as a sample survey. Since FY 1998, the survey has been a census of all known eligible universities and colleges.

Data Collection and Processing Methods

Data collection. The FY 2017 survey questionnaires were sent by e-mail in November 2017. Respondents could choose to submit a questionnaire downloaded from the Web or use a Web-based data collection system to respond to the survey. Every effort was made to maintain close contact with respondents to preserve both the consistency and continuity of the resulting data. Survey data reports for each institution were available on the survey website; these showed comparisons between the current and 2 prior years of data and noted any substantive disparities. Questionnaires were carefully examined for completeness upon receipt. Respondents were sent personalized e-mail messages asking them to provide any necessary revisions before the final processing and tabulation of data. These e-mail messages included a link to the HERD Survey Web-based collection system, allowing respondents to view and correct their data online.

Respondents were asked to explain significant differences between current-year reporting and established patterns of reporting verified for prior years. They were encouraged to correct prior-year data if necessary. When respondents updated or amended figures from past years, NCSES made corresponding

changes to trend data in the 2017 data tables and to the underlying microdata. For accurate historical data, use only the most recently released data tables.

Mode. Respondents could choose to submit a questionnaire downloaded from the Web or use the Web-based data collection system to respond to the survey. One institution submitted data using the downloaded questionnaire.

Response rates. By the survey's closing date in June 2018, forms had been received from 869 universities and colleges out of a population of 903, a response rate of 96.2%. Responses were received from 97.2% of all doctorate-granting institutions. The R&D expenditures reported by these doctoral institutions constituted 98.9% of the estimated national R&D expenditures for FY 2017. Table A-4 displays a detailed breakdown of response rates by survey form and highest degree granted, and table A-5 displays a breakdown of response rates for each survey question.

Data editing. The HERD Survey was subject to very little editing. Respondents were contacted and asked to resolve possible self-reporting issues themselves. Questionnaires were carefully examined by survey staff upon receipt. Reviews focused on unexplained missing data, expenditures that were outliers compared to those of peer institutions, and explanations provided for changes in reporting patterns. If additional explanations or data revisions were needed, respondents were sent personalized e-mail messages asking them to provide any necessary revisions before the final processing and tabulation of data.

Imputation. Missing values were imputed based on the previous year's data and the reported data of peer institutions in the current cycle. For the 32 institutions that had not responded by the closing date of the survey and had been included in the FY 2016 HERD Survey population, R&D expenditures were imputed by applying inflator and deflator factors to the prior year's key totals. The key totals for FY 2017 included total R&D expenditures, federal R&D expenditures, expenditures received as a subrecipient from higher education sources, expenditures received as a subrecipient from non-higher education sources, expenditures passed through to higher education entities, and expenditures passed through to non-higher education entities. Imputation factors were ratios derived from the 2-year-trend data of responding institutions with similar characteristics, including highest degree granted, type of institutional control (public or private), and level of total R&D expenditures. Other values that were not identified as key totals were imputed by applying ratios from the previous year's data.

For two institutions that were new to the survey population, no past-year data were available. For these institutions, total R&D expenditures were assumed to be \$150,000 based on the institutions' responses to the population review screener. Other values were then imputed as a proportion of total R&D expenditures based on the data of institutions with similar characteristics. Data for partial nonresponse were imputed using similar techniques.

Tables A-6 through A-19 present imputed amounts for each applicable survey variable. The dollar amount imputed is displayed, along with the percentage it represents of the national estimate for universities and colleges for a variable. The imputed total R&D was \$110 million, or 0.1%, of the \$75.3 billion in total R&D expenditures (table A-6).

Several surveyed institutions have responded intermittently in past years. For years in which no response was received, data have been imputed as previously described. Although the imputation algorithm accurately reflects national trends, it cannot account for specific trends at individual institutions. For this reason, a re-imputation of institutional data for prior years is also performed. For each institution, previously imputed values from the HERD Survey (FYs 2010–16) were recomputed to ensure that the imputed data are consistent with reporting patterns from the FY 2017 survey. These procedures result in

much more consistent reporting trends for individual institutions but have little effect on aggregate figures reflecting national totals. In the data tables, the letter *i* is used to identify imputed data.

R&D expenditures from unspecified federal agencies (Question 10) and capitalization thresholds for software and equipment (Question 13) were not imputed. Response summaries for these questions can be found in tables A-20 through A-21.

Weighting. Survey data were not weighted.

Variance estimation. No variance estimation techniques were used.

Survey Quality Measures

Sampling error. Because the FY 2017 survey was distributed to all institutions in the universe, there was no sampling error.

Coverage error. Coverage error of large research institutions is minimal because of comprehensive lists. These institutions are easily identified using the NCSSES Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions. However, institutions with smaller amounts of R&D expenditures have been more difficult to identify because they often do not receive federal funding for science and engineering (S&E) R&D.

As part of the expanded HERD Survey collection, a special effort was undertaken in 2010 to screen 1,715 4-year and higher postsecondary institutions that were not currently included in the survey to identify additional institutions meeting the \$150,000 threshold. These institutions were given detailed instructions regarding what to include as R&D expenditures and were asked to respond to Question 1, total R&D expenditures by source of funds, of the HERD Survey. This short form survey achieved a 64.4% response rate and identified 187 additional institutions that met the \$150,000 threshold. The total R&D expenditures reported by these institutions in FY 2010 was \$249 million, or 0.42%, of the \$61.2 billion reported by FY 2010 HERD Survey respondents. More details on this effort are included in the methodology report and technical notes for the FY 2010 survey. NCSSES continues to annually screen all 4-year and higher institutions reporting nonzero amounts of research expenses to IPEDS to determine whether new institutions qualify for inclusion in the survey.

Nonresponse error. Thirty-four universities and colleges did not respond in FY 2017, out of a total of 903 eligible institutions, for a nonresponse rate of 3.8%. Table A-4 displays a detailed breakdown of response rates by survey population and highest degree granted.

The item nonresponse rates varied from 0.0% for Question 1, total R&D expenditures by source of funds, and Question 9, federal expenditures by R&D field, to 7.2% for Question 6, R&D expenditures by type of R&D (basic research, applied research, and experimental development). No question had a nonresponse rate of 10% or higher. Table A-5 displays a breakdown of response rates for each question in each of the two surveys. See section “Imputation” for mitigation of item nonresponses. Tables A-6 through A-19 present imputed amounts for each applicable survey variable.

Measurement error. The most likely source of measurement error is institutional records containing categories different from those on the survey. For example, institutions were asked to report all R&D expenditures by field. The NCSSES-designed fields do not always translate to an institution’s departmental structure, and adjustments must be made by the institution in order to complete the survey. Fields were revised for the FY 2016 survey to better reflect the R&D currently being conducted at universities and colleges and make HERD Survey fields more consistent with those used by other

NCSES surveys as well as with the National Center for Education Statistics Classification of Instructional Programs (CIP) codes. Details of this change are included in the methodology report and technical notes for the FY 2016 survey.

Another source of error is the survey's category of institutionally financed research. The survey requests that institutions report discretionary internal funds used for research. NCSES discovered through debriefings conducted at the conclusion of the FY 2010 survey that there were varying definitions of what should be included on the HERD Survey as institutionally funded research. Some institutions were including all expenditures from separate accounts designated for research; others were including only internal R&D projects that are competitively awarded and have detailed budgets. A workshop was held in summer 2012 to discuss these differences in definitional interpretation. Based on the findings from the workshop, the FY 2012 survey was modified to clarify that all expenditures designated for research can be included in this category. This includes expenditures for organized research and expenditures of other funds designated for research but not categorized as organized research. A checklist question (Question 1.1) was also added to encourage the inclusion of all eligible expenditures and to determine the full extent of the variations in reporting across institutions. This question has been on the survey since FY 2012. An analysis of Question 1.1 responses from FY 2016 indicated that the majority of institutions that reported some institutionally funded R&D were including funds that would not be considered organized research (e.g., 77% included startup funds, bridge funding, or seed funding, and 79% included other departmental funds designated for research). However, many institutions reported that they still could not report institutionally funded research that was not organized research because those funds were not separately accounted for. Therefore, survey totals are missing expenditures for R&D that come from multipurpose accounts, and as such, they represent an undercount of the total amount of internal discretionary funding that institutions make available to conduct R&D.

The reporting of unrecovered indirect costs is another known source of error. The survey requests that the total amount of indirect costs associated with a research grant or contract be calculated and reported, including costs that were not reimbursed by the external funding source. The unrecovered indirect cost is calculated by multiplying the institution's negotiated indirect cost rate by the corresponding base and then subtracting the actual indirect cost recovery, preferably on a project-by-project basis. In FY 2017, 6.0% of respondents reported that these data were unavailable. Respondents who were unable to provide values were asked to provide information on their nonresponse. Based on the collected information, survey guidance is revised to encourage response.

It should also be noted that because institutions were asked to include funds passed through to higher education institutions as well as subrecipient funding from higher education institutions, there is double counting included in national and group totals. For example, Institution A's survey included the \$2 million passed through to Institution B, and Institution B's survey also included that \$2 million in subrecipient funding that it received from Institution A. Overall, institutions reported \$3.3 billion in expenditures from subrecipient funding received from other universities in FY 2017 and \$3.3 billion in funds passed through to higher education subrecipients in FY 2017. Adjustments are made to R&D totals presented in the NCSES *National Patterns of R&D Resources* publications.

Data Comparability (Changes)

Annual data are available for FYs 1972–2017. When the review for consistency between each year's data and submissions in prior years reveals discrepancies, it is sometimes necessary to modify prior years' data. This is especially likely to affect trends for certain institutions that fail to report every year, because current-year data are used to impute prior-year data. For accurate historical data, use only the most recently released data tables. Individuals wishing to analyze trends other than those in the most recent

data tables are encouraged to contact the Project Officer for more information about comparability of data over time.

Changes in survey coverage and population. Before FY 2010, the population included only institutions with R&D expenditures and degree programs in S&E fields. Institutions that performed R&D in only non-S&E fields were excluded from the population. Although not a change in the coverage or population, each campus headed by a campus-level president, chancellor, or equivalent began completing a separate survey in 2010 rather than combining its response with the responses of other campuses in the university system. As a result, the overall number of academic institutions in the population increased from 711 in FY 2009 to 742 in FY 2010.

To compare HERD Survey data across university systems by aggregating member campuses, table 6 shows all institutions in the FY 2017 population, including short form survey institutions, by state, institutional control, and system.

Universities and colleges can merge or separate, possibly resulting in large changes in data from previous years. For FY 2015, the Indiana University School of Medicine (IUSM) reporting line was changed from the Chancellor of the Indiana University-Purdue University, Indianapolis (IUPUI) campus to the President of Indiana University. As such, the research expenditures for IUSM are now included in the Indiana University–Bloomington figures, resulting in an increase in total R&D expenditures of approximately \$280 million for this campus. IUPUI total R&D expenditures decreased from \$324 million in FY 2014 to \$56 million in FY 2015. In September 2015, Yeshiva University relinquished control of Albert Einstein College of Medicine to Montefiore Health System. As a result, FY 2016 data for Yeshiva University included only 2 months (July–August 2015) of R&D expenditures from the college of medicine. Albert Einstein College of Medicine reported separately for its entire FY 2016 (January–December 2016). Because of this change, FY 2016 research expenditures for Yeshiva University decreased by \$260 million. For FY 2017, Yeshiva University included no expenditures from the college of medicine, and total research expenditures decreased by \$43 million.

Changes in questionnaire. Tables include data from the Academic R&D Expenditures Survey (FYs 1972–2009) and the HERD Survey (FYs 2010–17). Analysts should be cautious when examining trend data. Although many variables are similar across the two surveys, because of clarification of which funds are to be included in the definition of R&D and the inclusion of non-S&E expenditures, exact comparisons may be misleading. In prior years, the Academic R&D Expenditures Survey collected expenditures for S&E and non-S&E fields separately. Institutions were not always able to provide non-S&E expenditures, and those data were not imputed previously. Also, revisions to the instructions on what types of activities are included as R&D in 2010 may have influenced reported values to varying degrees, depending on the numbers of clinical trials and training grants at an institution. Specific changes are described below:

- For the FY 2012 data collection, NCSES modified the survey instructions to clarify what types of institutionally funded activities should be included in reported data. The instructions explained that all expenditures for R&D from an institution’s current operating funds that are separately accounted for should be reported. This includes expenditures separately budgeted for organized research and expenditures of other funds designated for research but not categorized as organized research. The instructions also specified that funds from an institution’s 501(c)3 foundation should be reported under institutionally financed research.
- For the FY 2013 collection, the instructions were revised to clarify that funds from foreign and U.S. universities and colleges should be reported under All other sources (Question 1, row f). The

instructions also specified that gifts designated by donors for research should be included in Question 1, row f.

- Several changes were made to the FY 2016 questionnaire:
 - Question 16 on the FY 2015 questionnaire, regarding the number of postdocs paid from R&D expenditures, was removed from the survey.
 - Question 2, regarding foreign funding of R&D, was expanded to identify sources of foreign funding. The question now collects R&D expenditures funded by foreign governments, businesses, nonprofit organizations, and higher education (see definition *Foreign sources* for additional information).
 - Questions 9, 11, and 14 include revisions to the fields of R&D that better reflect the R&D currently being conducted at universities and colleges. The revisions make the HERD Survey fields more consistent with those used by other NCSES surveys as well as with the CIP codes.
- For FY 2017, the instructions were revised to clarify that funding from federally funded R&D centers (FFRDCs) should be reported as direct federal funding from the FFRDC's sponsoring agency.

Changes in reporting procedures or classification.

- In order to reduce the burden for institutions with minimal amounts of R&D expenditures, NCSES introduced a shorter version of the HERD Survey beginning with the FY 2012 collection. The short form includes four core questions. For the FY 2017 cycle, the short form population included 259 institutions that reported R&D expenditures between \$150,000 and \$1 million during FY 2016. The remainder of the institutions (644) received the full version of the survey.
- Short form survey data for FYs 2012–17 appear only in those tables that specify in their title that the data presented include data from the short form version of the survey. Data from the short form survey population are included in the year totals prior to FY 2012, aggregated under “all other surveyed institutions.” The total FY 2017 R&D expenditures reported by institutions in the short form survey population (\$140.0 million) represent 0.2% of the expenditures reported by all institutions (\$75.3 billion).

Definitions

- *Clinical trials.* Research studies designed to answer specific questions about the effects of drugs, vaccines, medical devices, tests, treatments, or other therapies for patients. Clinical trials are used to determine safety and effectiveness. Includes Phase I, Phase II, and Phase III clinical trials with human patients but excludes Phase IV clinical trials.
- *Contracts.* Legal commitments in which a good or service was provided by the reporting institution and benefited the sponsor. The sponsor specified the deliverables and gained the rights to the results.
- *Federal agency.* Any agency of the United States government. Expenditures were reported by six specific agency funding sources (the Department of Agriculture; Department of Defense; Department of Energy; Department of Health and Human Services, including the National

Institutes of Health; National Aeronautics and Space Administration; and National Science Foundation). Any expenditures funded by other federal agencies were reported under Other. The names of agencies included in the Other category are also requested.

- *Fields of R&D.* A list of the 40 fields of R&D reported on can be found on the survey questionnaire. In the data tables, the fields are grouped into 10 major areas: computer and information sciences; engineering; geosciences, atmospheric sciences and ocean sciences; life sciences; mathematics and statistics; physical sciences; psychology; social sciences; other sciences; and non-science and engineering.
- *Fiscal year.* Institution's financial year.
- *Foreign sources:*
 - Foreign government.* All levels of foreign government, including national, regional, municipal, or other local government.
 - Business.* Foreign for-profit organizations. Projects sponsored by a U.S. location of a foreign company were not considered foreign. Funds from a company's nonprofit foundation were not reported here; they were reported under Nonprofit organizations.
 - Nonprofit organizations.* Foreign nonprofit foundations and organizations, except higher education institutions. Funds from foreign universities were reported under Higher education.
 - Higher education.* Foreign colleges and universities and units owned, operated, and controlled by such institutions.
 - All other sources.* International governmental organizations located in the United States, such as the United Nations, the World Bank, and the International Monetary Fund, and all other entities sending funds to the United States from a location outside the United States and its territories.
- *Medical schools.* A medical school awards MD or DO degrees. Expenditures from projects assigned to the medical school or to research centers that were organizationally part of the medical school were included.
- *Pass-through entity.* Organizations that pass through grant or contract funds to subrecipient organizations. Vendor relationships were not included.
- *Principal investigators (PIs) and all other R&D personnel.* A PI is designated by the institution to direct the R&D project or program and be responsible for the scientific and technical direction of the project. All other R&D personnel includes other employees and students paid from R&D accounts.
- *Research and development (R&D).* R&D is creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture, and society—and to devise new applications of available knowledge. R&D covers three activities: basic research, applied research, and experimental development. R&D does not include public service or outreach programs, curriculum development (unless included as part of an overall research

project), or non-research training grants. R&D as measured on this survey does not include capital projects (i.e., construction or renovation of research facilities).

- *R&D expenditures.* Expenditures from the institution's current operating funds that were separately accounted for. For the purposes of the survey, R&D includes expenditures for organized research as defined by 2 CFR 220 Part 200 Appendix III and expenditures from funds designated for research. Expenditures came from internal or external funding and included recovered and unrecovered indirect costs. Funds passed through to subrecipient organizations were also included. R&D was excluded if it was conducted by university faculty or staff at outside institutions and was not accounted for in the reporting institution's financial records.

- *Sources of funds:*

U.S. federal government. Any agency of the U.S. government. Federal funds that were passed through to the reporting institution from another institution were included.

State and local government. Any state, county, municipality, or other local government entity in the United States, including state health agencies. State funds that supported R&D at agricultural and other experiment stations were included. Public institutions reported state appropriations restricted for R&D activities in this category.

Business. Domestic or foreign for-profit organizations. Funds from a company's nonprofit foundation were not reported here; they were reported under Nonprofit organizations.

Nonprofit organizations. Domestic or foreign nonprofit foundations and organizations, except universities and colleges. Funds from the reporting institution's 501(c)3 foundation were reported under Institutional funds. Funds from other universities and colleges were reported under All other sources.

Institutional funds. Includes institutionally financed research (all R&D funded by the institution from accounts that are only used for research), cost sharing (committed), and unrecovered indirect costs (the portion of indirect costs associated with a sponsored project that was not reimbursed by the sponsor in accordance with the institution's negotiated indirect cost rate).

All other sources. Sources not reported in other categories, such as funds from foreign governments, foreign or U.S. universities, and gifts designated by the donors for research.

- *Subrecipient.* The subrecipient for an award carries out the work but receives the funds from a pass-through entity rather than directly from the original funding source. Subrecipients tend to be the coauthors of publications, writers of technical reports discussing findings, inventors, and similar. Vendor relationships were not included.

- *Type of cost.* R&D expenditures were reported in the following categories:

Salaries, wages, and fringe benefits. Includes compensation for all R&D personnel whether full time or part time, temporary or permanent, including salaries, wages, and fringe benefits paid from institution funds and from external support.

Software purchases, noncapitalized and capitalized. Includes payments for all software, both purchases of software packages and license fees for systems.

Capitalized equipment. Includes payments for movable equipment exceeding the institution's capitalization threshold, including ancillary costs such as delivery and setup.

Pass-throughs to other organizations. See the definition for *Subrecipient*.

Other direct costs. Other costs that do not fit into one of the above categories, including (but not limited to) travel, tuition waivers, services such as consulting, computer usage fees, and supplies.

Indirect costs. Includes both recovered and unrecovered indirect costs.

- *Type of R&D.* R&D expenditures were reported in the following categories:

Basic research. Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Applied research. Original investigation undertaken in order to acquire new knowledge. It is directed primarily towards a specific, practical aim or objective.

Experimental development. Systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.