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QUALITY REPORT

Research and Development in Sweden

Subject area
Education and research

Statistical area
Research

Product code
UF0301

Reference time
2023

Sveriges officiella statistik

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Quality of the statistics

1 Relevance

1.1 Purpose and information needs

1.1.1 Purpose of the statistics

The purpose of the statistics is to provide an overall picture of the resource inputs used for research and development (R&D) activities in the Business enterprise sector, the Government sector, the Higher education sector, the Private non-profit sector and Sweden as a whole.

The statistics are mainly produced to enable decision-makers, researchers and other stakeholders to follow the development of Swedish R&D activities. The statistics enable comparisons between different performers within the country, within the EU, over time and between EU countries.

1.1.2 User information needs

One of the main users of the statistics is the European Commission, which also commissions the statistics. The Commission needs statistics that are comparable across EU countries, which requires a high level of compliance with international standards and definitions. Good comparability over time is also of great importance for the Commission. Internationally, the OECD is also an important user of R&D statistics.

Among national users, the Ministry of Education and the Ministry of Climate and Business are the most important users. They need to be able to follow developments and comparability over time is therefore of great importance. Among other things, the statistics form a basis for the Budget Bill. The data are also used internally by Statistics Sweden for national accounts purposes.

In order to obtain information about user needs and to be able to discuss key issues concerning R&D statistics, Statistics Sweden has a user council for R&D statistics. The following organisations are represented:

- Ministry of Education
- Ministry of Climate and Business
- Swedish Agency for Innovation Systems (VINNOVA)
- Growth Analysis
- Swedish Research Council
- Swedish Agency for Economic and Regional Growth
- University Chancellor's Office
- Institute for Business Research
- Research Institutes of Sweden (RISE)
- Technology enterprises
- Lund University
- Swedish Association of Local Authorities and Regions

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In the user council for R&D statistics, changes and opportunities for development in the statistics are discussed.

1.2 Content of the statistics

The main target variables measured by the statistics are expenditure on intramural R&D and personnel in intramural R&D activities. The content of the statistics is primarily regulated under EU Commission Implementing Regulation 2020/1197[1]. The regulation defines the scope of the statistics in terms of target variables, domains and reference periods. In order to meet national information needs, statistics in some cases go beyond what is specified in the EU regulation in terms of scope and level of detail.

1.2.1 Unit and population

The statistics cover all institutional units in Sweden, broken down into four sectors: Business enterprise sector, Government sector, Higher education sector and Private non-profit sector. For all sectors, the population of interest consists of all institutional units which, according to the definitions set out in the Frascati Manual[2] (Chapters 7 to 10), belong to the sector. The target populations for each sector are limited to those entities that perform intramural R&D or, for the Business enterprise sector and the Government sector, finance R&D carried out by others (extramural R&D). The target populations are thus a subset of the interest populations and constitute the part of the population that is relevant to measure in terms of R&D.

Business enterprise sector

For the reference year 2023, two target populations have been surveyed for the Business enterprise sector: one consisting of enterprises with 10 or more employees and one consisting of micro-enterprises (with 1 to 9 employees). Otherwise, these two target populations are defined in the same way and comprise all private and state-owned financial and non-financial enterprises operating in Sweden that conduct or finance R&D. The target populations also include private non-profit organisations that are market producers or that serve only enterprises. Private higher education institutions are not included in the target populations of the sector, but instead belong to the target population of the Higher education sector.

For more information, see the Frascati Manual Chapter 7.

The target units of the survey are enterprise units (hereinafter referred to only as enterprises) and the observed units are legal units. In cases where enterprises consist of only one legal entity, the target unit and the observed

[1] Commission Implementing Regulation (EU) 2020/ of 30 July 2020 laying down technical specifications and procedures pursuant to Regulation (EU) 2019/2152 of the European Parliament and of the Council on European business statistics, and repealing 10 legal acts in the field of business statistics.
[2] Frascati Manual 2015, OECD

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unit coincide. For enterprises consisting of several legal entities, there is a difference between the target unit and the observed unit. However, the selection of observed units is designed to minimise this discrepancy.

Government sector

The target population for the Government sector consists of government agencies, regional and municipal institutional units in Sweden, and public non-profit organisations performing or financing R&D. The exceptions to this are state-owned universities and colleges that instead belong to the target population for the Higher education sector and state-owned enterprises and enterprises that belong to the target population for the Business enterprise sector.

For more information, see the Frascati Manual Chapter 8.

The target unit of the survey is the institutional unit[3] and the observed units are legal units. In practice, there is no difference between the target unit and the observed unit.

Higher education sector

The target population for the Higher education sector consists of private and public universities and colleges performing R&D, as well as research institutes, experimental stations and clinics whose R&D activities are controlled or administered by tertiary education institutions.

For more information, see the Frascati Manual Chapter 9.

The target unit for the sector is the institutional unit. For economic variables, the observed units are legal units that well with the target units. For personnel variables, the observed units are positions at the institutional units. In order to measure the personnel variables for the target units, a large number of observed units per target object are used.

Private non-profit sector

The target population of the Private non-profit sector consists of non-commercial organisations and private non-profit organisations serving households, i.e. the general public, as well as private individuals and households. In addition to non-profit organisations, the sector also includes individuals and households. Higher education institutions operating in the form of foundations are not included in the target population for the sector, but are instead included in the target population for the higher education sector.

For more information, see the Frascati Manual Chapter 10.

[3] Institutional unit is a concept from national accounts that in principle includes all units (enterprises, authorities, organisations, etc.) that can make economic decisions.

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The target unit of the survey is the institutional unit and the observed unit is the legal units. In all instances, the target unit and the observed unit coincide.

1.2.2 Variables

The main target variables of the statistics are:

- Expenditure on intramural R&D
- Expenditure on extramural R&D
- Personnel in intramural R&D activities

Definitions of what constitutes R&D can be found in the Frascati Manual.

The target variables and the interest variables do not differ. The observation variables are consistent with the target variables in most cases. However, in the Higher education sector, a combination of observation variables on revenue for research and post-graduate education and on personnel working hours and working time distribution is used to estimate the target variables expenditure on intramural R&D and R&D personnel.

1.2.3 Statistical measures

The statistics on expenditure are presented in current prices in millions of kronor (SEK). Personnel variables are reported as number of persons (head counts) and full-time equivalents. Full-time equivalents are a measure of human resources corresponding to the effort of a full-time worker over one year. Thus, an individual working half-time on R&D throughout the reference year represents 0.5 FTE. For a few variables, proportions are also used as a statistical measure.

1.2.4 Study domains

The target variables of the survey are estimated and reported for different domains. Statistical tables covering all sectors contain expenditure on intramural R&D and R&D personnel by sector and region. Expenditure on extramural R&D is reported by sector. Below is an overview of the classification criteria in each sector used to create the domains.

Business enterprise sector

Expenditure on intramural R&D is reported by industry, size class and by region.

Expenditure on extramural R&D is reported by industry.

R&D personnel are reported by industry, size class and region. The classification is based on accepted standards; industry by SNI2007[4] and region by NUTS[5].

[4] Standard for the classification of economic activities in Sweden (SNI).
[5] EU regions - NUTS (scb.se).

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Government sector

Expenditure on intramural R&D and extramural R&D and R&D personnel is reported by subsector and region. The classification is based on accepted standards; region by NUTS.

Higher education sector

Expenditure on intramural R&D is reported by higher education institution and region.

R&D personnel are reported by higher education institution, type of higher education institution, gender, region, field of research and development, category of employment, scope of employment and level of education. The classification is based on accepted standards; region by NUTS, field of research and development by FORD[6] and level of education by ISCED2011[7].

Private non-profit sector

Expenditure on intramural R&D and R&D personnel are reported only as sector totals.

1.2.5 Reference times

The reference time for all variables is the calendar year 2023.

2 Accuracy

2.1 Overall accuracy

The statistics are based on five in-depth surveys and register data from the business register, as well as the registers of the Swedish Higher Education Authority (Universitetskanslersämbetetet) Employees in higher education and Doctoral students and degrees in third-cycle education. The accuracy of the statistics is thus affected by both the quality of the data collected and the administrative data.

The estimation procedure is largely the same for the Business enterprise sector, the Government sector and the Private non-profit sector. For all these, census surveys are carried out, i.e. all units in the frame population are surveyed. The estimation procedure used is therefore a summation of the data collected.

For both the Business enterprise sector and the Private non-profit sector, the EZS method is used to protect sensitive data by adding a random noise to the data. This reduces accuracy but enables a larger amount of data to be published without the risk of disclosing confidential data. There is no measure of the uncertainty added by the EZS method as the protection itself lies in users not knowing the size or direction of the noise. However, the method is designed in such a way that the noise is greatest where the risk of disclosure is

[6] Standard for the Swedish classification of research subjects.
[7] International Standard Classification of Education, ISCED2011.

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high and minimized where the risk of disclosure is small. At the aggregate level, therefore, the impact on accuracy is very small. For a more detailed description of the method, see section 2.7.4 Confidentiality in the Methodology Report.

The statistics for the Higher education sector are based on two surveys. The economic statistics are based on a census survey, while the personnel statistics are based on a sample survey. The estimation procedure for the target economic variables is based on a number of different modelling assumptions: (i) that income received by the higher education institution over the course of a year can be equated with expenditure over the same period; (ii) that the costs associated with different types of work activities are the same; and (iii) that the distribution of investments by source of funds is the same as that of current costs.

The estimation procedure for the target personnel variables for the Higher education sector is based on the Horvitz-Thompson estimator with non-response-compensated weights. The method is based on the assumption that object non-response can be represented by the reporting objects within the same stratum. The uncertainty caused by the method is estimated in the form of 95% confidence intervals. This means that the true value of a variable with a 95 percent probability is within the specified range. For 2023, total R&D personnel in the sector are estimated at 21 730 FTEs, with a confidence interval of +/- 435 FTEs. This means that the sector's R&D personnel, with a likelihood of 95 %, was between 21 295 and 22 165 FTEs in 2023.

Both preliminary and final statistics are published. The estimation procedure for the preliminary statistics is the same as for the final statistics in all sectors. However, the accuracy of the preliminary statistics is judged to be lower as the data collection is not completed when the preliminary statistics are produced and the non-response is therefore greater. The extent to which a larger non-response affects accuracy depends largely on whether some important, large enterprises have not responded.

Statistical values for Sweden are estimated by summarising the data for each sector. This means that the accuracy of sector-specific data affects the accuracy of aggregates for the whole country. Since more than 70 per cent of the R&D carried out in Sweden is carried out in the Business enterprise sector, this sector has the greatest impact on the accuracy of the aggregates for Sweden.

The overall assessment is that the accuracy of the statistics is high. Statistics Sweden uses established standards, both national and international, to ensure comparability both over time and between countries. The coverage of the registers used in the production of statistics is judged to be good, but some measurement errors may occur. As register data are only used to create study domains and not to measure the target variables, this does not affect the accuracy of total estimates for any sector. On the other hand, it has an impact on the accuracy of some domains.

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2.2 Sources of uncertainty

The main source of uncertainty in R&D statistics is measurement. The data collected is rarely directly available to respondents and misinterpretations or inaccurate estimates may reduce the accuracy of the statistics. For personnel statistics in the Higher education sector, non-response is also a significant source of uncertainty.

2.2.1 Sampling

The majority of the underlying surveys include all units in the frame population, i.e. they are census surveys, and thus there is no sampling uncertainty. The exception to this is the survey measuring personnel variables in the Higher education sector.

Higher education sector

Estimates of the target economic quantities are based partly on a census survey and partly on data from the time-use survey in the same sector. The sample uncertainty that exists for the time-use survey thus also affects the economic variables.

The estimations of the target personnel variables are based on a sample survey where the sample is a subset of the sampling frame delimited from the register Employees in higher education. The sample is a systematic sample within strata. Sample uncertainty, in the form of a 95% confidence interval, is estimated and reported together with the point estimates of the number of full-time equivalents and the number of persons, respectively. The confidence interval for total R&D personnel in 2023 is presented in section 2.1.

2.2.2 Frame coverage

Business enterprise sector

The frame population consists of all enterprises identified as likely to engage in or finance R&D with at least 10 employees, regardless of industry. Research institutes are included in the frame population regardless of the number of employees. In addition to these, all enterprises in Scientific Research and Development (industry division 72 according to SNI) with at least 10 employees and enterprises with more than 199 employees, regardless of industry, that are not identified in any of the data sources are included.

In addition to this population, micro-enterprises, enterprises with 1-9 employees, from all sectors were also surveyed for the reference year 2023. The frame population for micro-enterprises was limited to enterprises that used the tax deduction for R&D personnel for at least one month in 2023.

Over-coverage consists of enterprises that have not performed or financed R&D during the reference year and enterprises that are no longer active at the time of the survey. The under-coverage consists of enterprises that were not identified in any of the data sources despite having performed or financed

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R&D in the reference year or that were created after the frame population was established. Statistics Sweden's business register from November 2023 was used in this survey to find active enterprises.

For the reference year 2023, the over-coverage of the population of at least 10 employees amounted to 54 percent. Among micro-enterprises, the over-coverage was 27 percent. Over-coverage has no impact on the accuracy of the statistics. The under-coverage is also considered to have very limited impact on the accuracy of the statistics. R&D activities in the Business enterprise sector are largely concentrated in a small number of large enterprises (the ten largest enterprises accounted for around 50 percent of R&D expenditure in 2023) which are well known. To the extent that there is under-coverage, it concerns smaller providers that have little impact on the statistics.

Government sector

The frame population consists of government agencies, regions, municipalities, local and regional R&D units, and public non-profit organisations. There is no systematic under-coverage in these sub-sectors and the frame population is considered to cover the target population very well.

Some under-coverage may occur among the public NPIs and R&D units (municipal associations) as some exclusions are made when they are included in the frame population. The R&D activities that may not be included are considered to be negligible. Over-coverage consists of organisations that have indicated that they do not have any form of R&D activity in the reference year. For the reference year 2023, the over-coverage was 44 per cent and mainly consisted of municipalities and government agencies whose main tasks do not include conducting or financing R&D. As R&D activities can occur sporadically among these, they are included in the frame population. Over-coverage has also occurred to a small extent when organisations that were dismantled during the reference year were included in the survey.

Higher education sector

The frame population for measuring the economic target variables consists of higher education institutions that have reported revenues for research and doctoral education for the reference year to the Swedish Higher Education Authority. There is no over-coverage in the survey. Under-coverage may occur if there are HEIs engaged in R&D without reporting any revenue for research and doctoral education. In such cases, the research activity is likely to be very limited. Thus, any under-coverage is deemed to have a negligible impact on the accuracy of the statistics.

The frame population used to measure the personnel target variables is delimited from the register Employees in higher education. This is a register of all positions of employment at Swedish higher education institutions in October of the reference year. The frame is limited to services which are likely

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to include R&D activities at the higher education institutions belonging to the frame population for the economic survey.

Under-coverage occurs when positions are added at the higher education institutions belonging to the target population after October but before the end of the reference year. As it is not known in advance which positions include R&D activities, under-coverage may also occur if positions involving R&D are excluded from the frame. Another source of under-coverage applies to non-employees, also known as external personnel. This subset is not measured by survey data collection but by a model estimate based on register data from the Swedish Higher Education Authority's register Doctoral students and degrees in third-cycle higher education. However, this frame population only includes doctoral students with external funding while other external staff are not included. Overall, uncertainty due to the frame coverage has little impact on the accuracy of statistics for the higher education sector. However, for external R&D personnel statistics, under-coverage contributes to significant uncertainty.

Private non-profit sector

The frame population for the Private non-profit sector is delineated based on information from administrative data sources. Probable R&D performers are identified based on the organisation's purpose according to the statutes, the organisations industry, or that the organisation has received support for R&D or innovation activities from the R&D funding authorities. Under-coverage can thus occur if organisations with R&D activities are wrongly excluded from the frame. Over-coverage in the form of organisations reporting that they did not perform R&D in the reference year also occurs. The assessment is that uncertainty due to the frame coverage has little effect on the accuracy of the statistics.

2.2.3 Measurement

All sectors are surveyed using questionnaires. The measuring instrument is primarily web forms, but the Higher education sector survey also includes a paper form and an Excel template. In order to prevent logical inconsistencies in the data, the online forms contain various automated checks that will be triggered if a respondent enters data that contain logical errors. These controls can be either soft or strict[8]. As a complement to the forms, there are also instructions where concepts are defined in more detail and examples are given of how the concepts should be interpreted. A more detailed description of the

[8] A soft check alerts the respondent that something in the submitted data may be wrong by a prompt appearing on the page. However, the respondent does not need to adjust the data and can proceed to submit the form. This differs from strict controls whereby the respondent cannot submit the form without adjusting the data flagged.

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measuring instruments can be found in the documentation 'Production of statistics' on the product website[9].

Measurement errors are the main source of uncertainty for several sectors in the survey. The target variables that the survey intends to measure can be difficult to interpret, which can lead to uncertainty in the measurement. In addition, the requested data are not always directly available in the financial and human resources systems of the respondents. In order to provide data, estimates may be required, which also adds uncertainty.

In order to minimize the risk of measurement errors, a review by the Cognitive Lab is always carried out when changes are made to the questionnaire. The purpose of the review is to ensure a natural flow through the questionnaire, that questions are formulated in a way that makes it easy for the respondent to understand what information is to be provided and that all necessary additional information, such as definitions, examples or explanations, is included in the form.

Business enterprise sector

Data to measure the majority of target characteristics for the enterprise sector are collected through a web form. Due to the automatic checks implemented in the web form, logical errors are very rare. To the extent that such errors occur, they can be detected through data validation and corrected by re-contacting the respondent. Other types of measurement errors may also occur, for example, many respondents find it difficult to delineate R&D from more routine development activities in many cases, in particular in gaming and other software development. These errors are more difficult to detect and can therefore contribute to uncertainty in the statistics.

In a few cases there are also model calculations. In the survey, enterprises with at least 200 employees are only required to provide a regional breakdown of their R&D expenditure. This distribution is then also used to model the distribution of R&D personnel. Enterprises with fewer than 200 employees in industries where R&D activities are usually small respond to a slightly shorter survey, where a breakdown of expenditure on intramural R&D per region is not requested. Instead, all R&D expenditure and R&D personnel are attributed to the region in which the enterprise is located according to Statistics Sweden's business register (FDB).

Government sector

Data to measure the majority of target characteristics for the Government sector are collected through a web form. Automatic checks in the web form prevent logically inconsistent data, but other types of measurement errors

[9]Product page for Research and Development in Sweden, www.scb.se/uf0301.

may also occur. The assessment based on contacts with respondents is that there are no systematic measurement errors for the sector.

Model calculations are used for some distributions of R&D personnel. The distribution of R&D personnel by field of research and development is modelled by means of a flat rate, which is based on the distribution of R&D expenditure between the fields of research and development. For government agencies, the regional distribution of R&D personnel is also modelled based on the regional distribution of R&D expenditure. The model has been compared against previously collected data for these distributions and the consistency has been good. Therefore, model assumptions are not considered to contribute to bias in the statistics.

Higher education sector

The economic variables are collected through an Excel template in which higher education institutions are asked to allocate their revenues for research and doctoral education by funding source according to fields of research and development. The form is comprehensive and consists of a total of 984 cells to be filled in. As a result, several HEIs have developed models or templates for distributing revenues. In some cases, these models cause errors in the data. To the extent that there are logical errors, such as the sum of sub-items exceeding the total, this can be detected and corrected in the data validation process. Other types of errors are more difficult to detect and may contribute to statistical uncertainty. However, the assessment is that the errors are minor and the impact on the accuracy of the statistics is therefore limited.

The time-use survey is collected using both a web form and a paper form. Around 10 percent of the responses are received via paper forms where it is not possible to have automatic checks. As participation is voluntary, the number of checks in the online form is also limited and there are only soft checks. This means that there may be errors in the collected data. Logical errors such as the fact that the distribution in shares does not sum up to 100 percent can be detected and corrected in the data validation process. Another error that may occur is proximity bias. This means that the respondent only takes into account short-term circumstances, despite the fact that the reference period for the survey is for the full calendar year. Such errors cannot be detected in the data validation process and thus contribute to uncertainty in the statistics.

Administrative data used to create domains for R&D personnel statistics are retrieved from UKÄ's register Employees in higher education. Data on the scope of employment and field of research and development are collected from the higher education institutions' administrative systems and there are no indications of significant measurement errors. The register also contains data derived from other registers, such as the Register of Educational Attainment of the Population and the Register of the Total Population. The Register of Educational Attainment of the Population contains known errors

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in the measurement of the level of education related to qualifications obtained outside Sweden. This affects accuracy as the statistics are broken down by level of education. Otherwise, the data from these registers are considered to be of good quality.

2.4.4 Non-response

There are two types of non-response: unit non-response and item non-response. Unit non-response occurs when a unit does not respond to the survey, while item non-response occurs when a unit has responded to the survey but not to all questions. In general, non-response, both unit non-response and item non-response, is limited as all questions are subject to the obligation to answer except for non-profit organisations, for which some items are voluntary, and the time-use survey in the Higher education sector.

Table1. Number of respondents and response rate per sector.

Sector	Number of respondents	Response rate
Business enterprise sector		
1-9 employees	1 512	80 %
10 or more employees	3 913	86 %
Government sector	502	90 %
Higher education sector		
Economic survey	39	100 %
Time-use survey	5 494	44 %
Private non-profit sector	85	90 %

Business enterprise sector

Enterprises are obligated to provide data to Statistics Sweden and the unit non-response rate was therefore low (see Table 1). Data for nine key R&D performers who did not respond were manually imputed. Non-response compensation for the remaining enterprises has been carried out by post-stratification followed by imputation of the averages within each stratum. The method is based on the assumption that the non-response can be considered completely random.

Item non-response occurs to some extent for all variables, but its effects are deemed to be limited. Variables where item non-response occurs to a greater extent are external personnel (consultants and other hired personnel), in head counts and full-time equivalents, broken down by gender and occupation as well as the number of doctoral graduates.

Government sector

The obligation to provide data applies to government agencies, municipalities, regions and municipal associations, which means that the unit non-response

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in the sector is very low (see Table 1). For public non-profit organisations, the reporting obligation applies only to certain parts of the survey. Manual imputation has been performed to compensate for unit non-response in the case of one government agency and three municipalities that were assessed as having significant R&D activities in the previous reference year and their R&D activities were considered continuous. After non-response compensation, the underestimation caused by unit non-response is considered to be small.

Partial non-response has occurred for issues of extramural R&D among public non-profit organisations as these issues have not been subject to data obligations for these organisations. The public non-profit organisations that are deemed to have significant expenditure on extramural R&D and thus have disrupted the effect on the statistics have submitted complete answers. Otherwise, partial non-response has occurred to a small extent and is mainly due to the fact that reporting agents have had difficulties in allocating sums. The assessment is that the partial non-response has only a limited impact on the accuracy of the statistics.

Higher education sector

The response rate in the survey that estimates the economic target characteristics is 100 percent, which means that there is no unit non-response. Item non-response does not occur.

For the time-use survey estimating the personnel target characteristics, the un-weighted unit non-response amounted to 56 percent for the reference year 2023. Item non-response also occurs due to the fact that participation in the survey is voluntary. In case of item non-response, this is compensated by imputation. In case of unit non-response, weighting within strata is used as the method for non-response compensation. The method is based on the assumption that the non-response can be considered completely random. If this is not the case, there is a risk that the estimates may contain biases. Since no non-response analysis is carried out, it is not possible to say with certainty whether such biases occur or not.

Private non-profit sector

The response rate among private non-profit organisations was 90 percent for the reference year 2023. Since the reporting obligation does not apply to all questions in the survey, there is some item non-response. This is compensated by imputation and is considered to have little impact on the accuracy of the statistics.

2.2.5 Data processing

Processing errors can occur during data registration, calculations or during data validation. For all surveys using an online questionnaire, automatic data registration with built-in checks on the plausibility of the data are included in the questionnaires. The purpose of this is to be able to identify incorrect data that may have a distortive effect on the statistics.

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In addition to the built-in checks in the web forms, the collected data are reviewed to find outliers that have a distortive effect on the estimation of the target variables. Overall, the impact on the accuracy of the statistics due to errors in the processing of data is assessed to be small.

In the time-use survey in the Higher education sector, only logical errors are reviewed and corrected. No contact is made with respondents. Validation at the macro level is also carried out after the logical corrections have been made in order to compare the results with the previous reference year. The discrepancies that may arise from data processing are considered to have little impact on the accuracy of the statistics.

2.2.6 Model assumptions

No model assumptions other than those described in sections 2.1 and 2.2.1 to 2.2.5. For more detailed information about model assumptions in the estimation process, see the Methodology Report.

2.3 Preliminary statistics compared with final statistics

A report with preliminary results for R&D statistics, *Research and expenditure in Sweden 2023 – preliminary statistics*, was published in July 2024 and is available on Statistics Sweden's website, www.scb.se/uf0301. The preliminary statistics are produced on behalf of the Ministry of Education for the upcoming budget bill. The size and direction of revisions vary from year to year. In general, however, total expenditure on intramural R&D in Sweden is revised upwards in connection with the final statistics by around SEK 2 billion.

Business enterprise sector

In the Business enterprise sector, there are some differences between preliminary and final statistics. The reason for this is that the collection was not completed when the preliminary statistics were published and several important enterprises had not yet responded at the time of publication of the preliminary statistics.

Government sector

In the Government sector, the differences between preliminary and final statistics are small. This is due to the fact that most objects submitted responses early in the collection period.

Higher education sector

The preliminary data are relatively consistent with the final statistics. For the R&D personnel variables, the differences are due to the fact that the collection was not completed when the preliminary estimates were published. The non-response is therefore greater when the preliminary estimates are made, which may lead to differences.

For R&D expenditures, the differences are due to the fact that the processing of economic data is partly based on data from the time-use survey. As a result, the estimates are affected by the same factors as the R&D personnel variables.

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Private non-profit sector

Minor differences may occur between preliminary and final statistics for the Private non-profit sector. This is because the data collection was not completed when the preliminary statistics were produced and the non-response rate was therefore higher in the preliminary statistics. As no non-response compensation is applied for the sector, the statistical values are affected by a larger non-response.

3 Timeliness and punctuality

3.1 Production time

The production time, i.e. the time elapsed between the end of the reference period and the time of publication, is approximately 10 months, from 1 January 2024 to 31 October 2024.

3.2 Frequency

The statistics are reported annually with the previous calendar year as the reference period. Data collection is carried out every two years and requires data for the previous calendar year and a forecast for the current calendar year.

3.3 Punctuality

The publication follows the publication plan for Sweden's official statistics. Dates for planned publications can be found in the publication calendar on Statistics Sweden's website.

4 Accessibility and clarity

4.1 Access to the statistics

Research and development statistics are published on Statistics Sweden's website www.scb.se/uf0301, in the Statistical Database.

4.2 Possibility of additional statistics

Statistics Sweden can, for a fee, provide customised statistics, such as finer industry divisions or aggregates. Researchers can be allowed access to de-identified micro data for their own processing.

4.3 Presentation

The statistics are disseminated in the form of statistical news, tables and charts and reports on Statistics Sweden's website, www.scb.se/uf0301.

4.4 Documentation

In addition to the Quality report, the survey is documented in a Methodology Report. Detailed information about the statistics is found in the metadata system MetaPlus. The documentation is available at www.scb.se/uf0301 under the heading *Documentation.*

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5 Comparability and coherence

5.1 Comparability over time

The study is based on the international recommendations described in the OECD Frascati Manual and comparability over time is generally considered to be good. However, users of the statistics should be aware that improvements are made to the surveys continuously and that production-related changes can affect the estimates. Statistics at an aggregated level for Sweden are comparable over time to the extent that each sector is comparable over time.

Annex 1 provides a complete history of changes in the surveys that affect comparability over time. Below is an account of the changes made since the previous collection round for each sector.

Business enterprise sector

A number of major changes have been implemented in the survey between 2021 and 2023 that affect comparability between years. Until 2021, the survey was designed as a sample survey, but from 2023 the framework procedure changed and the survey was converted into a census. Furthermore, a new interpretation of the statistical unit enterprise (SUE) was also implemented, which means that the number of enterprise units consisting of more than one legal unit increased from just over 30 to over 50 000. This also entails changes in the industry structure and affects comparability with previous years. Finally, a new method for protecting enterprises' data, the EZS method, was also implemented.

Government sector

In order to improve the coverage of the survey, the frame population was extended with regard to municipal associations and public non-profit organisations for the reference year 2023. The change has little effect on comparability over time for the sector as a whole, but for the sub-sectors of public non-profit organisations and local and regional R&D units, comparisons with previous periods should be made with caution.

Higher education sector

As of reference year 2023, the classification of R&D personnel by occupation (researchers and support staff, respectively) is based on responses from the time-use survey instead of register data. The purpose of the change is to improve the quality of the estimates by better following the recommendations set out in the Frascati Manual. The change means that a time series break occurs in the statistics broken down by occupation. However, total R&D personnel is comparable to previous periods.

Private non-profit sector

In the period 2019-2021, the sector’s R&D activities were estimated using a model estimate. The model meant that the estimate for 2017 was projected using a moving average based on the development rate for government

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agencies. As of reference year 2023, data collection for private non-profit organisations is resumed. The obligation to report data to Statistics Sweden applies to EU-regulated statistics, which reduces the risk of extensive unit non-response. The survey is designed as a census of all foundations and non-profit associations performing intramural R&D. The frame population is identified using information from a number of different administrative sources in order to reduce over-coverage.

5.2 Comparability among groups

Research and development in Sweden, and all sub-sectors, follow the international guidelines specified in the Frascati Manual (OECD), which makes the statistics comparable to corresponding statistics produced in other countries. The OECD also produces compilations as a basis for comparisons between member countries' R&D activities.

However, it is important to note that municipalities and regions were not included in the accounts for R&D activities in the Swedish Government sector before 2005. This means that the share of the Government sector has been small compared to other countries. In Sweden, the Government sector's R&D activities are characterised by the fact that they are mainly carried out in higher education institutions, which are surveyed separately in Research and Development in the Higher education sector.

Statistics Sweden annually reports a forecast of future government R&D investments, based on the content of the Government's Budget Bill, Government Budget Allocations for R&D (UF0306). However, direct comparisons with research statistics in government agencies should be made with caution.

5.3 Other coherence

The Community Innovation Survey (CIS) is conducted every two years and overlaps with Research and Development in Sweden. This survey also collects data on business expenditure on R&D. The surveys use the same definition of R&D, and the samples are coordinated through the SAMU system, which creates good conditions for coherence.

The Swedish Higher Education Authority (UKÄ) is the responsible authority for official statistics concerning the university in addition to research. Coherence between R&D statistics on the Higher education sector and other statistics on higher education is considered to be good. For more information about the Swedish Higher Education Authority's statistics on Swedish higher education, see the University in figures | UKÄ.

5.4 Numerical consistency

The results are controlled and consistent.

For the Business enterprise sector, the sum of expenditure per region is not in line with total expenditure for the whole of Sweden for the reference years

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2007, 2009 and 2013. The reason for this is that there was item non-response in the survey.

General information

A The classification Official Statistics of Sweden

Research and development in Sweden are official statistics.

For statistics included in the Official Statistics of Sweden (SOS), special rules for quality and accessibility apply, see the Official Statistics Act (2001:99) and Official Statistics Ordinance (2001:100) and Statistics Sweden's regulations (SCB-FS 2016:17) on the quality of official statistics.

B Confidentiality and the handling of personal data

In the authorities' special activities for the production of statistics, secrecy applies in accordance with Chapter 24, Section 8 of the Public Access to Information and Secrecy Act (2009:400). In order to protect the confidential information of individuals or enterprises in the published statistics, it is ensured that it cannot be disclosed either directly or indirectly.

When processing personal data, i.e. information that can be directly or indirectly attributed to a person who is alive, the Official Statistics Act (2001:99) and the Official Statistics Ordinance (2001:100) and the EU General Data Protection Regulation (2016/679) apply.

C Storage and elimination

For the higher education sector, there is a deadline of 10 years, after which personal data must be erased.

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D Obligation to provide information

Business enterprise sector

The obligation to provide data is regulated by the Official Statistics Act (2001:99) and Statistics Sweden's regulations on the obligation for enterprises to provide data to statistics on research and development in the Business enterprise sector (SCB-FS 2024:03).

Government sector

Government agencies are obliged to provide information under the Official Statistics Act (2001:99) and the Official Statistics Ordinance (2001:100).

The obligation for municipalities, regions and municipal associations to provide data is regulated in accordance with the Official Statistics Act (2001:99) and Statistics Sweden's regulations on the obligation for municipalities, regions and municipal associations to provide data to statistics on research and development in the Government sector (SCB-FS 2024:04). To the extent that individuals are included in the survey, providing information is voluntary.

Higher education sector

For the survey on revenues for research and doctoral education, there is a reporting obligation in accordance with the Act on Official Statistics (2001:99).

The time-use survey is not subject to the reporting obligation.

Private non-profit sector

The obligation to provide data is regulated by the Official Statistics Act (2001:99) and Statistics Sweden's regulation on the obligation for foundations and non-profit associations to provide data to statistics on research and development in Sweden (SCB-FS 2024:02).

E EU regulation and international reporting

Research and development in Sweden, and all sub-sectors, are regulated by Commission Regulation (EU) 2020/1197. Data are reported annually to Eurostat and to the OECD.

F History

From the 1950s onwards, there was a growing recognition that R&D activities carried out in all sectors of society should be of great importance for the country's economic growth. From the beginning, Statistics Sweden was mostly interested in the scientific research of large industrial enterprises, as these were considered to have the greatest impact on the economy.

In interaction with the OECD, Statistics Sweden intended to produce statistics to measure the intensity of R&D activities and, perhaps somewhat strange to us today, *their effectiveness*. Statistics Sweden began with what was called stage 1, to investigate scientific R&D in enterprises in the industrial sector.

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Business enterprise sector

Statistics Sweden conducted the first survey on research and development (R&D) in the Business enterprise sector in 1964, covering the year 1963. The survey covered only technical and scientific R&D in enterprises in the manufacturing industry. From the mid-1980s, R&D surveys in this sector became more systematic and quality-wise more sustainable than before. It was only with the 1993 version that the survey also included R&D within social science and humanities.

The surveys coverage in terms of industries ahs expanded over time. It is only with the survey regarding the reference year 1995 that the surveys on R&D can be said to have a reasonable coverage in terms of both sectors and scientific disciplines. As of 2001, all sectors are included in the survey, this year enterprises engaged in financial activities were included. As regards the size of the enterprises included in the survey, the scope was extended in 2005 to include enterprises with 10 to 49 employees. In reference year 2023, data were also collected from micro-enterprises, enterprises with 1-9 employees.

Government sector

In 1969, government agencies were surveyed for the first time. The target population then consisted of, among others, government agencies and central government quasi-corporations, municipal quasi-corporations, trade associations, state and semi-state institutes and foundations. In addition to scientific R&D, it could also be considered that the entity carried out some technological R&D activity.

Statistics Sweden had problems with the creation of the frame population, as there was no register of the units that should be included in the population. The study covered the reference period 1964, but the units were also required to provide a forecast of future R&D costs. It is worth noting that more than half of the research funded by the state was nuclear research.

Higher education sector

Higher education R&D statistics have been progressively extended since 1982/83 and from the 1993/94 survey, the coverage can be considered comprehensive. The surveys mainly follow the guidelines for R&D statistics developed by the OECD and published in the 2015 Frascati Manual.

G Contact details

Statistical agency	Statistics Sweden
Contact information	Research and Development

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E-mail	fou-statistik@scb.se
Telephone	010-479 50 00 (Statistics Service)

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Annex 1. History of changes in the survey

Business enterprise sector

The population has gradually expanded since the survey was first conducted in the 1960s. In addition to industrial enterprises, the survey today also includes service enterprises, construction enterprises and energy supply enterprises. In publications up to 1999 only the non-financial sector is included. Below are some further changes over time that may affect comparability between years.

- Until 1991, only technical and scientific R&D activities in the Business enterprise sector were examined. It is only from the reference year 1993 that the survey also covers R&D within social sciences and humanities.
- Until 1995, comparability over time is limited to industrial enterprises.
- As of the reference year 2001, financial enterprises are included in the survey, which limits comparability with previous rounds of the survey.
- As of reference year 2005, the population is extended to include small enterprises with 10 to 49 employees.
- Due to the introduction of the new industry nomenclature SNI 2007, comparability with previous years is affected. Results for the years prior to 2007 are reported according to SNI 02.
- As of the reference year 2013, a more comprehensive explanation of the concept of R&D is included in the survey. Previously, only the terms 'research' and 'development activities' were defined and explained, while the 2013 Instruction defines and explains the terms 'basic research', 'applied research' and 'development activities'.
- As of reference year 2013, the break down by occupation changed from three categories (researchers, product developers or equivalent, technical experts, and other R&D personnel) to two categories (researchers, product developers or equivalent and supporting R&D personnel).
- As of the reference year 2015, no inquiry was sent out to request contact information to the person to whom the regular survey was to be sent. The inquiry also included questions about whether the company had intramural or extramural R&D expenditure in order to limit which enterprises received the regular survey.
- When the reference year 2015 was published, data in the Statistical Database were revised so that industrial research institutes is reported as a sub-item for all reference years from 2007 onward.
- The new Frascati Manual (FM15) was implemented as of reference year 2017. The updated the definition of R&D affects comparability with previous years.
- For the reference year 2017, the questionnaire was revised to remove regional distribution of personnel and the question of biotech. The option of answering the questionnaire on paper was also removed.

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- As of reference year 2019, the methodology for the regional distribution of R&D expenditure and R&D personnel was updated for enterprises with less than 200 employees that are replying to a slightly shorter questionnaire.
- As of the reference year 2019, public service broadcasters are no longer included in the Business enterprise sector, but are instead reported in the Government sector. The change was implemented as a result of clearer EU rules and in order to improve comparability with other countries.
- As of reference year 2023, the survey went from being a sample survey to being conducted as a census, affecting comparability with previous years.
- As of reference year 2023, the new interpretation of the statistical unit enterprise (SUE) was used, which means that the number of complex enterprise units, consisting of more than one legal unit, increased from just over 30 to over 50 000. This entails changes in the industry structure and affects comparability with previous years.
- As of reference year 2023, a new approach to protecting enterprises' data was implemented, affecting comparability with previous years.

Government sector

Since the beginning of the survey in the 1960s, the population has expanded in several stages. In addition to including government agencies, the survey also covers municipalities, regions and public non-profit organisations. The following is a summary of the changes that may affect comparability in the general government sector over time.

- As of the reference period 1993/94, the population of the survey was extended to include units performing social science or humanities R&D. Previously, only entities performing R&D in technology and natural science were included.
- From the reference year 1997 onwards, research foundations established from the employee funds are included. These are reported among public non-profit organisations unless otherwise stated.
- R&D in regions and municipalities has been surveyed at irregular intervals between 1994 and 2007. Since reference year 2007, they have been part of the regular biennial survey. However, comparisons with periods prior to 2007 should be made with caution as both sampling methods and the questionnaire have changed significantly.
- As of reference year 2019, public service broadcasters are included in the subsector public non-profit organisations. These were previously reported in the Business enterprise sector. The change was implemented as a result of clearer EU rules and in order to improve comparability with other countries.
- As of reference year 2019, the survey has been coordinated across all sub-sectors of general government. The change means that the sub-

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sectors reply to the same web form, although some sector-specific adjustments have been made to the questions. Previously, the survey has been carried out separately in the sub-sectors.

- As of reference year 2021, the Institute of Space Physics is included in the Government sector. Previously, the agency had been included in the Higher education sector. The change was made as a result of a new assessment based on a change in the definition of the Higher education sector in the latest edition of the Frascati Manual.
- In order to improve the coverage of the survey, the frame population was extended with regard to municipal associations and public non-profit organisations for the reference year 2023.

Higher education sector

The population of the economic part of the survey in the Higher education sector has undergone some changes over time. From having included more than 50 higher education institutions in the second half of the 1990s, the population has decreased to 39 higher education institutions. However, in the vast majority of cases, the changes are due to real changes in the population, i.e. the closure, merger or addition of higher education institutions. The time-use survey has undergone major changes in the collection method that limit the comparability of the R&D personnel variables over time. Below is a summary of major changes that affect comparability between the years.

- Up to and including the reference year 2003, data on the R&D personnel variables were collected through a questionnaire sent to the departments of Swedish higher education institutions. As of reference year 2005, a time-use survey is used instead, which is sent out to a sample of employees at higher education institutions.
- Between 1997-2003, a methodology based on data from the part of the survey measuring the R&D personnel variables was used to exclude the costs of the training component of the research training activities from the R&D revenues in order to derive R&D expenditure as defined in the Frascati Manual. As of the reference year 2005, the method was changed and instead the education costs for doctoral education were calculated on the basis of a general assumption that the education component represented 37.5 per cent of the doctoral education.
- As of the reference year 2011, the Standard for the Swedish Classification of Research Subjects replaced the previous classification National List of Research Subjects. In order to create better conditions for comparability between years, data were collected for the reference year 2011 according to both standards.
- As of the reference year 2013, HEIs no longer allocate their revenues for R&D per faculty. Instead, only totals for the entire institution are collected. Revenues will also continue to be allocated by source of funds and fields of research and development. Investments, depreciations and costs of premises that were previously collected by faculty are instead collected by field of research and development.

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- As of reference year 2015, the sampling framework for the time-use survey is delimited by providing information on the category of service and research topic, as well as by means of a preliminary survey in which higher education institutions may specify, for certain job titles, which titles are relevant for the survey on the basis of certain criteria.
- As of reference year 2021, the costs of the training component of doctoral education are deducted from the R&D expenditure on the basis of the data collected in the time-use survey. The change was implemented when the data from the time-use survey was judged to create better accuracy than the previous assumption that 37.5 per cent of doctoral education consists of education in the form of courses.
- As of the reference year 2021, data on income from ALF funds are no longer collected in the economic survey. These expenditures are instead reported in the Government sector, which is the sector where the R&D is performed.
- As of the reference year 2021, the Swedish Institute of Space Physics is no longer part of the Higher education sector, but is instead reported in the Government sector. The change was made as a result of a new assessment based on a change in the definition of the Higher education sector in the latest edition of the Frascati Manual.
- As of reference year 2023, the classification of R&D personnel by occupation (researchers and support staff, respectively) is based on responses from the time-use survey, instead of register data. The change was made to improve the quality of the estimates by better following the recommendations set out in the Frascati Manual. The change means that a time series break occurs in the statistics broken down by occupation. However, total R&D personnel is comparable to previous periods.

Private non-profit sector

Comparability between years is primarily affected by population changes and changes in the sampling method. The lack of exhaustive records of the target population has been the main reason for these changes. Below is a summary of major changes that affect comparability between the years.

- Until the reference year 2009, the frame population of the survey consisted of organisations which, according to data from previous surveys, perform R&D activities. For the survey concerning the reference year 2011, the sample was coordinated with the survey Non-profit institutions serving households.
- For reference year 2017, a new sampling method was introduced as coordination with the survey Non-profit institutions serving households was no longer possible.
- In the period 2019-2021, the sector's R&D activities were estimated using a model estimate. The model meant that the estimate for 2017

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was projected using a moving average based on the development rate for government agencies.

- As of reference year 2023, data collection for private non-profit organisations resumed. The obligation to provide data applies to EU-regulated statistics, which reduces the risk of extensive unit non-response. The survey is designed as a census survey of foundations and non-profit associations engaged in R&D. The frame is delineated using information from a number of different administrative sources in order to reduce over-coverage.