

# Business enterprise research and development QMI

UK business enterprise research and development statistics, with strengths and limitations of the data, methods used, and data uses and users.

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# 1 . Output information

- Statistical designation: for the 2022 and 2023 results, only the UK level estimates have been designated as accredited official statistics; all other estimates have been designated as official statistics
- Survey name: Business Enterprise Research and Development (BERD) Survey
- Data collection: sample of approximately 20,000 businesses for 2023
- Frequency: annual
- How compiled: sample-based survey
- Geographic coverage: UK

Related publications:

- [Business enterprise research and development \(BERD\) statistical bulletin](#)
- [Gross domestic expenditure on research and development \(GERD\) statistical bulletin](#)

## 2 . About this QMI report

This quality and methodology report contains information on the quality characteristics of the statistics (including the European Statistical System five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the statistics
- learn about existing uses and users of the statistics
- understand the methods used to create the statistics
- decide suitable uses for the statistics
- reduce the risk of misusing statistics

## 3 . Important points

The Business Enterprise Research and Development (BERD) survey measures expenditure on research and development (R&D) performed by UK businesses; the source of funding for this expenditure on R&D work and the employment of people working on R&D in UK businesses.

The Office for National Statistics (ONS) publishes results from the BERD Survey in our [annual Business enterprise research and development statistical bulletin](#) and our [Gross domestic expenditure on research and development \(GERD\) statistical bulletin](#).

The survey uses the [Organisation for Economic Co-operation and Development \(OECD\)](#) definition set out in the [Frascati Manual 2015](#), where R&D is defined as “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 must contain an appreciable amount of novelty.

R&D performed by businesses in Northern Ireland is measured in a separate survey conducted by the [Northern Ireland Statistics and Research Agency](#) (NISRA); the results from this are aggregated with those collected from the survey of businesses in Great Britain to form UK estimates.

For the 2022 and 2023 reference periods, the BERD Survey incorporated a new sample design and results methods, which replaced the previous uplift approach used to compile BERD statistics for 2021, as published in our [Business enterprise research and development, UK: 2021 statistical bulletin](#).

The new sample design for the 2022 reference period saw the sample size increase from approximately 5,400 UK businesses to approximately 38,500. This new design enabled us to better reflect the level of R&D performance across the UK business sector.

We used data from the 2022 BERD Survey to optimise the design for the 2023 Survey, targeting areas performing R&D. Because of this better targeting, we reduced the sample size back to around 20,000 UK businesses.

The 2022 BERD Survey used electronic questionnaires for the first time, to enhance the experience of the respondent. This also improved the data quality, with automatic validation at the point of entry. To further improve the quality of the data collected, the questionnaire guidance was enhanced to help businesses better interpret the questions asked.

We commissioned an academic review of international methods used for R&D statistics to better understand methods we can draw on to improve our estimates. This was published on the SOCARXIV website and titled: [An International Review of Approaches to Measuring Research and Development](#).

## 4 . Quality summary

### Overview

The statistics on research and development (R&D) expenditure by UK businesses consist primarily of:

- expenditure on in-house R&D performed by businesses in the UK
- the source of funding for R&D performed
- employment of people working on R&D

Estimates are provided in current and constant prices. Current prices (also known as nominal or cash) are expressed in terms of prices at the time of the reference period, while constant prices (also known as real terms) are adjusted using the gross domestic product (GDP) deflator, as shown in our [Gross domestic expenditure on research and development, UK statistical bulletin](#). This removes the effects of price inflation by fixing the prices of goods and services in one period (the base year), so that change from that period reflects change in the volume of R&D. This allows changes in businesses' R&D to be examined on a comparable basis over time.

## Uses and users

Our Business Enterprise Research and Development (BERD) Survey results, as reported in our [BERD UK statistical bulletins](#), measures the largest contribution to the UK's gross domestic expenditure on research and development (R&D), as reported in our [Gross domestic expenditure on research and development, UK statistical bulletins](#).

Information is used by government departments and other organisations for planning, policy and monitoring purposes. There are many other users within and outside government who use these results to produce analyses and to inform policy decisions. These include Eurostat and the [Organisation for Economic Co-operation and Development \(OECD\)](#).

The Office for National Statistics (ONS) provides R&D statistics to OECD. The estimates in the BERD publication are comparable with other EU countries which also align to the Frascati definition and collection guidelines on R&D statistics.

The Department for Science, Innovation and Technology (DSIT) is the policy owning department for research and development. DSIT uses BERD data to assess policy impact and inform debate. R&D data underpin their assessments of UK R&D performance as well as international work in the field.

The OECD uses our UK [BERD data](#) in preparing internationally comparable data tables and producing regular statistical publications such as the [OECD's Main Science and Technology Indicators \(MSTI\)](#) and the [OECD's Analytical Business Enterprise Research and Development statistics \(ANBERD\)](#).

The [Welsh Government \(WG\)](#), the [Scottish Government \(SG\)](#) and the [Northern Ireland Executive](#) use our BERD data as an important indicator for measuring the performance of their respective economies within the UK, as well as to monitor and develop R&D policies that seek to increase R&D investment.

His Majesty's Revenue and Customs (HMRC) use our BERD data for analysis purposes and policy development.

There is also interest in the BERD results data from the academic community.

## Strengths and limitations

### Strengths of the survey include:

- Target response rates for BERD are 75%; these are usually exceeded, the exception being during the coronavirus (COVID-19) pandemic when generally survey response rates fell, for BERD, response rates have now returned to usual levels.
- To minimise respondent burden, short-form questionnaires are sent to most responders and collect high-level variables only; larger businesses with 250 or more employees receive long-form questionnaires that capture more detail about a business's R&D expenditure.
- BERD uses electronic questionnaires and survey responses are validated at the point of entry, with potential anomalies checked with the respondent.
- The sample size is now far larger than it used to be, with approximately 38,500 businesses in the UK sampled for 2022 and 20,000 sampled for 2023; this compares with 5,400 UK businesses sampled in previous years.

### Limitations of the survey include:

- There is little scope for further detailed breakdowns of the results beyond those published in the statistical bulletins.
- It is assumed that short-form responders only perform one type of R&D and that this relates to their industrial classification – this may not always be the case.
- The BERD results are usually published 11 months after the period to which the data relate.
- It is assumed for short-form responders that all their R&D is performed at their registered office address.

## Transformation of research and development statistics

Our [Update on transformation of research and development statistics: November 2023 article](#) describes in detail the changes to how our R&D statistics have been produced since the 2022 reference period. These changes involved the introduction of a new sample design and new methods for calculating results.

## 5 . Quality characteristics of the data

### Relevance

The BERD Survey meets its requirements as a statutory annual survey conducted under the Statistics of Trade Act 1947, for the production of the UK National Accounts.

### Accuracy and reliability

In all surveys, the estimates from the survey are subject to various sources of uncertainty, or statistical error. The total error in a survey estimate is defined as the difference between the estimate derived from the data collected and the true (unknown) value for the population. The total error consists of two main elements: sampling error and non-sampling error, as explained in our [Uncertainty and how we measure it for our surveys methodology article](#). The survey was designed to minimise both these errors.

### Coherence and comparability

#### Comparability between BERD and HMRC statistics

HM Revenue and Customs (HMRC) publishes an annual report, [Research and Development Tax Credits Statistics](#). It contains detailed information about the number and value of research and development (R&D) tax credit claims made by UK businesses. The report also includes statistics on R&D expenditure that are used to support claims for tax credits. BERD measures R&D performed by businesses regardless of whether R&D tax credits are claimed for the work. In addition, HMRC's report includes comparisons of their R&D estimates, with those published by the Office for National Statistics (ONS).

More information on the comparability between BERD and HMRC statistics is available in our [Comparison of ONS business enterprise research and development statistics with HMRC research and development tax credit statistics article](#), published on 29 September 2022.

### OECD

The UK BERD statistics are supplied to the Organisation for Economic Co-operation and Development (OECD). The [UK R&D results are published by the OECD](#) alongside results from other countries to allow comparisons to be made between countries.

## Accessibility and clarity

The ONS's [Gross domestic expenditure on research and development \(GERD\) statistical bulletin](#), brings together estimates from the [Business enterprise research and development \(BERD\) statistical bulletin](#) as well as the other R&D sectors. The latest and previous editions of the bulletins are available on the ONS website. The publication comprises a brief bulletin with the main points from the latest estimates together with reference tables with estimates in current and constant prices.

The ONS's recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel. Our website also offers users the option to download the narrative in PDF format. For further information, please refer to our [accessibility statement](#).

## Timeliness and punctuality

The time between the end of the reference year and the BERD publication date is approximately 11 months, as the results are usually published in November each year. The results for the 2022 reference period were published in February 2024, 14 months after the reference period, because of the impact of development work on BERD throughout 2023.

In the event of a change to the release dates, public attention will be drawn to the change and the reason fully explained, as set out in the UK Statistics Authority's [Code of Practice for Statistics](#).

For more details on related releases, the [ONS release calendar](#) is available online and provides 12 months' advance notice of release dates.

## Concepts and definitions

Research and development (R&D) and related concepts follow internationally agreed standards defined by the [Organisation for Economic Co-operation and Development \(OECD\)](#), and published in the [Frascati Manual on the OECD website](#). An updated version of the manual was published in 2015, determining that to be classed as R&D, an activity has to be:

- novel
- creative
- uncertain
- systematic
- transferable and/or reproducible

R&D activity is distinguished by the presence of an appreciable element of novelty. If the activity follows an established pattern, it is excluded; if it departs from routine and breaks new ground it is included. For example: activities such as routine testing, market research, patent applications, trial production runs and artistic work are excluded. Overheads of R&D projects are included. Value Added Tax (VAT) is excluded.

The reclassification of R&D as an intangible asset in the European System of Accounts 2010 (ESA 2010) resulted in us carrying out the work to implement the change in the national accounts from treating R&D as intermediate consumption, to gross fixed capital formation.

## Regional statistics

Results for Great Britain are added to results for Northern Ireland to produce UK totals. These are broken down by UK country and region for our [Business Enterprise Research and Development \(BERD\) statistical bulletin](#).

## Sampling error

Sampling error arises when estimates are based on a sample rather than a full census of the population. The range of possible differences between the estimates derived from the sample and value that would be obtained from a census is referred to as the sampling error. Sampling errors are not currently provided in the Business Enterprise Research and Development (BERD) bulletin.

## Non-sampling error

Non-sampling errors are not easy to quantify and include errors of coverage, measurement, processing, and non-response. Despite adopting a new sample design there is still some difficulty in identifying the true population of actual or likely research and development (R&D) performers. It can also be difficult to ensure that businesses adhere to the Frascati Manual R&D definitions.

Response rates provide an indication of the likely impact of non-response error on estimates.

## Response accuracy

It is difficult to accurately quantify the effect of response inaccuracy, where the data reported by a respondent for a business does not reflect the true position. Questionnaires are tailored to capture businesses' R&D expenditure. Data are put through an editing and validation process that also helps to reduce inaccuracy.

## BERD calendar year results

BERD estimates relate to the calendar year. However, to reduce the burden on respondents, businesses have, and some use, the option to return data for their business year-end, covering any 12-month period up to and including the end of the financial year that follows the end of the calendar year. It is possible that, particularly if the economy is undergoing a period of rapid change such as during an economic downturn, the different reporting periods could introduce a small element of bias.

## Revisions

Data relating to the 2022 period have been revised in the 2023 BERD statistical bulletin. Revisions occur because of either late survey submissions, or because of changes made during the validation process at a later date.

## Why you can trust our statistics

The ONS is the UK's largest independent producer of statistics and its national statistical institute. We treat the data that we hold with respect, keeping it secure and confidential, and we use statistical methods that are professional, ethical and transparent.

# 6 . Methods used to produce the data

## How we collect the data

Our [Business Enterprise Research and Development \(BERD\) Survey](#) measures "business enterprises" as defined in the [Frascati Manual, published on the OECD website](#). This excludes government organisations and higher education establishments, as R&D information is collected from them by other means. From 2024, for the 2023 reference period, the same electronic questionnaire was sent to private non-profit organisations, which have previously been surveyed separately.

The survey uses an electronic questionnaire to collect respondent data. The statutory basis of the BERD Survey in Great Britain is the Statistics of Trade Act 1947 and in Northern Ireland, it is the Statistics of Trade and Employment (NI) Order 1988.

## Sample frame

BERD utilises the [Inter-Departmental Business Register \(IDBR\)](#), as explained in our article, as its main sampling frame and this is the same sampling frame used by the ONS for the majority of other business surveys. This is a change for BERD as, prior to the new sample design implemented for the 2022 reference period, the sampling frame was a reference list of expected R&D performers.

## Sample design

The ONS BERD Survey collects data from approximately 19,000 businesses in Great Britain. This is supplemented by data from the Northern Ireland BERD Survey conducted by the Northern Ireland Statistics and Research Agency (NISRA) covering approximately 1,500 businesses in Northern Ireland.

Of the 19,000 businesses sampled in Great Britain, approximately 800 are selected from a reference list of expected R&D performers that the ONS updates annually. The reference list comprises the top 400 businesses, in terms of R&D expenditure, identified in the previous year's BERD Survey together with 400 of the businesses that receive the largest R&D tax credits. Businesses claiming R&D tax credits can be identified, as the ONS has data sharing agreements in place with HM Revenue and Customs that permit limited and secure access to the R&D tax credit microdata solely for the process of preparing and processing the BERD Survey.

Sample selection is carried out using a stratified random sample design. Groups of businesses (strata) are defined by three criteria: employment size-band, BERD Product Groups (PG) and UK country. Sample selection occurs independently for each cell. When the sample is designed, the size of the sample in each cell is determined by an algorithm that distributes the sample among the cells to give the lowest predicted variance (uncertainty) in the estimates. This design is substantially more efficient (that is, it gives a much more precise estimate for the same sample size) than a simple random sample and is more accurate than a census with a poor response rate.

A sample re-optimisation will be carried out regularly to improve the efficiency of the sample estimation and reduce sampling variability as part of the regular process to improve estimates.

## Survey questionnaires

Sampled businesses will receive either a short or long questionnaire dependent on the size of the business. Both questionnaires request a calendar year report, from January to December. If this is not available, businesses are asked to provide the dates of the 12-month period they are reporting for. Estimates are acceptable if actual figures are unavailable.

Long-form questionnaires are sent to all businesses sampled from the ONS's maintained reference list; these are known to have been the larger R&D performers in Great Britain. For the remaining sample, all businesses with 250 or more employees receive a long form, while all businesses with under 250 employees receive a short form.

The [questions for the 2023 BERD Survey](#) are available.

For the 2023 reference period, the long-form questionnaire was sent to approximately 8,500 businesses. The long-form questionnaire asks:

- for a breakdown of capital and non-capital expenditure on in-house R&D
- for a description of the type of R&D performed (referred to as product group) and the type of research undertaken (basic, applied or experimental)
- whether R&D relates to civil and/or defence
- how in-house R&D expenditure for the survey year was funded
- for the value of any R&D that was purchased by the business
- for the number of employees working on R&D and the full-time equivalent (FTE)
- for the type of employees (researchers, technicians and support staff)
- for postcodes that relate to the workplaces where R&D is carried out

The short questionnaire was sent to approximately 10,500 businesses for the 2023 reference period, and asks:

- for expenditure on in-house R&D
- whether R&D related to civil and/or defence
- how much R&D was purchased
- the number of employees working on R&D

Questionnaires are usually dispatched annually each February with a return-by date of April the same year. To achieve optimum response, two written reminders are sent to businesses, the first in April and the second in May. All businesses that are expected to have a substantial impact on the survey (known as "key responders") that have not responded by the return-by date will be contacted and asked to return their BERD Survey prior to any BERD results being produced.

## **How we process, analyse and validate the data**

### **Editing and validation**

The use of an electronic questionnaire means data can be collected more quickly as responses can instantly be submitted to the ONS for editing and validation. The electronic questionnaire validates the business's return at the point of data entry to help improve the quality of the data reported. When the data are processed by the ONS, a validation system will flag records failing pre-programmed validation rules. The validation rules check for large changes in data year-on-year and that components sum to totals and identifies partially completed returns. The ONS may re-contact businesses to resolve these data issues.

### **Imputation**

Where important values are missing with submitted responses, these are imputed using methods designed to best reflect the missing values.

For imputation techniques to work effectively for BERD, data are grouped by product group (the type of R&D performed) and whether the R&D performed was either civil or defence work. These groups are referred to as imputation classes. Imputation methods are applied to three types of records: long-form non-responding businesses, long-form responding businesses whose data are in error, and short form non-responding businesses selected from fully enumerated strata.

If previous data are available, the mean of ratios imputation technique is applied. Mean of ratios imputation identifies the same responding businesses in the current and previous period (known as matched pairs) and calculates the average growth rate of these matched pairs. Where data for long form non-responding businesses exist in the previous period, these are carried forward and the mean of ratios is applied to those values. If previous data are not available, trimmed mean imputation is applied to key variables only. This takes a mean of similar cases, excluding outlying values and uses that to impute the missing value. As trimmed mean imputation is used to calculate estimates for key variables only, expansion imputation techniques are also used to produce estimates for the lower-level components.

Questions not collected on the short forms are all calculated based on the long-form R&D responders within the same imputation class.

### **Estimation**

As BERD is a sample survey and not a census, there are businesses performing R&D, which are listed on the Inter-Departmental Business Register (IDBR) but have not been selected for the BERD Survey. These non-sampled businesses are accounted for through expansion estimation. This is a new approach for BERD and was incorporated as part of the work to transform BERD for the 2022 Survey. Expansion estimation uses a weight which is applied to survey returns to estimate for the non-sampled businesses, non-responders or those businesses that provided invalid returns. This weight is calculated independently for each individual stratum. This provides an unbiased estimate of population totals under the assumption that the businesses with a valid response in each stratum are the same, on average, as all businesses in that stratum.

## Outliering

For the BERD Survey, outliers are defined as those returned values that are atypical when compared with similar businesses and have an overly large individual impact on estimated totals. When outliers are identified, the weight of the outlier is reduced to one, so that a business identified as an outlier does not have a large distorting effect on the estimates. The weights of other businesses in the same cell as the outlier are then recalculated. Outliering treatment is only applied to short-form respondents by where the top 5% of businesses are trimmed. Additional manual outliers can be made as part of the results quality assurance process.

## Statistical disclosure

Statistical disclosure control methodology is applied to BERD data. This is to make sure that information attributable to an individual business is not identifiable in any published outputs.

The [Code of Practice for Statistics](#), and specifically the pillar on trustworthiness set out practices for how individual data are protected from disclosure. The pillar includes the statement that “Personal information should be kept safe and secure, applying relevant security standards and keeping pace with changing circumstances such as advances in technology.” (Practice T6.3, Data governance). More information can be found on our [Disclosure control](#) web pages.

## How we disseminate the statistics and data

Our primary method of disseminating the data is through our [UK business enterprise research and development statistical bulletin](#) and as part of our [Gross domestic expenditure on research and development statistical bulletin](#).

Results are also supplied to the [Organisation for Economic Co-operation and Development \(OECD\)](#). The UK R&D results are published by the OECD to allow comparisons to be made between countries.

Results are also annually delivered to the [Secure Research Service \(SRS\)](#), which is a Trusted Research Environment (TRE). We give accredited or approved researchers secure access to a wealth of de-identified, unpublished data to work on research projects for the public good. Again, no information attributable to an individual business is identifiable in outputs from the SRS.

The ONS has been accredited by the UK Statistics Authority (UKSA) as a [Digital Economy Act \(DEA\) 2017](#) processor for the provision of data for research purposes.

We no longer provide R&D data to Eurostat under European Commission (EC) Regulation Number 995/2012 as the UK is no longer an EU member state.

## 7 . Other information

For information regarding conditions of access to data, please refer to the following links:

- our [Terms and conditions \(for data on the website\)](#)
- the UK government's [Copyright and licensing information in the National Archives](#)
- our [Accessibility statement](#)

## 8 . Cite this methodology

Office for National Statistics (ONS), last updated 3 January 2025, ONS website, [Business Enterprise Research and Development Survey QMI](#).

