

Higher Education Research and Development Survey, Fiscal Year 2015

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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 (OMB) control number is 3145-0100 and expires on 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 2015.

Response unit. Establishment.

Sample or census. Census.

Population size. A total of 906 research-performing academic institutions.

Sample size. Sample is 906; the survey was a census of all known eligible universities and colleges.

Survey Design

Target population. The FY 2015 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 budgeted R&D in FY 2015; and were geographically separate campuses headed by a president, chancellor, or equivalent.

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 course of 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 2014 and FY 2015 surveys.

After data collection closed, institutions were reviewed to verify that only those reporting at least \$150,000 in separately budgeted R&D were included in the population. Of the 927 institutions surveyed, 21 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 2015 survey totals. The total and federally financed R&D expenditures for these 21 institutions are listed in table A-2.

Sample frame. The frame for the FY 2015 HERD Survey included (1) all institutions considered in scope for the FY 2014 survey, (2) institutions that granted a bachelor's degree or higher and reported greater than \$0 for research on the Integrated Postsecondary Education Data System (IPEDS) 2013 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, did not report to IPEDS, were not already part of the HERD Survey population, and conducted research. When FY 2014 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 2014 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 268 institutions. A total of 50 institutions were added to the survey population during the population review. Two other institutions were added when representatives of university systems contacted data collection staff about campuses that newly qualified for the survey. During the course of the data collection, 33 institutions were removed from the population after they indicated via their survey response or a special contact that their R&D expenditures were less than \$150,000 for FY 2015 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 889 in FY 2014 to 906 in FY 2015 (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 2015 survey questionnaires were sent by e-mail in November 2015. Respondents could choose to submit an Adobe PDF 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 in order to preserve both the consistency and continuity of the resulting data. Questionnaires were carefully examined for completeness upon receipt. Survey data reports were then prepared for each institution; these showed comparisons between the current and 2 prior years of data and noted any substantive disparities. 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 2015 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 an Adobe PDF or Microsoft Excel questionnaire downloaded from the Web, or use the Web-based data collection system to respond to the survey. Only one institution submitted data using the PDF or Excel form.

Response rates. By the survey's closing date in June 2016, forms had been received from 876 universities and colleges out of a population of 906, a response rate of 96.7%. Responses were received from 98.9% 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 2015. 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 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 21 institutions that had not responded by the closing date of the survey and had been included in the FY 2014 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 2015 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 the 9 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 or \$1 million, depending on the institution's response 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-20 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 in a particular field. The imputed total R&D was \$77 million, or 0.1%, of the \$68.8 billion in total R&D expenditures (table A-6).

A number of 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 2011–14) were recomputed to ensure that the imputed data are consistent with reporting patterns from the FY 2015 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-21 through A-22.

Weighting. Survey data were not weighted.

Variance estimation. No variance estimation techniques were used.

Survey Quality Measures

Sampling error. Because the FY 2015 survey was a survey distributed to all institutions in the universe, there was no sampling error.

Coverage error. Coverage of large research institutions is excellent because they 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 non-zero amounts of research expenses to IPEDS to determine whether new institutions qualify for inclusion in the survey.

Nonresponse error. Thirty universities and colleges did not respond in FY 2015, out of a total of 906 eligible institutions, for a nonresponse rate of 3.3%. Table A-4 displays a detailed breakdown of response rates by survey population and highest degree granted.

The item nonresponse rates varied from 0% for Question 1, total R&D expenditures by source of funds, to 7.8% for Question 16, headcount of R&D postdocs. No questions 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. Tables A-6 through A-20 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. A crosswalk between the NCSSES fields of R&D and the National Center for Education Statistics Classification of Instructional Programs codes was provided with the survey in order to mitigate this source of measurement error.

Another source of error is the survey's category of institutionally financed research. The survey requested that institutions report discretionary internal funds used for research. NCSES discovered through debriefings conducted at the conclusion of the FY 2010 survey that there are varying definitions of what should be included on the HERD Survey as institutionally funded research. Some institutions include all expenditures from separate accounts designated for research; others include 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 interpretations. Based on the findings from the workshop, the FY 2012 survey questionnaire was modified to clarify that all expenditures designated for research can be included in this category. This includes expenditures separately budgeted 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 inclusion of all eligible expenditures and to determine the full extent of the variation in reporting across institutions. An analysis of Question 1.1 responses from FY 2012 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., 70% included startup funds, bridge funding, or seed funding, and 71% 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 funding institutions make available to conduct R&D.

The reporting of unrecovered indirect costs is another known source of error. The survey requested 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 2015, 6.2% of respondents reported that these data were unavailable.

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 \$3.0 billion in expenditures from subrecipient funding received from other universities in FY 2015 and \$3.1 billion in funds passed through to higher education subrecipients in FY 2015.

Data Comparability (Changes)

Annual data are available for FYs 1972–2015. 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 other campuses in a university system. As a

result of this step, the overall number of academic institutions in the population increased from 711 in FY 2009 to 742 in FY 2010. For data users wishing to compare HERD Survey data across university systems by aggregating member campuses, table 83 shows all institutions in the FY 2015 population, including short form survey institutions, by state, institutional control, and system.

Frequently, universities and college merge or separate, 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 close to \$280 million for this campus. IUPUI total R&D expenditures decreased for \$324 million in FY 2014 to \$56 million in FY 2015.

Changes in questionnaire. Tables include data from the Academic R&D Expenditures Survey (FYs 1972–2009) and the HERD Survey (FYs 2010–15). Analysts should be cautious when examining trend data. Although many variables are similar across the two surveys, exact comparisons may be misleading for a couple of reasons. 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 a particular institution.

- 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.
- For the FY 2012 data collection, NCSSES 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.

Changes in reporting procedures or classification.

- In order to reduce the burden for institutions with minimal amounts of R&D expenditures, NCSSES introduced a shorter version of the HERD Survey beginning with the FY 2012 collection. The short form included only a few core questions. For the FY 2015 cycle, the short form included 266 institutions that reported R&D expenditures between \$150,000 and \$1 million during FY 2014. The remainder of the institutions (640) were included in the full version of the survey.
- Short form survey data for FY 2012–15 appear only in those tables that specify in their title that the data presented include 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 2015 R&D expenditures reported by institutions in the short form survey population (\$140 million) represent 0.2% of the expenditures reported by all institutions (\$68.8 billion).

Definitions

- *Equipment expenditures by source and field.* In Question 14, institutions were asked for expenditures for capitalized equipment (defined below under “Expenditures by type of cost”) by field of study and source of funds (federal or nonfederal).
- *Expenditures from contracts.* In Question 3, institutions were asked how much of the total R&D expenditures reported in Question 1 came from contracts rather than grants, reimbursements, or other agreements. Contracts were defined as 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.
- *Expenditures by type of R&D.* In Question 6, institutions were asked for the amount of federal and nonfederal R&D expenditures by type of R&D, as defined below:

Basic research. Research undertaken primarily to acquire new knowledge without any particular application or use in mind.

Applied research. Research conducted to gain the knowledge or understanding to meet a specific, recognized need.

Development. The systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes.

- *Expenditures for clinical trials.* In Question 5, institutions were asked to report the amount of total R&D expenditures that were expended for Phase I, Phase II, and Phase III clinical trials with human patients. Clinical trials were defined as research studies designed to answer specific questions about the effects of drugs, vaccines, medical devices, tests, treatments, and other therapies for patients. Clinical trials are used to determine safety and effectiveness.
- *Expenditures by federal agency and field of research.* In Question 9, institutions were asked for R&D expenditures in 36 fields of study by federal funding agency. If an individual project involved more than one field of R&D, respondents were asked to prorate expenditures to report an amount for each field involved. Subrecipient funding was reported under the agency that sponsored the original award. Institutions were asked to report expenditures funded by six specific agencies (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 were requested in Question 10. A list of the 36 fields of study reported on can be found on the survey questionnaire. In the data tables, the fields are grouped into 10 major areas: engineering, physical sciences, environmental sciences, mathematical sciences, computer sciences, life sciences, psychology, social sciences, other sciences, and non-science and engineering.
- *Expenditures funded by foreign sources.* In Question 2, institutions were asked how much of the total R&D expenditures reported in Question 1 came from foreign sources. Foreign sources included foreign governments, businesses, universities, nonprofit organizations, and any other entity sending funds to the United States from a location outside the United States and its territories. Also included were funds from international governmental organizations located in the

United States, such as the United Nations, World Bank, and International Monetary Fund. Projects sponsored by a U.S. location of a foreign company were not considered foreign.

- *Expenditures within medical schools.* In Question 4, institutions were asked to report expenditures for R&D projects in their medical schools. A medical school was defined as one that 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.
- *Expenditures by nonfederal source and field of research.* In Question 11, institutions were asked for R&D expenditures by field of study and nonfederal sources of funds (see the definitions below under “Expenditures by source”).
- *Expenditures passed through to subrecipients.* In Question 8, institutions were asked for the amounts of federal and nonfederal expenditures passed through to subrecipients from four types of pass-through entities (U.S. higher education institutions, businesses, nonprofit organizations, and other). Expenditures from vendor relationships were not included. Institutions were asked to report expenditures as federal or nonfederal based on the original source of funds.
- *Expenditures received as a subrecipient.* In Question 7, institutions were asked for the amounts of federal and nonfederal expenditures received as a subrecipient from four types of pass-through entities (U.S. higher education institutions, businesses, nonprofit organizations, and other). 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. Expenditures from vendor relationships were not included. Institutions were asked to report expenditures as federal or nonfederal based on the original source of funds.
- *Expenditures by source.* In Question 1, institutions were asked to report their total R&D expenditures by funding source, as defined below:

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. Included institutionally financed research (all R&D funded by the institution from accounts that are used only 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.

- *Expenditures by type of cost.* In Question 12, institutions were asked for expenditures by type of cost, as defined below:

Salaries, wages, and fringe benefits. Included 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. Included payments for all software, both purchases of software packages and license fees for systems.

Capitalized equipment. Included 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 above for Expenditures passed through to subrecipients.

Other direct costs. Other costs that did 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.

- *Fiscal year.* Institutions were asked to report data for their fiscal year (or financial year).
- *Headcount of R&D principal investigators (PIs) and all other R&D personnel.* In Question 15, institutions were asked to report the number of PIs and other personnel paid from the R&D salaries, wages, and fringe benefits reported in Question 12. 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. Co-investigators (co-PIs) were reported as PIs. Institutions were asked to count each person only once. If a person served as a PI or co-PI on one project and as other personnel on another project, that person was counted as a PI. The headcount included all personnel and students paid from R&D accounts, regardless of how much they received.
- *Headcount of postdocs working on R&D.* In Question 16, institutions were asked for the number of PIs or other personnel categorized as postdocs. NCSSES defined a postdoc as someone who holds a recent doctoral degree, generally awarded within the past 5 years, and has a limited-term appointment, generally no more than 5–7 years.
- *Research and development (R&D).* R&D is defined as creative work conducted systematically to increase the stock of knowledge (research) and to use that knowledge to devise new applications (development). R&D included basic research, applied research, and development (see the definition of Expenditures by type of R&D for additional information). 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. Respondents were also asked to exclude capital projects (i.e., construction or renovation of research facilities) from reported expenditures.

- *R&D expenditures.* Institutions were asked to report R&D expenditures from the institution's current operating funds that were separately accounted for. For the purposes of the survey, R&D included expenditures for organized research as defined by 2 CFR 220 (OMB Circular A-21) 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 that was not accounted for in an institution's financial records.