UK gross domestic expenditure on research and development QMI

Contact: RandD@ons.gsi.gov.uk	Release date: 31 May 2017	Next release: To be announced

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1 . Methodology background

National Statistic	
Survey name	UK gross domestic expenditure on research and development QMI
Frequency	Annual
How compiled	A combination of sample and census based surveys and administrative sources
Geographic coverage	UK
Last revised	31 May 2017

2 . Executive summary

The purpose of the UK gross domestic expenditure on research and development (GERD) publication is to produce estimates of the total value of research and development (R&D) performed in the UK. Four sectors of the economy are measured, as defined in the Frascati manual, namely business enterprise (BERD), higher education (HERD), government (GovERD), which includes research councils and private non-profit institutions (PNP), and together these form GERD. This uniquely provides information on total R&D expenditure in the UK, and is the UK's preferred measure for international comparisons of R&D expenditure.

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. This sets out the methodology for collecting and using statistics about R&D in countries that are members of the OECD. The Frascati manual defines R&D 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.

As well as being included in the GERD publication, estimates from the four sectors' surveys that contribute to GERD are also transmitted to Eurostat to comply with EU Commission Regulation no. 995/2012 (PDF, 842.3KB).

This report contains the following sections:

- Output quality

- About the output

- How the output is created

- Validation and quality assurance

- Concepts and definitions

- Other information, relating to quality trade-offs and user needs

- Sources for further information or advice

3 . Output quality

This report provides a range of information that describes the quality of the output and details any points that should be noted when using the output.

We have developed [Guidelines for measuring statistical quality](#); these are based upon the five European Statistical System (ESS) quality dimensions. This report addresses these quality dimensions and other important quality characteristics, which are:

- relevance

- timeliness and punctuality

- comparability

- coherence

- accuracy

- output quality trade-offs

- assessment of user needs and perceptions

- accessibility and clarity

More information is provided about these quality dimensions in the following sections.

GERD is the measure used by the majority of commentators on R&D for international comparisons. It covers all R&D performed in the UK, irrespective of who pays for it, including funding from overseas. However, it excludes R&D performed overseas even if it is funded from the UK.

The components of GERD that relate to R&D performed in all sectors of the economy are:

- business enterprise

- higher education

- government – including research councils

- private non-profit organisations

Business enterprise

Estimates for the business enterprise sector are collected by the Business Enterprise Research and Development (BERD) Survey. This is conducted annually and the results are published in the [Business enterprise research and development statistical bulletin](#). In 2015, the business sector performed 66% of total UK R&D expenditure.

Full details of the methods used to produce the results for the business R&D sector are contained in a separate [BERD Quality and Methodology Information (QMI) report](#).

Higher education

Higher education data are provided by the Higher Education Funding Councils (HEFCs) for England, Scotland and Wales, and the Department for Employment and Learning in Northern Ireland. Additional data on external research funding from overseas, non-profit organisations and businesses are supplied by the Higher Education Statistics Agency (HESA). Data are provided to us during February, approximately one month before the GERD release is published. These timescales are the main reason for the timing of the GERD publication.

It is important to note that R&D funding provided to the higher education sector from government departments, research councils and HEFCs are collected as part of the Government Expenditure on Research and Development (GovERD) Survey.

Government (including research councils)

Estimates for the government sector are collected by the GovERD Survey. This is an annual census of approximately 140 government departments, including seven research councils. Government departments are asked to report the expenditure on R&D they perform, purchased R&D or funding provided for R&D and funding they receive for R&D. Estimates of R&D purchased from, or funding provided to, local authorities and NHS Trusts, serve as a proxy for R&D performed by these organisations as they are not surveyed directly.

The UK government owns many research institutes and laboratories that carry out R&D into various research areas. These are managed by a range of government departments, most notably the Department for Business, Energy and Industrial Strategy (BEIS), the Department for Environment, Food and Rural Affairs (DEFRA) and the Department of Health (DoH). The variety of R&D in the government sector includes research carried out by the Biotechnology and Biological Sciences Research Council, UK Atomic Energy Authority and the Food Standards Agency.

Private non-profit

Estimates for the private non-profit (PNP) sector are collected in a biennial survey that was introduced in 2011. The previous survey of the PNP sector ceased in 2005 due to difficulties producing robust estimates from a small number of organisations performing R&D in this sector. Estimates from this survey were used in the compilation of the 2011 GERD publication, the first time since the 2003 reference year. Previously, estimates had been based on a number of different sources.

The private non-profit sector includes registered charities and trusts that specialise in mainly health and medical research. This sector includes, for example, a number of cancer charities that carry out extensive research into all types of cancer prevention through to drug development and clinical trials.

The most recent survey was run in 2016 to collect 2015 data from an updated list of R&D performers in this sector. Results for PNP organisations performing R&D in 2014 were therefore estimated.

4 . About the output

Relevance

(The degree to which the statistical outputs meet users' needs.)

What it measures

GERD presents estimates of gross domestic expenditure on research and development in the UK carried out by the following sectors of the economy:

- business enterprise (BERD)

- higher education (HERD)

- government – includes research councils (GovERD)

- private non-profit (PNP)

Estimates are produced in current prices and constant prices, which have been adjusted for inflation. An R&D performer is an organisation that carries out R&D activities itself, instead of funding another organisation to undertake it.

Frequency

Estimates are published annually in March approximately 15 months after the year end. For example, 2015 GERD estimates were published in March 2017.

Sample size

The sample sizes for the four sectors are as follows:

- BERD – approximately 5,400 businesses (4,000 in Great Britain and 1,400 in Northern Ireland); there were approximately 4,600 responses in 2015

- GovERD is a census of all government departments; approximately 140 including agencies and research councils

- the PNP survey for 2015 was a census survey of approximately 200 non-profit organisations known to perform R&D

- HERD data are provided to us to cover all 164 UK higher education institutions

Periods available

GERD data are available from 1981.

Business and private non-profit estimates relate to the calendar year. Government estimates relate to the financial year and higher education estimates relate to the academic year.

Sample frame

The sample frame includes all known R&D performers. The sample frames are:

BERD – a reference list of approximately 31,400 known R&D performers in Great Britain and Northern Ireland. The reference list is updated annually, from a range of other sources, such as a question on the Annual Business Survey, but it should be noted that there is no definitive list of businesses that perform R&D. Further details are available in the BERD QMI.

HERD – data covers all 164 UK higher education institutions (HEIs). The list of these institutions is maintained by the Higher Education Statistics Agency (HESA) and each institution must complete an on- line survey. HESA provide data to the Higher Education Funding Council England (HEFCE) who carry out further analysis on the dataset and then provide this to us.

GovERD – a census survey of all UK government departments. There are approximately 140 including agencies and research councils that perform R&D and the list is updated annually prior to the survey. Sources that are used to keep the frame up to date include government websites like the UK Parliament site and the Cabinet Office. Each department is contacted 2 months before the survey to check changes in structure and responsibilities.

PNP – consists of approximately 200 non-profit organisations known to perform R&D. A reference list is maintained of these known R&D performers, which have been identified from previous surveys and proving exercises. Industries in this sector that have been identified as likely to perform R&D include library and archive activities, botanical and zoological gardens and nature reserve activities, engineering and design activities, and technical testing and analysis. All these are included in the sampling frame.

Weighting and estimation

BERD estimation uses a simple matched pairs methodology for long forms and ratio estimation for short forms. Full details are in the BERD QMI.

HERD is a census of all UK higher education institutions (HEIs). All universities provide required data to Higher Education Statistics Agency (HESA), otherwise they would receive financial penalties.

GovERD is a census of all UK government departments including research councils. The target response rate is 98%. Future estimates provided on previous surveys are used for any non-responding departments.

PNP is a census survey of non-profit organisations. The target response rate is 92% and non-responders were imputed. This was done by modeling the probability of a zero value, and if not zero we imputed the mean value from positive returns.

Outliers

This only currently applies to the BERD data – see the BERD QMI.

Uses and users

The primary use of GERD is to measure expenditure on R&D performed in the UK, to inform decision-making and assist policymaking.

There are various users within and outside government who use GERD data for analysis and policymaking. These include the following.

UK National Accounts – Changes introduced in the System of National Accounts (SNA) in 2008 and European System of Accounts (ESA) in 2010 specified that from 2014 onwards, R&D should no longer be considered as an ancillary activity and therefore used up in the production process as intermediate consumption. Instead, expenditure on R&D should be treated as investment in assets, which needed to be capitalised in the UK National Accounts. Therefore, since 2014, R&D expenditure has contributed to the compilation of the value of the UK's net worth and has been included as part of gross domestic product (GDP) estimates. See our ESA 2010 page for more information. The impact of this change has been to slightly increase the levels of GDP and slightly reduce the proportion of GDP spent on R&D.

European Union's Statistical Office (Eurostat) – The UK provides statistics measuring R&D activity in accordance with the European Commission Regulation No. 995/2012 of the European Parliament and the Council. The estimates in this publication are used to provide information that is consistent with other EU member states and to enable benchmarking to be achieved. Europe 2020 targets for economic growth include 3% of the EU's GDP (both private and publicly funded) to be invested in R&D by 2020. This means that estimates in this release are useful in monitoring progress towards this target. It should be noted that at the time of the GERD publication, Eurostat has already published provisional estimates for EU member states' gross expenditure on R&D for the reference year. The provisional estimates for the UK published by Eurostat were based on projections and so users are advised to use estimates from the GERD release for UK R&D expenditure when making comparisons with other countries.

Organisation for Economic Co-operation and Development (OECD) – Uses GERD data for constructing internationally comparable data tables and producing regular statistical publications such as the Main Science and Technology Indicators (MSTI) and the Analytical Business Enterprise Research and Development database (ANBERD). The data are also used for analytical studies, which underpin economic analysis and policy reviews.

The Department for Business, Energy and Industrial Strategy (BEIS) – Uses GERD data to assess policy impact. R&D data underpin their assessments of UK research and innovation performance.

Welsh Government and Scottish Government – Both use GERD data as an important indicator for measuring the performance of their respective economies, as well as to monitor and develop policies that seek to increase R&D investment. Regional GERD information is also published in the Scottish GERD tables.

Her Majesty's Revenue and Customs (HMRC) – Uses GERD data to support analysis and advice on policy development.

Department of Finance (DOF) in Northern Ireland – Carries out its own annual survey into R&D and provides us with data for inclusion in the UK published results.

The Research and Development Society is a UK-based organisation formed to promote the better understanding of R&D in all its forms. The Society makes use of GERD data, as an important source of information for understanding how much UK businesses are investing in R&D on an annual basis and to inform wider debates.

Her Majesty's Treasury (HMT) – Uses GERD data for policy and analysis.

Timeliness and punctuality

(Timeliness refers to the lapse of time between publication and the period to which the data refers. Punctuality refers to the gap between planned and actual publication dates.)

The time between the end of the reference year and publication is approximately 15 months. The results are usually published in March each year. It is not possible for us to bring forward the publication of the GERD bulletin because estimates for the higher education sector are provided to us around the middle of February each year. Allowing time to quality assure the datasets, the earliest that these estimates can therefore be published is in March.

In the unlikely 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 Code of Practice for Statistics.

For more details on related releases, the government statistics publication calendar is available online and provides 12 months' advance notice of release dates. If there are any changes to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change will be explained fully at the same time, as set out in the Code of Practice for Statistics.

5 . How the output is created

Data collection

Estimates for the four sectors of GERD are compiled as follows.

BERD – Paper questionnaires are sent to businesses. The BERD QMI provides more detailed information.

GovERD – All UK government departments are sent an Excel-based questionnaire via Secure Electronic File Transfer (SEFT). Government departments are provided with detailed notes that accompany the GovERD survey to ensure that they adhere to the Frascati manual definitions of R&D. The completed questionnaires are also returned to us via SEFT. Research councils are included in the annual government survey and their expenditure is shown separately in the published data tables.

HERD – Higher Education R&D data are provided by the Higher Education Funding Councils for England, Scotland, Wales and the Department for Education in Northern Ireland. Data are also obtained from them on the external research funding from abroad, non-profit organisations and businesses. The timeliness of these data is the main reason for the delay in publication of GERD. Data are provided to us during February of a given year.

PNP – Paper questionnaires are sent to businesses and the survey is operated in a very similar way to the BERD survey. The questionnaire asks the same questions as on the BERD questionnaire, apart from not asking respondents to provide a product group that relates to their R&D activity.

6 . Validation and quality assurance

Accuracy

(The degree of closeness between an estimate and the true value.)

Sampling error

Sampling errors arise because the variable estimates are based on a sample rather than a full census of the population. The difference between the estimates derived from the sample and the true population values is referred to as the sampling error. Standard errors are not produced as part of GERD as some of the sources are census collections, and therefore not subject to sampling error.

Non-sampling error

Non-sampling errors are not easy to quantify and include errors of coverage, measurement, processing and non-response. There is some difficulty in identifying the population of actual or likely R&D performers and also difficulties in ensuring that organisations adhere to the Frascati manual R&D definitions. However, response rates are high and attempts are made to minimise response bias by questionnaire design reviews.

Revisions policy

Estimates are revised in accordance with our revisions policy. The majority of revisions are due to misreporting and the late receipt of data. For BERD, results from the previous two years are open to revision. GovERD and HERD can both be revised for longer than two years and this then impacts on GERD since GERD is a combination of the BERD, GovERD, HERD and PNP series.

Discontinuities in data

The BERD, GovERD and PNP questionnaires were redesigned after the 2010 survey to better reflect user needs to address concerns about data quality, difficulty in completion and to include new national accounts and EU requirements. These followed large revisions to both the BERD and GovERD surveys for the 2007 data collections.

While all these changes are viewed as being an improvement, they may have an impact on the comparability of data over time. Unfortunately, it is not possible to measure this impact.

General information

Points to be noted when examining dataset tables:

- there may be differences between totals and the sum of their independently rounded components

- in addition to being analysed by sector of performance, GERD may be analysed by sector of funding; the R&D performed by any one sector of the economy can be funded by any of the other sectors, or by the performing sector itself

- the recommended practice of the Organisation for Economic Co-operation and Development (OECD) is to use information from those performing R&D, where this is available; these estimates are considered more reliable than those from surveys of R&D funders

- it is sometimes necessary to suppress figures for certain items to avoid disclosing data from individual institutions; tables containing disclosive data will contain a relevant footnote

- note that £1.0 billion equals £1,000 million in this release

Regional data

Regional estimates are produced for the four sectors as follows.

Business enterprise – See the BERD QMI for information on how regional results are produced.

Higher education – estimates for the four countries of the UK are co-ordinated and provided by the Higher Education Funding Council for England (HEFCE) and are based on the geographic region of all UK Higher Education Institutes (HEIs).

Government – The method used to produce regional estimates of expenditure on R&D for the government sector has been reviewed and improved. Until the 2015 survey, estimates used departments' full-time equivalent (FTE) R&D employees by region as a proxy to calculate regional expenditure. Departments now provide actual breakdowns of their R&D expenditure by region. To allow comparison of the government data, values using both methods were included in Table 6 of the datasets accompanying the 2015 GERD bulletin. Due to this change in methodology it is possible to compare regional GERD estimates on a comparable basis between 2014 and 2015.

Private non-profit – each organisation is asked to provide the workplace postcodes for all the sites that perform R&D and allocate the total expenditure figures of the organisation to the sites on a percentage basis. As this survey is a census, any non-responder's expenditure estimates are allocated regionally using the county region codes from the business register.

Comparability and coherence

(Comparability is the degree to which data can be compared over time and domain, for example, geographic level. Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar.)

Estimates of government departmental R&D expenditure were previously published by the Department for Business, Innovation and Skills as Science, engineering and technology statistics. From 2014, we have been responsible for publishing these statistics in the UK government expenditure on science, engineering and technology statistical bulletin. This includes estimates on a net expenditure basis (in-house R&D performed), plus purchased or funding provided for R&D, less funding received for R&D. This differs to the GERD publication where estimates are based solely on in-house R&D performed.

Defence Analytical Services and Advice Agency (DASA) provides professional analytical, economic and statistical services and advice to the Ministry of Defence (MOD), and defence-related statistics to Parliament, other government departments and the public.

Government departments are provided with detailed notes that accompany the GovERD survey to ensure that they adhere to the Frascati manual definitions of R&D.

In response to a UK Statistics Authority requirement to improve published information on the coherence of R&D statistics, which was reported in the Assessment of Compliance with the Code of Practice for Statistics: Statistics on Research and Development, we published an Information note on 20 November 2012. This information note concludes "that BERD and GERD statistics are consistent with most other National Statistics relating to R&D available from other departments".

7 . Concepts and definitions

(Concepts and definitions describe the legislation governing the output, and a description of the classifications used in the output.)

The provision of the information contained in the GERD output is required under EU legislation, Regulation (EC) no.995/2012.

R&D activity is characterised 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 updated Frascati manual introduced in 2015 included five new important criteria to help determine whether an activity should be regarded as R&D, for the purposes of R&D surveys that contribute to GERD. These criteria are that R&D work should be:

- novel – new findings that support new concepts, products and processes

- creative – original and not obvious

- uncertain – the final outcome cannot be predicted

- systematic – to be planned, budgeted and outcomes documented

- transferable or reproducible – to lead to results that could be reproduced

Work needs to meet these five criteria to be regarded as R&D for the purposes of the GERD bulletin.

Organisation for Economic Co-operation and Development (OECD) terminology is used throughout the statistical bulletin. "Government" corresponds to the "general government" sector of the national accounts and includes local as well as central government. "Business enterprise" corresponds to the "corporate" sector and includes public corporations and research associations as well as commercial and industrial companies. "Private non-profit" corresponds to the "personal" sector of the national accounts, except that higher education institutions are excluded and put into a separate OECD sector ("higher education"). "Abroad" corresponds to the "overseas" sector.

8 . Other information

Output quality trade-offs

(Trade-offs are the extent to which different dimensions of quality are balanced against each other.)

For the purposes of estimation, the recommended practice of the OECD is to use information from those performing R&D where this is available. These estimates are considered more reliable than those from surveys of R&D funders. This is why, in the UK GERD datasets, the estimate of businesses' R&D funded by government is taken from the business enterprise R&D survey rather than the government R&D survey.

Assessment of user needs and perceptions

(The processes for finding out about users and uses, and their views on the statistical products.)

Some users would like more regional data breakdowns and also more detailed information on R&D employees. The size of the R&D surveys means that it is very difficult to produce these extra variables as the number of respondents would be so small that they would be considered statistically unreliable. The additional cost and burden on respondents is also an important factor in not increasing sample sizes.

9 . Sources for further information or advice

Accessibility and clarity

(Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the release details, illustrations and accompanying advice.)

Our 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. In some instances other software may be used, or available on request. Available formats for content published on our website but not produced by ourselves, or referenced on our website but stored elsewhere, may vary. For further information please refer to the contact details at the beginning of this document.

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

- [Terms and conditions](#)

- [Accessibility](#)