

General Methodology

R&D data (Tables 1 to 62)

A. Definitions and coverage

1. OECD standards

The data in this publication have been collected and presented in line with the standard OECD methodology for R&D statistics entitled *The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys of Research and Experimental Development – Frascati Manual 2002* (OECD).

2. The two types of data

Most R&D data are derived from retrospective surveys of the units actually carrying out or “performing” R&D projects. Thus, the indicators in Tables 1 to 58 are based on the sum of performers’ reports of their R&D expenditure and personnel on national territory (i.e. excluding payments to international organisations and other performers abroad). Personnel data are expressed in full-time equivalent (FTE) on R&D (i.e. a person working half-time on R&D is counted as 0.5 person years) and headcount. Because of the complexity of the surveys, it is difficult to obtain very up-to-date series. In the present volume, some 2008 data are still provisional and data for later years are national estimates or projections (these data are annotated).

Given the difficulty of estimating defence R&D figures which are compatible with GERD (notably in industry), a number of countries have been unable to supply data and the information is shown in Table 5 with only one decimal.

More up-to-date information on government support for R&D can be derived from budgetary sources. The indicators in Tables 59 to 62 are based on Government Budget Appropriations or Outlays for R&D as reported by the funding ministry or agency and include payments to international organisations and other performers abroad.

The specifications of these two sets of R&D data vary significantly and the two types of data should not be combined.

3. Fields of science

In general, the tables cover R&D in both natural sciences (including agricultural and medical sciences) and engineering (NSE) and social sciences and humanities (SSH). A large number of countries collect data on R&D activities in the business enterprise sector for NSE only.

4. Sectors of performance and sources of funds

Domestic R&D efforts (expenditure or personnel) are divided into four *sectors of performance* for statistical purposes, business enterprise (industry), higher education, government and private non-profit institutions (PNP).

R&D expenditure is subdivided into five *sources of funds*, from business enterprise (industry), from government (public), from higher education, from PNPs and from abroad. By convention

and for international comparison purposes, public general university funds (GUF) are allocated to the government sector as a source of funds. Since the amounts financed by the higher education and PNP sectors are small, they have been combined as “other national sources” in Tables 15 and 37.

5. R&D in the business enterprise sector

The business enterprise sector covers private and public enterprises and institutes serving such enterprises. The breakdown between industries is, in principle, made at the level of the enterprise, though some countries are able to break down the R&D data for multi-product enterprises between their main lines of business. National statistical regulations prevent publication of results where there are very few firms in the given category, hence the many gaps in the tables. In principle R&D institutes serving enterprises are classified to the industry concerned; when this is not done the percentage of BERD performed by the non-manufacturing industry is overestimated compared with other countries.

The classification used to present business R&D series is the International Standard Industrial Classification, Revision 3 (ISIC Rev. 3). The indicators on industrial BERD concern high-technology manufactures and services:

	ISIC Rev. 3
• aerospace industry (Table 39)	353
• electronic industry (Table 40)	32
• office machinery and computer industry (Table 41)	30
• pharmaceutical industry (Table 42)	2 423
• medical, precision and optical instruments, watches and clocks (instruments) industry (Table 43)	33
• services industry (Table 44)	50-99

The above mentioned indicators were calculated using mainly the *Analytical Business Enterprise R&D Database* (ANBERD) for OECD member countries and selected non-member economies covered by this database. For further information on this database see: www.oecd.org/sti/anberd. ANBERD data and MSTI BERD indicators by sector of activity will switch from being reported on an ISIC Rev. 3 to an ISIC Rev. 4 basis in 2013 and an updated definition of high-technology sectors will be implemented. Reporting by countries on an ISIC Rev. 4 basis is currently incomplete. For countries which have ceased to report data on an ISIC Rev. 3 basis, an approximate conversion has been applied whenever possible. Breaks in series are included to signal the use of data based on the new ISIC classification

6. Government budget appropriations or outlays for R&D (GBAORD)

These data are assembled by national authorities using statistics collected for budgets. This essentially involves identifying all the budget items involving R&D and measuring or estimating their R&D content. The series generally cover federal or central government only. These estimates, based on funders’ reports, are less accurate than the “performer-reported” data in Tables 1 to 58 but as they are derived from the budget, they can be linked back to policy issues by means of a classification by “objectives” or “goals”. Programmes are allocated between socio-economic objectives on the basis of *intentions* at the time the funds are committed and not the actual content of the projects concerned. These breakdowns reflect *policies* at a given moment in time.

The classification used is the European Commission’s Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets – NABS, specially developed for R&D analysis (see *Frascati Manual 2002*, Sections 8.7.3 and 8.7.4).

The breakdown is as follows:

Defence (Table 60)

All defence R&D financed by government, including military nuclear and space but excluding civilian R&D financed by ministries of defence (e.g. meteorology).

Civil (Table 61)

Total GBAORD less defence.

Economic development (Table 62)

R&D programmes financed for the purpose of the advancement of agriculture, fishery, forestry; industry; energy; and infrastructure and general planning of land use.

Health and environment (Table 62)

R&D programmes funded for the purpose of the protection and improvement of human health; control and care of the environment; and for the exploration and exploitation of Earth.

Education and society (Table 62)

R&D programmes funded for the purpose of education; culture, recreation, religion and mass media; and political and social systems, structure and processes.

Space (Table 62)

Civil space R&D programmes.

Non-oriented research (Table 62)

Research programmes financed in view of the advancement of knowledge.

General university funds (Table 62)

The estimated R&D content of “block grants” to the higher education sector. This category is generally absent or underestimated for countries where only federal government is included.

7. International comparability

Though all OECD countries generally collect and report R&D in line with the *Frascati Manual*, some detailed national specifications may vary from OECD standards. These differences are generally too small to affect the general indicators quoted in this publication. The main exceptions are shown in Annex 1.

8. Expenditures in current dollars

National currency data have been converted to US\$ using purchasing power parities (PPPs) (Table C). The PPPs are those developed by the OECD National Accounts Division (for further details see *National Accounts of OECD Countries 2012, Volume I*, as well as *Eurostat-OECD Methodological Manual on Purchasing Power Parities [PPPs]*, and the Internet PPP site: www.oecd.org/std/ppp), updated for the most recent years by comparing the growth in prices (implicit GDP deflator) in each country with that in the United States. These estimated parities are footnoted “b” in the tables as are any data converted to current dollars using them.

For most of the non-OECD economies featured in MSTI, PPP rates provided by the World Bank are used to convert data from national currency into PPPs. Only TBP data have been converted using current exchange rates as these transactions are conducted on international markets.

9. Expenditures in constant dollars

R&D expenditure series have been deflated using the implicit GDP deflator taken from the *OECD National Accounts Database* updated for the most recent years by Secretariat projections of changes in the GDP deflator, as published twice a year in the *OECD Economic Outlook* (except in the case of Norway where a deflator excluding trends in petroleum prices has been used) (Table B). Any expenditures series calculated on the basis of these estimated rates are footnoted “b”.

10. Comparisons with economic indicators

R&D expenditures are shown as a percentage of selected indicators drawn from the *OECD National Accounts Database* updated for very recent years on the basis of the projections published in the *OECD Economic Outlook*. Any ratios where such estimated economic series are the denominator are footnoted “b” in the tables concerned. R&D personnel are shown per thousand of selected indicators from the *OECD National Accounts* and *Labour Force Databases*. The main indicators used are shown in Annex 2.

When possible, economic indicators for the non-member economies are also drawn from the OECD databases. Alternatively, other international databases are used, such as the *Eurostat NewCronos Database* (in the case of Romania, plus Bulgaria, Cyprus, Latvia, Lithuania and Malta for the EU zone totals), the *International Monetary Fund*, *International Labour Organisation* and *World Bank Databases*, as well as various national data sources.

11. Zone totals

Zone totals have been calculated for the EU27 and the OECD for most tables. The OECD zone includes all member countries of the OECD, i.e. Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. Zone totals for EU25 and EU15 are available in the electronic editions of this publication. In order to obtain a full set of data for the OECD countries the Secretariat has made a number of estimates to fill gaps and to bring series up to date. These estimates were done using simple statistical routines or information from national publications and observations of trends. Data points where such estimates exceed 25% of the zone total have been suppressed. Israel and Mexico are included in the OECD total as from 1991. The Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia are included in the OECD total as from 1995. OECD total integrates R&D expenditure data for Korea as from 1991 and personnel data as from 1995. Chile is included in the OECD total as from 2007. Luxembourg is included in the OECD and EU totals beginning 2000, and Malta is included in the EU27 total beginning 2002. Data for non-OECD countries used to calculate EU27 have been provided by the Statistical Office of the European Commission (Eurostat).

Due to the difficulty in forecasting R&D budgets, the zone totals for GBAORD are essentially arithmetic totals of the available national data. For missing intermediate years, data are interpolated and the total is annotated “b”. However, forecasts are not made nor are estimates for countries not providing GBAORD data. The resulting zone data are thus underestimated and are footnoted “m”. Data points where the sum of unavailable data probably exceeds 25% of the expected zone total have been suppressed. R&D financed by

the European Commission using funds from the Commission's own budget (data provided by Eurostat) is included in the zone totals.

B. Sources

The data are derived from national R&D surveys and budgets and are supplied to the Secretariat via the Common OECD/ESTAT Core questionnaire.

R&D expenditures of foreign affiliates (Tables 63 and 64)

A. Definitions and coverage

These data are collected as part of the OECD Secretariat effort to measure globalisation through the role of multinationals. Data on the activity of foreign affiliates are based on the concept of controlling interest and the statistical test for data collection is that of a majority interest (over 50% of shares that carry voting rights on a company's board of management). For further information on methodological and conceptual aspects of globalisation statistics, see *Handbook on Economic Globalisation Indicators* (OECD, 2005). Data, in some cases, are not directly comparable with standard business enterprise R&D. Details on national sources and definitions are published in *Measuring Globalisation, Activities of Multinationals, 2007*.

B. Sources

OECD Database on Activities of Foreign Affiliates (AFA).

Patents (Tables 65 to 68)

A. Definitions and coverage

1. Patents and patent families

A patent family is defined as a set of patents taken in various countries for protecting a single invention. An inventor seeking protection files a first application (priority) generally in his/her country of residence. Then, the inventor has a 12-month legal delay for applying or not for protection of the original invention in other countries. Patent families, as opposed to patents, are provided with the intention of improving international comparability (the "home advantage" is suppressed; the values of the patents are more homogeneous).

The patent families presented in this publication refer to triadic families: *i.e.* a patent is a member of the patent families if and only if it is filed at the European Patent Office (EPO), the Japan Patent Office (JPO) and is granted by the US Patent and Trademark Office (USPTO).

In addition, the number of patent applications filed under the Patent Co-operation Treaty (PCT) is now provided for two specific sectors of interest: the ICT and biotechnology sectors. These sectors are defined according to selected classes of the International Patent Classification – IPC. The PCT procedure offers the possibility to seek patent rights in a large number of countries by filing a single international application with a single patent office, and then enter the national stage in the desired countries at a later date.

2. Presentation and availability

For patent counts, the choice of the country and date of reference among the set of information included in patent documents is important. Patents are presented here according to the country(ies) of residence of the inventor(s), giving thus a measure of technological innovativeness of researchers and laboratories located in a country.

The *priority date*, the date of the first international filing of a patent, is chosen as a reference date. It is the earliest available date and therefore the closest to the invention date. Although the *application date* may provide more recent series, counts by *application date* introduce a bias between residents and foreigners for a selected patent office with respect to the *priority date*. Residents usually first file a patent application at their domestic office, the extension of application to other countries takes one year following the traditional procedure, and up to two and a half years for the PCT procedure.

However, counting patent families according to the earliest priority date increases the drawback of traditional patent counts with respect to timeliness. The time lag between the priority date and the availability of information on patent applications to the EPO and JPO could be up to 4 years, whereas for the USPTO patent grants, the time lag could be up to 6 to 10 years. Hence, for this publication, patent families data up to 2001 were almost complete. Therefore, from priority years 2002 to 2010, patent families for individual countries are Secretariat estimates. Estimates are derived from the number of biadic patent families (EPO and JPO) and from the number of patent applications filed at the EPO for the latest years. The estimated series are revised twice a year using the most recent data available.

The PCT procedure expanded after 1990 and is increasingly used by applicants from all signatory states: since the early 2000s, most countries are well represented. For the transition period (1990-2000), cross-country comparisons or time trends should be interpreted with care. 2010 data are Secretariat estimates.

A broader set of patent-related indicators is available on-line, along with methodological issues, at www.oecd.org/sti/ipr-statistics, covering notably patents by main technology classes, as well as indicators on international co-operation in patenting. For further details on patent data, refer to the *OECD Patent Statistics Manual, 2009*.

B. Sources

The data on patents at intellectual property offices (EPO, JPO, USPTO) are mainly derived from EPO's *Worldwide Statistical Patent Database (PATSTAT, April 2012)*. The series on triadic patent families have been compiled by the Secretariat. The series on PCT applications are based on data published by the EPO.

Technology balance of payments (TBP) (Tables 69 to 71)

A. Definitions and coverage

The TBP registers the commercial transactions related to international technology transfers. It consists of money paid or received for the acquisition and use of patents, licences, trademarks, designs, know-how and closely related technical services (including technical assistance) and for industrial R&D carried out abroad, etc.

Payments as a percentage of GERD (Table 71) give an indication of the share of imported technology to domestic R&D efforts.

It has not been possible to produce zone totals for the TBP due to the lack of data and because of the problem of excluding flows within the zones.

B. Sources

OECD Database on Technological Balance of Payments (TBP).

Trade balance and export market shares for R&D-intensive industries (Tables 72 to 76)

A. Definitions and coverage

These tables present indicators concerning international trade in goods by selected R&D intensive industries defined according to the International Standard Industrial Classification (ISIC) Revision 3. In general, prior to 1988 underlying source data are based on ISIC Revision 2.

These series are taken from the *OECD STAN Bilateral Trade Database* (BTD), which is derived from the *OECD International Trade Statistics Database*. Original data by product have been converted from the Harmonised System (HS) and the Standard International Trade Classification (SITC revision 2) to International Standard Industrial Classification (ISIC).

Industries concerned are the following:

	ISIC Rev. 3
• <i>aerospace industry (Table 72)</i>	353
• <i>electronic industry (Table 73)</i>	32
• <i>office machinery and computer industry (Table 74)</i>	30
• <i>pharmaceutical industry (Table 75)</i>	2 423
• <i>medical, precision and optical instruments, watches and clocks (instruments) industry (Table 76)</i>	33

A note indicating breaks in series is assigned to the first available year of Revision 3 data. Until 1992 inclusive, the data for Belgium include Luxembourg.

The zone total for EU15 (electronic editions) excludes intra-EU trade. The OECD total has not been adjusted to exclude trade between member countries. The zone totals are presented in ISIC Revision 3 from 1995.

From 2000, calculation of the export market shares is relative to total aggregate exports of the declaring countries available in BTD. While not covering all countries, the country coverage of BTD is considered to comprise close to 95% of world trade. Reporting countries included in *STAN Bilateral Trade Database* but not presented in this publication include notably Brazil, Hong Kong, India, Indonesia, Malaysia, the Philippines, Saudi Arabia and Thailand. Prior to 2000, Export market share was based on the share of OECD total exports (OECD = 100%).

B. Sources

OECD *Bilateral Trade in Goods by Industry and End-use Category Database* (BTDIxE), December 2011 (www.oecd.org/sti/btd).



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