

1. General

This publication presents a summary of national expenditure on civilian Research and Development (R&D) for the years 1989–2005, and provisional estimates for 2006 and 2007, by the sector in which R&D was carried out and financed. Comparisons between Israel and industrial countries for the year 2006 (the last year for which data on these countries are available) are also presented. Data on R&D expenditure of government ministries in 1990–2007 are provided as well.

Summaries of national expenditure on R&D were prepared for National Accounts, similar to those that were prepared in other fields such as education, health and culture. These summaries are part of the satellite accounts, which are intended to supplement the basic national accounts (product account, income and expenditure, investment and its financing, etc.) and focus on specific issues. Satellite accounts consolidate the value of goods and services produced by different industries for a specific purpose into one framework, and show the use of these goods and services and their financing, by sector. The satellite accounts have a more detailed classification than that of the basic national accounts, and in some cases a different classification is used. Satellite accounts are operated according to the recommendations of the new system of national accounts (SNA – 93) which was published in 1993 by the statistical offices of five international organizations: the Commission of the European Communities, The International Monetary Fund (IMF), OECD, The United Nations, and The World Bank.¹

This publication includes main findings of the national expenditure on R&D, a description of the statistical system, definitions and classifications, methods of estimation and data sources, as well as sources of the data for international comparison.

A detailed description of specific problems related to measurement of expenditure on research and development, and suggested solutions to those problems, are presented in Appendix 1. Appendix 2 discusses the relationship between R&D expenditure and macro-economic indicators such as capital formation and product.

The tables present the following:

- (a) National expenditure on civilian R&D by operating sector for 1990–2007, at current and constant prices, and changes in percentages (Table 1).
- (b) A summary of national expenditure on civilian R&D for 2004 and 2005, based on a combined classification of the sector in which research is conducted and the sector that finances the activity (Tables 2–3); a breakdown of expenditure in 2005, for each sector that conducted research and development, by type of expenditure – labour cost, intermediate consumption and capital formation in equipment (Table 4).
- (c) Summaries of expenditure of government ministries on R&D in 1990–2007, by type of expenditure – R&D purchase, transfers to other sectors and intramural expenditure (Tables 5–8) and expenditure of selected government ministries in

¹ See Commission of the European Communities, IMF, OECD, United Nations, World Bank. *A System of National Accounts* (New York, 1993).

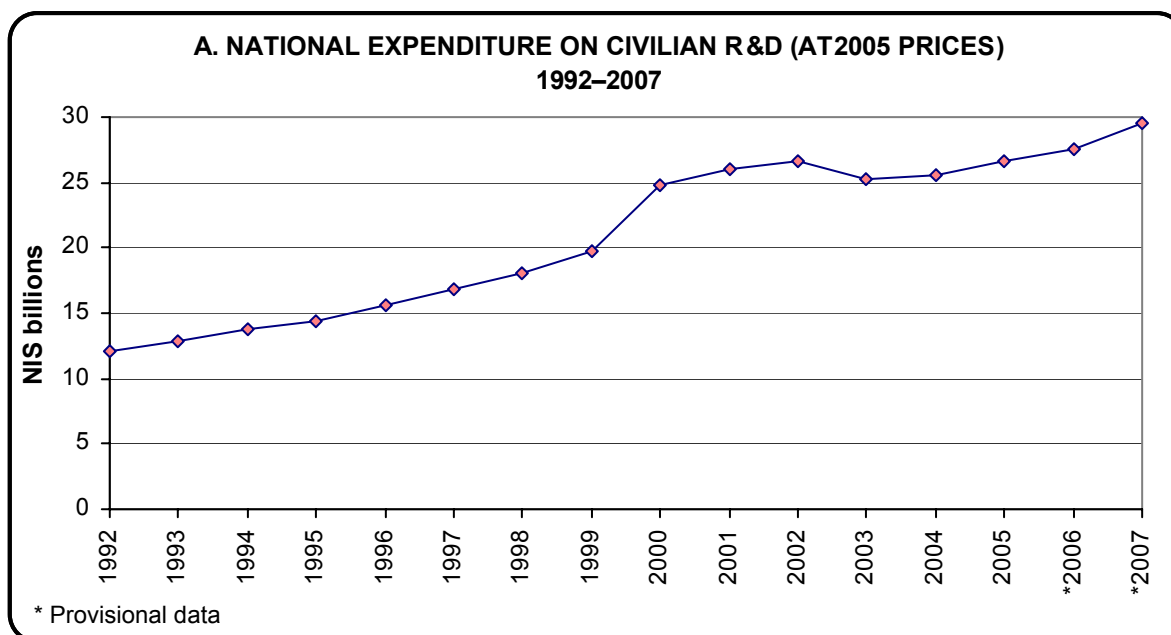
1994–2007 (Tables 9, 11). A breakdown of the expenditure of government ministries, by objectives, for 1998–2007 is presented in Table 10.

- (d) A breakdown of R&D expenditure of non-profit organizations for 2005, by scientific field (Table 12).
- (e) International comparisons of expenditure on civilian R&D in Israel and in OECD countries for 2006 (Tables 13, 15) and for 2005 (Tables 14, 16–20).
- (f) International comparison of expenditure on civilian R&D in manufacturing in 2006, by industry (Table 21).
- (g) Development of expenditure on civilian R&D in manufacturing, from 1989 to 2006 in Israel, by industry (Table 22).
- (h) International comparison of Government ministries' funding for R&D in Israel and in OECD countries in 2007, by objective (Table 23).

2. Main Findings

Research and Development (R&D) is defined as systematic and original activity intended to create new scientific or technological knowledge, or to develop a new application of existing scientific or technological knowledge. The total national expenditure on civilian R&D includes the value of goods and services produced in Israel for civilian R&D in manufacturing as well as in other industries in the business sector and in the universities, the general government, and various research institutes including R&D conducted by foreign companies in Israel.

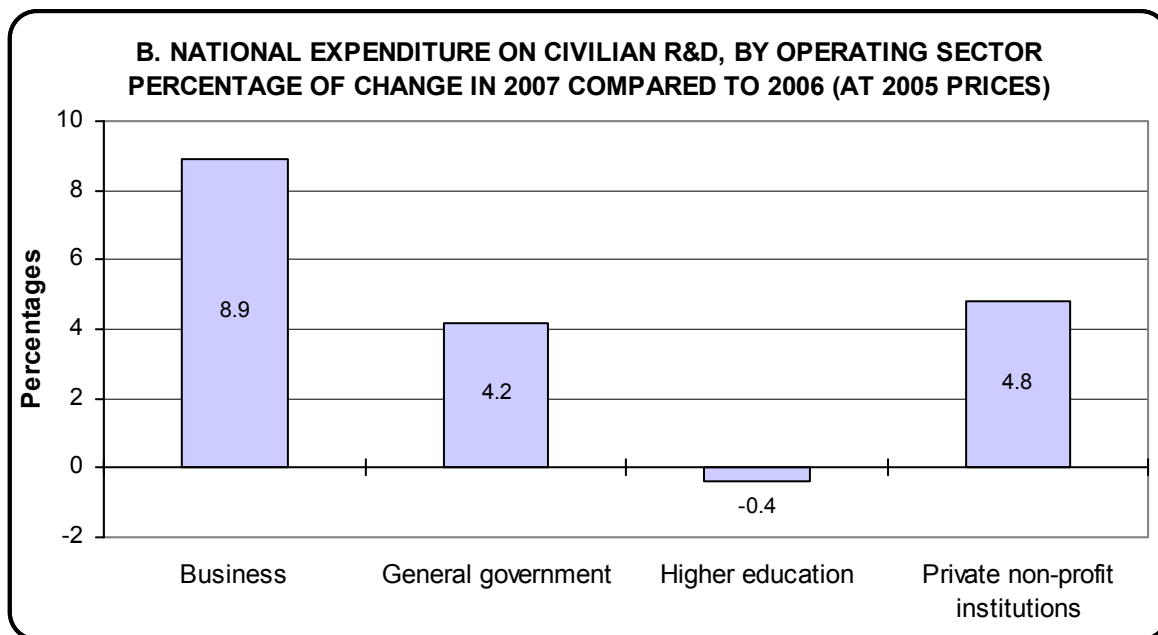
National expenditure on civilian R&D at current prices amounted to NIS 31.5 billion in 2007, and was 4.7% of the GDP, compared to 4.5% in 2006 (see Table A, below). According to provisional estimates, in 2007 the national expenditure on civilian R&D, at constant prices, increased by 7.2% (diagram 1), following an increase of 3.6% in 2006 and of 4.1% in 2005. This development reflects an 8.9% increase in expenditure on R&D in the business sector in 2007, following an increase of 4.3% in 2006, and of 5.5% in 2005.



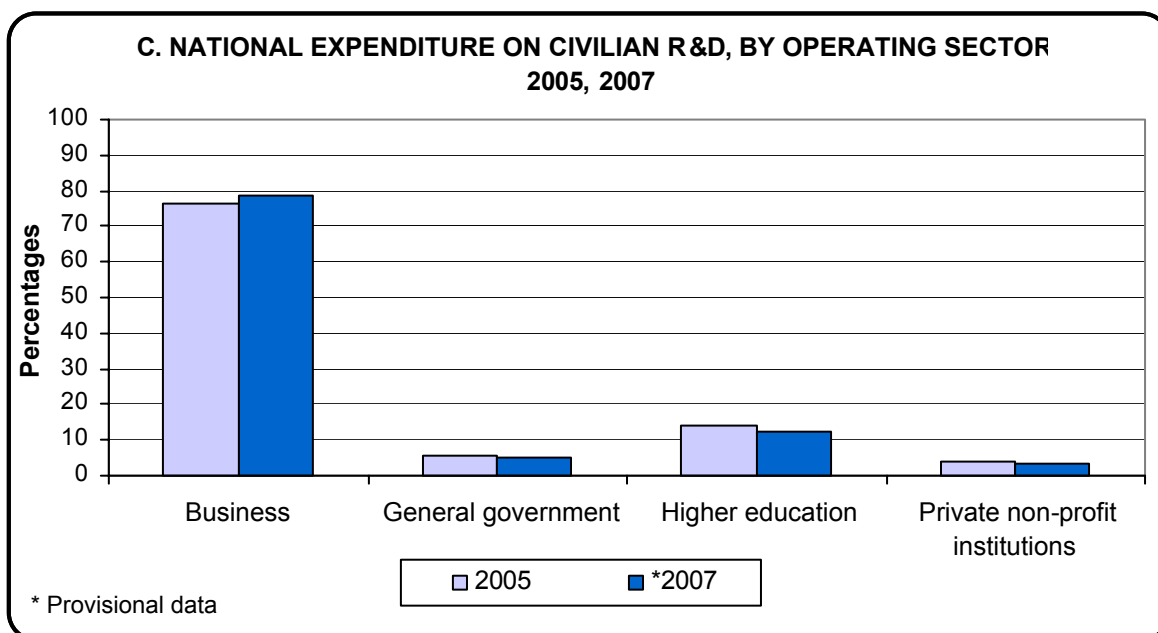
Worth mentioning that only part of the R&D performed in the country is used by local companies: part of the R&D, which is performed in international companies, is designated to be used abroad and another part of the R&D is sold abroad.

The increase in the expenditure on R&D performed in the business sector in 2007 reflects, mainly, an increase of 13% in the R&D industry and 10% in the software industry. In the manufacturing industries, R&D expenditures increased by 4.3% following an increase of 6.8% in 2006.

R&D expenditure in other sectors also increased in 2007: in the general government sector R&D expenditures increased by 4.2% following an increase of 0.2% in 2006, and the expenditures in non-profit institutions increased by 4.8%, following an increase of 2.9% in 2006. In higher education institutions, R&D expenditures decreased by 0.4%, following an increase of 1.4% in 2006.



Expenditure on civilian R&D performed in the business sector, in current prices, amounted to NIS 24.8 billion in 2007, comprising 79% of the total national expenditure on civilian R&D. Expenditure on R&D performed at universities was 12% of the total national expenditure on civilian R&D, it constituted 5% in the general government, and 4% in private non-profit institutions.



**TABLE A. – NATIONAL EXPENDITURE ON CIVILIAN R&D,
BY SELECTED MACROECONOMIC INDICATORS**

Percentages

Indicator	2000	2001	2002	2003	2004	2005*	2006*	2007*
1. National expenditure on civilian R&D, as percentage of:								
<u>Domestic product</u>								
Gross domestic product	4.4	4.7	4.7	4.4	4.3	4.4	4.5	4.7
Net domestic product	4.9	5.3	5.3	5.0	5.0	5.1	5.1	5.4
<u>Domestic capital formation</u>								
Gross domestic capital formation	21.3	23.3	25.8	24.9	24.5	22.9	23.3	22.8
Gross domestic fixed capital formation	23.4	26.2	26.9	26.2	26.3	27.2	26.1	25.1
Gross capital formation in industries	31.8	35.2	37.0	36.2	36.1	37.3	35.3	33.3
2. Business sector								
Civilian R&D operated, as percentage of gross fixed capital formation	17.7	19.9	20.2	19.2	19.7	20.8	20.2	19.7

* Provisional data.

2.1. National Expenditure on R&D, by Type of Expenditure

Labour cost comprised 75% of the total expenditure on research and development in 2005. Intermediate consumption costs, e.g., purchase of materials and energy products, excluding depreciation, comprised 19%, and fixed capital formation, such as acquisition of buildings, equipment and vehicles, comprised 6% of the total expenditure on R&D.

2.2. Financing the National Expenditure on R&D

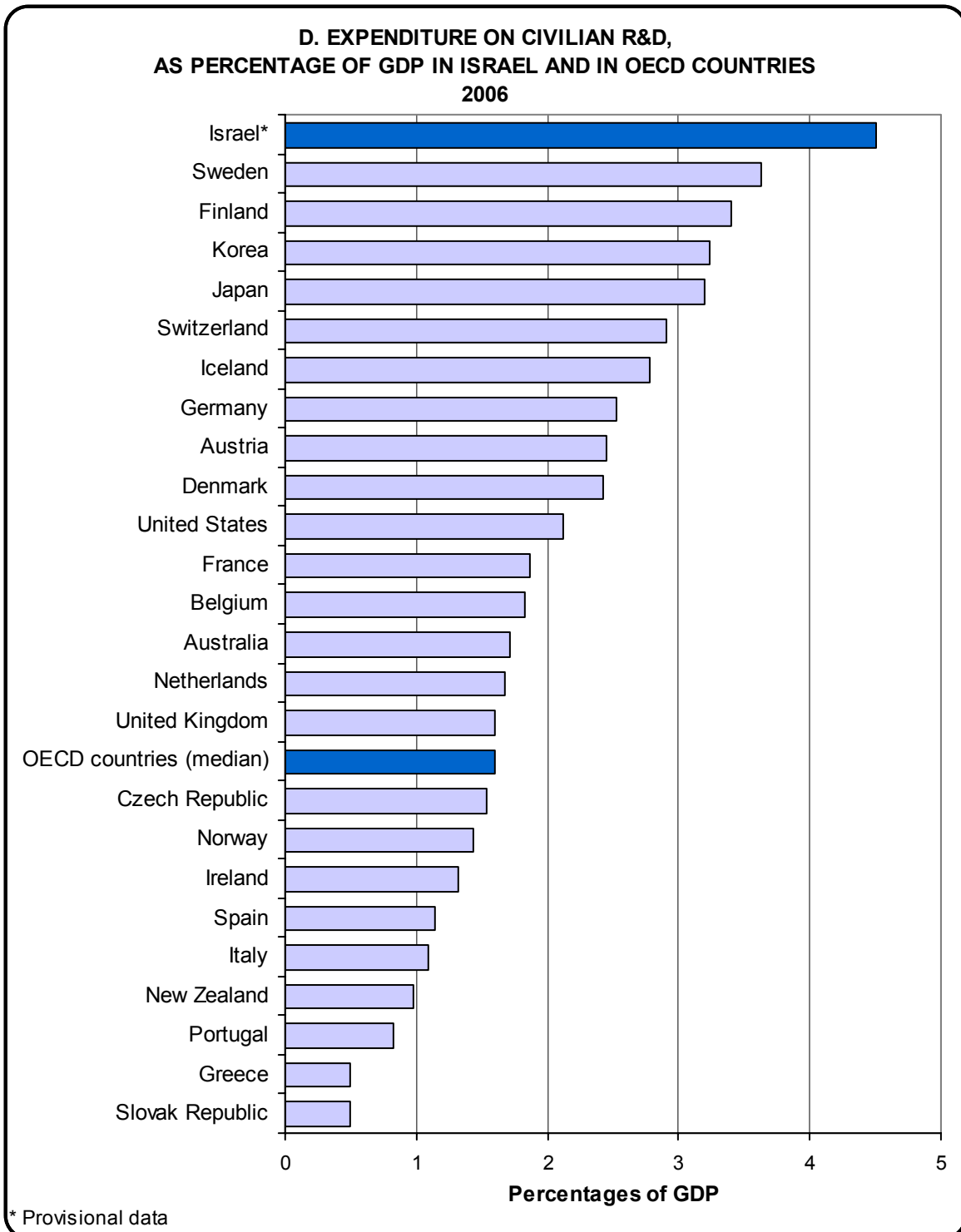
The most recent data on the distribution of financing (for 2005) show that, the business sector financed 76% of all civilian R&D expenditure in Israel, as opposed to 73% in 2004. The general government financed 18% of the expenditure, as opposed to 20% in 2004, (mainly through transfers to higher education institutions and to the business sector), higher education institutions – 2% and non-profit institutions – 1%. About 3% of the national expenditure on civilian R&D was financed by funds and donations from abroad.

The general government financed, through transfers, 57% of the expenditure on R&D conducted by higher education institutions, and 51% of R&D conducted by private non-profit institutions. In addition, 5% of R&D conducted by the business sector was financed by the general government through grants and subsidies.

2.3 International Comparison

In 2006, national expenditure on civilian R&D, as a percentage of the GDP in Israel was 4.5% – higher than in the OECD countries. The share of R&D in the GDP was 3% or above in Sweden (3.6%), Finland (3.4%), Japan (3.2%) and Korea (3.2%); in six

countries it was between 2.1% and 2.9%: Austria, Iceland, United States, Denmark, Germany and Switzerland and in the rest of the countries it ranged from 0.5% to 1.9%.



2.3.1 International comparison of government ministries' R&D financing, by objective

In 2007 the share of expenditure on advancement of industrial technology in Israel was 29.3% of R&D funds allocated by government ministries, compared to a median of the OECD countries – 10.9%. There were only two countries, Korea and Belgium, in which the share of R&D financing was higher than 30%. In Finland, Spain and Australia it was above 20% and in the rest of the countries it ranged between 1% and 16%. The share of financing allocated for advancement of general knowledge (General University Funds² and non-oriented research) in Israel in 2007 amounted to 54.1% of R&D financing by government ministries, compared to the median of the OECD countries – 46.3%. The lowest share (6.2%) was in Korea. The share of financing of health in Israel amounted to only 0.9% of R&D funds allocated by government ministries, compared to the median of the OECD countries – 7.8%. The highest rate was in the United States – 51.7%.

2.3.2 International comparison of R&D operated, by sector

The share of the higher education institutions in the national expenditure on R&D in Israel in 2006 was relatively low (13.7%), compared to the median of the OECD countries (26.1%). In contrast, the expenditure of private non-profit institutions on R&D in 2006 was high in Israel (3.7%), compared to the median of the OECD countries (0.6%).

The proportion of R&D expenditure by the business sector as a percentage of the total national expenditure on R&D was relatively high in Israel (77.3%), compared to the median of the OECD countries (59.8%). Only in Luxembourg the business sector share was higher (85.0%), in Korea, Japan, Switzerland and Sweden the percentage was slightly less than in Israel (between 74.0% and 77.0%), and in all other countries the percentage was lower.

2.3.3 International comparison of R&D financing, by sector

Comparison of financing by sector between Israel and the OECD countries indicates that in 2005, general government financing of the national expenditure on R&D in Israel (17.8% of the national expenditure on R&D) was lower than the median of the OECD countries (37.5%). In Italy, Poland, Turkey, Portugal and Slovakia, the share of the general government financing of R&D was especially high – over 50%. The R&D expenditure financed by the business sector in Israel (75.4% of the national expenditure on R&D) was higher than the median of the OECD countries (49.8%). In Korea, Luxembourg and Japan, the percentage of R&D financing by the business sector was higher than in Israel – between 75.0% and 79.7%. R&D financing by the higher education sector and by private non-profit institutions in Israel was 3.5% – higher than the median of the OECD countries (1.9%). Financing from abroad, which amounted to 3.3% of the R&D in Israel, was lower than the median of the OECD countries (6.3%).

² This relates to the Planning and Budgeting Committee of the Council for Higher Education.

2.4 Further Details of the Government Ministries' Expenditure

2.4.1 Summary of government ministries' expenditure on R&D in 1999–2007

In 2007, government expenditure on civilian R&D amounted to about NIS 4.0 billions (see Table B, below) which includes research, commissioning of research from other institutions and transfers for financing of R&D conducted by other sectors, including the General University Funds. The main expenditure of government ministries was by the Ministry of Industry, Trade and Labour. The expenditure of this ministry constituted 60% of the overall expenditure of government ministries on R&D. Expenditure on R&D by the Ministry of Industry, Trade and Labour, at current prices, decreased by 11%, following an increase of 4% in 2006.

TABLE B. – GOVERNMENT MINISTRIES' EXPENDITURE⁽¹⁾ ON CIVILIAN R&D
(AT CURRENT PRICES)

Type of Expenditure	2000	2001	2002	2003	2004	2005	2006	2007
Total financing and intramural expenditures (NIS millions)	4,347	4,572	4,380	4,575	4,082	3,938	4,082	3,964
	<i>Percentages</i>							
a. Government ministries' expenditure on civilian R&D, as percentage of current general government expenditure	1.98	1.95	1.76	1.83	1.65	1.56	1.53	1.44
b. Government ministries' expenditure on civilian R&D, as percentage of the general government expenditure on civilian consumption	4.73	4.66	4.22	4.44	3.88	3.64	3.59	3.29
Thereof: Intramural expenditure								
(1) Total expenditure on operation of civilian R&D, as percentage of current general government expenditure	0.55	0.55	0.55	0.55	0.58	0.58	0.57	0.59
(2) Civilian R&D operated, as percentage of general government consumption	0.92	0.92	0.89	0.92	0.97	0.95	0.93	0.96

⁽¹⁾ Including the General University Funds.

2.4.2. Government expenditure by objective

The breakdown of expenditures by government ministries on civilian R&D by objective (see Table C, below) reveals that in 2007 the share of expenditure for the advancement of general knowledge, financed mainly by the General University Funds, amounted to 54%. Expenditures for advancement of industrial technology amounted to 29%. The main expenditure in this field was for grants awarded by the Ministry of Industry, Trade and Labour. 8% of the R&D expenditure in 2007 was allocated for research on development in agriculture; 4% for research in social services – education, labour and social welfare, immigrant absorption, etc., and 1% was allocated for R&D in infrastructure (including research on transport and communications, and on urban and rural planning).

**TABLE C. – GOVERNMENT MINISTRIES' EXPENDITURE,⁽¹⁾ BY OBJECTIVE
(AT CURRENT PRICES)**

Objective	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL (NIS millions)	4,347	4,572	4,380	4,575	4,082	3,938	4,082	3,964
	<i>Percentages</i>							
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Advancement of general knowledge	47.2	47.5	50.5	46.2	49.3	51.4	52.0	54.1
Advancement of industrial technology	37.9	37.4	34.6	39.4	33.2	31.9	32.0	29.3
Agriculture, forestry and fishing	7.3	7.2	6.7	6.5	8.1	8.0	7.6	8.2
Social services	4.8	4.8	5.3	5.4	5.3	4.7	4.8	4.4
Infrastructure development	0.4	0.7	0.5	0.5	1.7	1.3	1.1	1.2
Other	2.3	2.4	2.4	2.0	2.4	2.7	2.5	2.8

⁽¹⁾ Including the General University Funds.

2.4.3. Expenditure of selected government ministries

The main expenditure of government ministries on R&D (at current prices) was by the Ministry of Industry, Trade and Labour. In 2007, the expenditure of this ministry constituted 60.2% of the overall expenditure of government ministries on R&D (excluding the General University Funds). Other ministries with significant shares of R&D expenditure were the Ministry of Agriculture and Rural Development, the Ministry of Science, Culture and Sports, and the Ministry of National Infrastructure.

The Ministry of Industry, Trade and Labour's expenditure on R&D amounted to about 35% of the overall expenditure in that ministry. The main R&D expenditure of the ministry was for transfers by the Chief Scientist to industrial establishments and to the R&D planning framework of the European Union, as well as to the R&D Fund and to the "Magnet" project, which conducts generic R&D.

Government transfers to the business sector included gross financing, i.e., without deduction of income from royalties. Income from royalties decreased by 26% in 2007 compared to 2006, and amounted to NIS 444 millions.

The expenditure of the Ministry of Agriculture and Rural Development on R&D in 2007 amounted to 17.2% of the total R&D expenditure by government ministries (excluding the General University Funds). In 2007, as in 2006, this ministry's share of the expenditure for direct operation of R&D industries was relatively high, and amounted to 83.2% of intramural expenditures of all government ministries on R&D. The ministry includes the Agriculture Research Administration (Volcani Institute), which coordinates and conducts government agricultural research and operates 6 research institutes that deal with applied infrastructure research in all areas of agriculture, 3 agricultural farms and 5 regional R&D stations throughout the country, that conduct applied research and field experiments for the purpose of solving local problems. In 2007, about 32% of the ministry's budget was allocated to the Agriculture Research Administration and to R&D.

The share of the Ministry of Science, Culture and Sports of R&D expenditure was about 10% of total government ministries' expenditure on R&D in 2007. The total budget for science in this ministry is included under R&D expenditure, due to the special nature of the ministry, whose activities are all directly or indirectly related to R&D. The expenses of the ministry include overhead, administration of research, and the products of research financed by the Israel-Germany Research Foundation.

The share of the Ministry of National Infrastructure of R&D expenditure was about 2% of total government ministries' expenditure on R&D. About 84% of the ministry's expenditure on R&D in 2007 was allocated for oceanographic research, oceanographic agriculture, and oil research.

**TABLE D. – EXPENDITURE FOR FINANCING CIVILIAN R&D
IN SELECTED GOVERNMENT MINISTRIES⁽¹⁾
(AT CURRENT PRICES)**

NIS millions

Ministry	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL	4,347	4,572	4,380	4,575	4,082	3,938	4,082	3,964
Industry, Trade and Labour	1,648	1,711	1,517	1,811	1,366	1,269	1,314	1,172
Agriculture and Rural Development	289	325	295	301	339	328	313	334
Science, Culture and Sports	213	229	195	128	133	138	165	187
National Infrastructure	92	67	55	52	44	35	46	44
General University Funds	1,887	1,984	2,063	1,992	1,886	1,905	2,009	2,019
Other	218	256	255	291	314	262	235	208

(1) Over the years, activities have been transferred from some ministries to others. Therefore, caution should be exercised in analyzing the series.

**TABLE E. – SELECTED GOVERNMENT MINISTRIES' EXPENDITURE⁽¹⁾
ON CIVILIAN R&D IN 2007, BY TYPE OF EXPENDITURE**

Percentages

Ministry	Grand total	Intramural expenditure	R&D purchase	Transfers
TOTAL	100.0	18.3	6.0	75.7
Industry, Trade and Labour	60.2	0.8	5.5	78.9
Agriculture and Rural Development	17.2	83.2	..	2.6
Science, Culture and Sports	9.6	8.1	..	10.8
National Infrastructure	2.3	..	37.3	..
Other	10.7	7.8	57.2	7.7

(1) Excluding the General University Funds.

3. Definitions and Classifications

3.1. Definition of R&D

The R&D definition, in Israel and in OECD countries, is the definition in the *Frascati Manual*,³ which was published by the Statistical Office of the OECD (called after a conference of experts on the subject, held in Frascati, Italy, in 1980):

“Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of knowledge to devise new applications”.

“The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty”.

“The term R&D covers three activities: basic research, applied research and experimental development.

***Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.*

***Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.*

***Experimental Development** is systematic work, drawing on existing knowledge gained from research and/or practical experience which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed”.*

R&D activities are a part of a wide range of activities, which includes Science and Technology Activities (STA), as identified by the Statistical Office of UNESCO.⁴ Science and Technology Activities include activities related to the production, development, dissemination and application of scientific and technical knowledge.

In addition to R&D activities, the STA includes scientific and technical education and training activities, as well as scientific and technical services. Scientific and technical services include, among other, activities of scientific libraries and museums, data collection on socioeconomic phenomena, testing, standardization and quality control.

The industrialized countries ascribe great importance to R&D activities because of their role in economic growth processes, the transformation of the industrial structure, the increased competitiveness of producers in local and international markets, etc.

³ See: OECD. *The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys on Research and Experimental Development. The Frascati Manual – 2002* (Paris, 2002).

OECD. *The Measurement of Scientific and Technological Activities, R&D Statistics and Output Measurement in the Higher Education Sector: The Frascati Manual, Supplement* (Paris, 1989).

⁴ See: UNESCO. *Recommendations Concerning the International Standardization of Statistics on Science and Technology* (The General Conference of the United Nations Educational, Scientific and Cultural Organization meeting in Paris from 24 October to 28 November, 1978, at its twentieth session) (<http://portal.unesco.org/en>).

The definitions and classifications in this publication are based on the recommendations in the *Frascati Manual* of the OECD for measuring expenditure on R&D, so the data on Israel are comparable to those of the OECD countries.

In the framework of national accounts, as in establishments' accounts, expenditure on R&D is classified as current expenses and not as a part of capital formation; this in spite of the possibility to consider this expenditure as capital formation, since it may have similar economic effects to those generated by the accumulation of fixed capital assets (see Appendices 1 and 2).

The system of national accounts published by the statistical offices of five organizations recommends the presentation of a separate estimate for R&D expenditures, in order to enable economic analysts, policy makers and other users of macroeconomic data to apply R&D figures along with other macroeconomic indicators.

The value of R&D services output is difficult to measure. The part of R&D sold separately by the establishments has a market price, but this part is relatively small. The main part is R&D used by the enterprises in the process of producing their products and is embodied in the value of their sales, but is difficult to separate. Therefore, we calculate the value of R&D that was not sold, as the sum of production expenditure on R&D.

In accordance with the recommendations of the *Frascati Manual*, the main concept in this publication is the **Expenditure on Research and Development (GERD)**. National expenditure on R&D includes expenditure on R&D performed in the country, hence expenditure on R&D funded from abroad was included, but payments made for R&D operated abroad were excluded.

In the estimate of the national expenditure on R&D presented here, defence R&D was excluded. Defence R&D includes all R&D activities for military purposes, irrespective of their contents or secondary civilian applications.

3.2. Sectorial Classification

The national expenditure on R&D was classified by sector according to the OECD recommendations, and a matrix was constructed which represents a combined classification by operating sector and financing sector. Financing from abroad for R&D conducted in the different sectors is shown in a separate row.

The units operating and financing R&D are classified into four sectors:

- (a) **Business** – including private and public establishments and business type units engaged in different kinds of industries (agriculture, computer services, etc.)
- (b) **General government** – broadly defined, including government ministries, local authorities, national institutions, the National Insurance Institute and private non-profit institutions financed mainly by government. Higher education institutions are considered as a separate sector because of their intensive R&D activity.
- (c) **Higher Education Institutions** – including the following institutions and research establishments associated with them: The Hebrew University, Technion – Israel Institute of Technology, Tel Aviv University, Bar-Ilan University, Haifa University, Ben Gurion University of the Negev and the Weizmann Institute of Science.
- (d) **Private Non-Profit Institutions** – including private or semi-private organizations which operate on a non-profit basis, and whose main source of financing is not governmental. R&D financing by households, such as donations, is presented together with financing by private non-profit institutions. Sources of R&D funding from abroad are shown separately.

3.2.1. Classification by operating sector

In the classification by operating sector, all direct expenses for conducting R&D are taken into account, regardless of the funding source.

Operation expenses include:

(a) **Current expenditure**

Compensation of employees – Wages and salaries paid to employed persons, including overtime, taxes on wages, deductions for severance pay and pension funds, etc. The government's expenditure on R&D includes imputed expenditure on pensions, which reflects the government's commitment to pay retirement pensions.

Intermediate Consumption – The value of non-durable goods and services consumed as inputs in R&D production, including materials, energy, communications, security, maintenance of buildings and equipment, and other current expenditure.

In order to avoid duplication when estimating national expenditure on R&D, expenditure on R&D in the establishment is included, while

purchase of R&D performed by other producers is not included, even if it is used as an intermediate input to generate R&D.

Following OECD recommendations, consumption of fixed capital and depreciation of equipment used for R&D activity is not included in current expenditure.

(b) Gross capital formation

Expenditure on buildings, equipment, machinery and vehicles acquired for R&D purposes.

3.2.2. Classification by financing sector

In the classification of R&D expenditure by the financing sector, the following are included: the cost of self-produced and independently financed R&D, the purchase of R&D from resident units, donations, grants and other capital transfers to resident sectors for the purpose of financing R&D.

Government ministries finance R&D in other sectors by means of: direct transfers or subsidies; transfers from R&D endowment funds; contracts of operation.

General government finance for the universities through the General University Funds is shown separately in the tables and is not included in the finance of the Ministry of Education.

General government transfers to the business sector include gross financing, i.e., without deduction of income from royalties. Income from royalties was 26% lower in 2007 than in 2006, and amounted to NIS 444 millions.

3.3. Classification by Scientific Field

The statistical units in the Non-Profit Institutions sector are classified by five main scientific fields, in accordance with the recommendations of the *Frascati Manual*.⁵

- (a) Natural Sciences
- (b) Medicine
- (c) Social Sciences
- (d) Humanities
- (e) Other

An institution is classified by scientific field according to the type of the main activity performed or financed in it.

⁵ See OECD. *Main Science and Technology Indicators*, 2008/1 (Paris, 2008).

3.4. Classification by Objective

Government ministries' expenditure is classified by objective, according to the recommendations of the *Frascati manual*:

- a. **Development of agriculture, forestry and fishing** – this group covers all R&D that is aimed primarily at developing these activities, including, for example, work with chemicals. It excludes the food processing and packaging industries, which are described in section b, below.
- b. **Advancement of industrial technology** – the core of this group consists of R&D programs aimed primarily at advancing development in the manufacturing industries; also includes the construction industry, wholesale and retail trade, restaurants and hotels, banking, insurance and other commercial services. It does not include R&D performed in manufacturing in support of other objectives, for example, in the fields of space, defence, and transport and communications.
- c. **Production and utilization of energy** – this group covers all R&D activities aimed at the supply, production, conservation and distribution of all forms of energy.
- d. **Infrastructure development**
 - (1) Transport and communications – R&D directed towards better and safer transportation systems, including traffic safety. R&D of all communication services (excluding satellites), as well as R&D of the planning and organization of networks.
 - (2) Urban and rural planning – This includes R&D referring to the total planning of urban and rural areas, better housing and improvements of the community environment, location of institutions such as hospitals, etc.
- e. **Control and care of the environment** – This group covers R&D directed towards an advancement of environmental quality. It covers pollution of air, water, and soil; noise; solid waste disposal; and radiation.
- f. **Health** – This group covers R&D programs directed towards the protection and improvement of human health. It includes R&D of epidemiology, preventative medicine and drug addiction.
- g. **Social services** – R&D related to social and cultural problems, for example, national insurance, welfare services, culture, recreation and leisure, law and order, consumer protection, working conditions, labour relations, advancement of individuals, peace, national economy and other international objectives.
- h. **Exploration and exploitation of the earth** – This group covers exploration and exploitation of the seas, oceans, earth and atmosphere. It includes R&D of meteorology (except when conducted by satellites).

i. Advancement of general knowledge

- (1) Non-oriented research – This group covers all R&D which contributes to the advancement of general knowledge and cannot be attributed to a specific objective.
- (2) General University Funds – All R&D financed by general purpose grants from the Ministry of Education.

j. Exploration and exploitation of space – This group covers all civil R&D concerning space.

3.5 Administrative Classification

The expenditure of government ministries is also presented by an administrative classification – by ministries (Industry, Trade and Labour; Agriculture and Rural Development; Science, Culture and Sports; National Infrastructure; and other ministries).

3.6 Classification by Industry

The expenditure of manufacturing industries was classified by divisions, in accordance with the *Standard Industrial Classification of All Economic Activities – 1993*.⁶

4. Methods and Sources

Methods and Sources for Israel's Estimates

Estimates of national expenditure on R&D in Israel include only civilian R&D, and are based on surveys in the following sectors and sub-sectors.

4.1. Business Sector

4.1.1. Manufacturing

The estimates are based on R&D Surveys in Manufacturing for the years 1989–2006,⁷ (see questionnaire on manufacturing enclosed as an example in Appendix 4).

The 1989 survey was based on a sample list of establishments that employ 50 or more persons who engage in R&D activities.

In 1990 an expanded survey was conducted among all manufacturing establishments that employ five or more persons who engage in R&D activities. The establishments in this survey were selected according to the sample of the manufacturing survey. The findings of the 1990 survey were used to estimate the R&D activities of establishments that were not covered by the 1989 survey.⁸

⁶ See Central Bureau of Statistics. *Standard Industrial Classification of All Economic Activities – 1993* (Technical Publication No. 63, Second Edition) (Jerusalem, 1993).

⁷ See Central Bureau of Statistics. *Business Research and Development – 2005* (Publication No. 1334) (Jerusalem, 2008).

⁸ Additional explanations of sources and methods related to R&D in manufacturing appear in: Central Bureau of Statistics. *Survey of R&D in Industry 1980/81–1984/85* (Publication No.799) (Jerusalem, 1987).

These surveys exclude manufacturing establishments of the defence system which engage in defence R&D activities.

4.1.2. Electricity, water, communications and business services industries

Data on the Electricity, Water, Communications, Computer Services and Business Services industries were obtained through special questionnaires sent to establishments classified according to industry, sampled from administrative sources or analysis of financial reports. In addition, interviews were conducted with personnel in charge of R&D activities.

Since 1995, the Central Bureau of Statistics has been conducting an annual survey of software companies. In 1997 the survey coverage has been expanded and provides a detailed definition of R&D in software companies.

The business sector includes R&D centres of foreign companies, as well as technological incubators, which help out small businesses during their initial stages of activity, and contribute toward the absorption of new immigrant scientists.

4.1.3. Other industries

For transportation and other industries that were not covered in the surveys imputation was done on the basis of data on personnel engaged in R&D, by industry⁹ and were updated according to indices.

4.2. General Government Sector

4.2.1. Government ministries

Estimates of expenditure on R&D in government ministries were based primarily on locating and collecting the relevant items in the financial reports compiled by the Accountant General on the performance of the current and development budgets. Additional sources were annual reports of the State Comptroller and the explanatory notes to the ministries' budgets. The reports obtained from the ministries on their budget performance were at the most expanded level (8 items). Nevertheless, at this level of specification, only some of the expenditures on R&D in government ministries were presented as separate items.

A list was prepared of all budget items that include or may include expenditure on current production of R&D, or financing of R&D activities performed by other resident sectors. On the basis of this list, information was collected through interviews with the accountants or officials in charge of implementing the specific budget items. Several examples were given and the R&D boundaries were clarified. For example, it was clarified that statistical data collection is defined as R&D only if it is conducted as part of a specific research project or development plan.

As of 2001, in addition to the financial reports compiled by the Accountant General, data on R&D in government ministries are based on a questionnaire (see Appendix 5). In this questionnaire, the accountants or other staff members responsible for R&D were requested to fill in the data on R&D expenditure in

⁹ See Central Bureau of Statistics. *Business Research and Development – 2005* (Publication No. 1334) (Jerusalem, 2008).

their ministries at the highest level of specification, by the relevant budget items which were categorized as follows: intramural expenditure (including compensation of employees, current expenditure and capital formation), type of research (basic, applied and experimental), R&D purchase, current transfers, capital transfers and income. In addition to expenditure and income data, respondents were asked to indicate the number of employees in the ministry that engage in R&D and the number of their posts.

The estimates are updated in accordance with structural changes in government ministries.

4.2.2. Local authorities and national institutions

These estimates were based on financial reports of the national institutions (the Jewish Agency for Israel, Jewish National Fund, Keren HaYesod and the World Zionist Organization) and the local authorities. Additional information was gathered in interviews with treasury officials.

4.2.3. Public non-profit institutions

Data on these institutions were obtained through a survey conducted by the Central Bureau of Statistics, which included all the institutions defined as “Non-Profit Institutions” by the VAT division in the Ministry of Finance. They were collected through special questionnaires, financial reports and interviews with personnel in charge of the subject, covering 133 institutions (40 public and 93 private non-profit institutions).

These institutions were found on the list of institutions recognized as “Non-Profit Institutions” by the VAT authorities.

4.3. Private Non-Profit Institutions Sector

Data were obtained through the same survey described above, which also includes, as mentioned, private non-profit institutions.

4.4. Higher Education Sector

Data are taken from a survey conducted by the Central Bureau of Statistics, based on financial reports of the universities. The survey covers R&D activities in these institutions: the Hebrew University, Technion – Israel Institute of Technology, Tel Aviv University, Bar-Ilan University, Haifa University, Ben Gurion University of the Negev, and the Weizmann Institute of Science.

In order to estimate the expenditure on conducting R&D activities in the higher education sector, three main funding sources were investigated.

4.4.1. Current budget

R&D is an integral part of the academic activities in higher education institutions. It is difficult to separate R&D from educational activities, and R&D expenditure is not shown separately in the current budget. Therefore, the Central Bureau of Statistics conducted a survey, which examines how the universities’ faculty distribute their work time between R&D and teaching. The results are used to estimate the expenditure on R&D, which is financed through the current budget.

Following the Frascati Manual's recommendation, tuition fees paid by households as well as donations, which are not designated for a specific research activity, are considered the university's self-financing.

4.4.2. Specially financed research

Funding for specific research is provided by individuals and institutions in Israel and abroad, in the form of research grants allocated by foundations, individual donations, research commissioned by establishments, government ministries, etc. Separate accounts are kept for R&D activities financed by these sources, and data on them are collected from R&D authorities and accountants of the institutions.

4.4.3. Internal institutional research funds

Each of the higher education institutions has a fund or funds to finance research by faculty. These funds are separately financed by or reimbursed from general expenses (overhead) on research projects funds by external resources. Data on R&D financed by these funds are collected from the funds' management.

4.5. Preliminary Estimates

4.5.1 The business sector

For 2007, a preliminary estimate has been calculated, based on revenue and employment data in establishments in which R&D is performed, together with data from labour force surveys and the National Insurance institute.

The 2006–2007 estimates for the industries: Electricity, Water, Communications, Computer and Related Services, and Business Services, are based on incomplete reports, as well as on budget and employment data.

For transport and other industries that were not surveyed (paragraph 4.1.3), an imputation by industry was carried out, based on data from Labour Force Surveys and National Insurance Institute on personnel employed in R&D.

4.5.2. The general government sector

The estimate for 2007 is based on final reports provided by government ministries on their budget performance in 2007, as well as on a questionnaire for 2006 filled out in the ministries. As for the public non-profit institutions, The most recent survey for which reports were obtained was conducted in 2005. Estimates for 2006–2007 are based on that survey as well as on extrapolation of data based on wage and employment statistics reported to the National Insurance Institute.

4.5.3. The sector of private non-profit institutions

The estimates are the same ones of the public non-profit-institutions specified in paragraph 4.5.2, above. As mentioned, the survey includes public as well as private non-profit institutions.

4.5.4. The higher education sector

A preliminary estimate for 2005–2007 was computed according to the budgets of the universities.

4.6. Other Adjustments

Gross fixed capital formation for R&D in universities was estimated on the basis of data from Planning and Budgeting Committee of the Council for Higher Education, and from the Central Bureau of Statistics survey on capital formation in universities.

Data obtained for academic years (September–August) were adjusted to calendar years by using specific price indices for each type of expenditure.

4.7. Estimates at Constant Prices

The annual changes in the national expenditure on R&D and its main components, at constant prices, were calculated separately for each sector (business, government, higher-education and non-profit institutions), and in most cases, for each type of expenditure.

- (a) In the general government, in higher education institutions, and in non-profit institutions, the change in compensation of employees was estimated by using the employee job average wage index for the specific sector. Current expenditures for the purchase of goods and services were calculated by deducting the estimates, at current prices, from a price index that considers the special composition of the expenditures made by these institutions; capital formation in buildings was assessed by the Price Index of Input in Residential Building; and capital formation in equipment was estimated by price changes in the output of industries that manufacture such equipment and price changes in imported equipment.
- (b) In the business sector, whose data are based mainly on the Manufacturing Survey until 1995, estimates were calculated at constant prices, by using the Consumer Price Index. Since 1996 estimates are calculated at constant prices as in other sectors.

Sources and Methods for the International Comparison

4.8. Sources

Data on R&D for OECD countries were taken from OECD publications.¹⁰

For countries with no detailed data for the years 2005 and 2006 data for the nearest year were taken instead.

4.9. Methods

4.9.1. Purchasing Power Parity (PPP)

An international comparison project was conducted for 30 OECD countries, and 12 countries (including Israel) that are not members of the organization but participated in the comparative project. The project was coordinated jointly by the OECD and Eurostat. The aim of the project was to conduct international comparisons of the GDP and of the main items of expenditure per capita. To conduct the project, special exchange rates were constructed, known as “Purchasing Power Parity” (PPP). Based on these values, it is possible to deduct the differences between countries. The value of the GDP based on the PPP is in constant prices, and variations in the level of the GDP in different countries reflect only differences in amounts of goods and services.

To prepare the PPP, data on prices of a wide variety of goods and services (about 2,500 items) were collected, according to specific definitions that were formulated for all of the countries that participated in the project. The international comparison of expenditure on R&D was compiled considering the PPP of the products, in the absence of a special PPP for the R&D expenditure basket.

4.9.2. Medians for financing and performance

The composition of expenditure on R&D by operating and financing sectors is provided for individual countries. In addition, median expenditures for all of the OECD countries that provided data are presented.

The tables of international comparison present weighted medians for OECD countries.

4.9.3. Civilian and general R&D

For Israel, civilian expenditure on R&D is presented, whereas total expenditure on R&D, including defence R&D, is presented for some other countries. The share of defence R&D expenses is relatively high in the United States (about 58% of total R&D).

The inclusion of defence R&D in Israel’s expenditure would increase the relative share of the business and general government sectors and consequently diminish the relative proportion of other sectors.

¹⁰ See: OECD. *Main Science and Technology Indicators*, 2008/1 (Paris, 2008).
OECD. *Basic Science and Technology Statistics* (2003 Edition) (Paris, 2005).

5. Reliability of the Data

When analyzing R&D expenditure data, it is important to remember that the statistics of R&D are less comprehensive and reliable than in other fields. There are no separate accounts of expenditure on R&D in most institutions and establishments, and R&D expenditure is usually mixed with other cost components of producing goods and services (see discussion on problems of measuring in Appendix 1). Even when separate data on R&D are available, the definition of R&D in establishments is not uniform, and depends on subjective considerations. A similar problem exists in other areas, although apparently on a smaller scale. This problem exists particularly in higher education institutions, where education and research activity are combined.

When comparing the international data of R&D it should be taken into account that besides the above-mentioned problems of measuring, there are also differences between the various countries which make comparison more difficult:

- (a) The level of development of statistics in different countries is not uniform and there are differences in the coverage and quality of statistics.
- (b) Differences in institutional structure in the different countries affect the composition of R&D activity by operating sector and financing sector. For example, similar operating units such as higher education institutions are owned by government in some countries and by private non-profit institutions in others.

The discrepancy between the price levels and relative prices of the components of expenditure on R&D is only partially solved by comparing the expenditure on R&D in terms of purchasing power, which was calculated for all goods and services within the GDP but not for expenditure on R&D.

6. Revisions and Improvement of the Estimates

The estimates published in *National Expenditure on Civilian Research and Development 1989–2006*,¹¹ were revised following receipt of detailed information and updated statistics.

¹¹ Central Bureau of Statistics. *National Expenditure on Civilian Research and Development – 1989–2006* (Publication No. 1321) (Jerusalem, 2008) (Internet only).