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Maurizio Rocchi is responsible for the targeted project “Science and Innovation” of the Ceris-Cnr Rome research unit, within which this publication has been realized.
It was compiled thanks to the commitment of Anna Maria Scarda (CERIS-CNR associate), Cinzia Spaziani, and Mario de Marchi.
In particular, besides acting as supervisor, Anna Maria Scarda handled the general framework of this volume and the selection and construction of the most relevant indicators, together with Mario De Marchi. Cinzia Spaziani’s fundamental contribution consisted in collecting and elaborating the data and in drawing up graphs and tables.

The on-line version of this edition and updates are available at:
http://www.cnr.it
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Foreword

Scientific research and technological innovation are terms commonly used to describe the competitiveness of a country, region, or territory. Nevertheless, those who are familiar with the political and economic debate cannot but be aware that most of the issues put forward are based on a very limited number of indicators, starting from the research expenditure/gross domestic product ratio. Yet, as the experts know well, a great amount of data is now available in Italy and in the most developed countries. These data are provided by national statistics offices as well as by international organisations, such as Eurostat and the OECD.

Although they can be accessed electronically, the data are unfortunately scattered across various sources, each with its own collection and elaboration methods and its own communication and circulation strategies, with different timeframes. To further complicate matters, data are also provided by other bodies – such as ministries, observatories, and agencies for the evaluation of research –, but usually in an inconsistent and fragmented way. With the exclusion of research and innovation policy scholars, the general public is often made aware of a small fraction of this wealth of information, i.e. what is reported by the media when the data are presented.

It is also worth noting that continuous steps forward in technology, as well as the drawing up of research policies, constantly require new knowledge. It is therefore necessary to provide indicators at the international level to detect, for instance, new phenomena or to further investigate situations that have already been partially studied. CERIS (Institute of Economic Research on Firms and Growth) participates in this process through its "Science and innovation" research group, which has compiled this Data Book, now in its second edition. Its objective is to reduce problems of direct access to the sources by presenting, above all to non-experts, the available updated information, organised by broad thematic areas. Besides a printed edition, CERIS also provides an on-line electronic edition that, as was done in the past, will be regularly updated.

Secondo Rolfo
Director CERIS-CNR

Research and innovation indicators

The analysis of science and technology indicators is one of the areas studied by the Institute for Economic Research on Firms and Growth (CERIS). CERIS has deemed it appropriate to follow on from its 2007 initiative by publishing an updated version of "Science and technology in numbers" (with data available in mid-2010), which has been improved and enriched with new statistical information on scientific research and technological innovation.

This publication aims at providing a comprehensive description of the Italian scientific and technological system, based on the input of financial and human resources into the system and on its most important output, i.e. original knowledge.

It presents a selected set of the main indicators traditionally used to describe the involvement of a country in research and technological innovation. The statistical information on science and technology in Italy and other countries is drawn from surveys and data gathering activities carried out by Italian public institutions (Italian National Institute of Statistics - ISTAT, Bank of Italy, Ministry of Education, University and Research - MIUR), by the European Union (Eurostat, DG XII), by the Organisation for Economic Co-operation and Development (OECD), by institutions from other countries (NSF), and by associations that monitor trends in their own sectors (AIFI, WIPO).

Data uniformity and comparability are ensured by the use of the Frascati Manual[1] as a reference. The Manual

[1] OECD, *Frascati Manual*, OECD, Paris, 2002. Statistical surveys on R&D were initiated in Italy for the first time in 1963, when ISTAT launched a survey based on the OECD's methodological guidelines contained in the first edition of the so-called "Frascati Manual". The Frascati Manual is the reference document at the international level (also adopted by Eurostat) for the harmonisation of the methodologies used for statistical surveys on R&D activities. It was followed by other manuals focusing on specific indicators sectors (personnel, patents, TBP, innovation).

provides main methodological guidelines for statistics on research and its criteria are adopted by OECD member countries as well as by external non-member countries.

The overall internal R&D expenditure of a statistical unit is certainly a useful indicator to assess the extent and potential of its involvement in research activities. To provide a balanced assessment of its research effort, the size of the considered statistical unit must be taken into account. As for countries, among the various options to calculate their economic potential, the most suitable indicator to normalise R&D expenditure appears to be the gross domestic product (GDP). It is clear that the resources that can be allocated to research each year are a limited portion of the GDP. Moreover, research exerts a positive influence on the GDP, which creates an even stronger connection between science and technology and the wealth generated.

The absolute values of R&D expenditure are also reported in constant terms, i.e. deflated with indices determined on base years. For the sake of simplicity and controllability, this is done by using the same deflator adopted for the gross domestic product.

In international comparisons, besides the issue of deflating values within each country, there is the problem of the often considerable difference between the actual exchange rates (also depending on the irregular evolution of speculation) and the ratios of the currencies' purchasing powers. This problem is dealt with by calculating ideal exchange rates based on the purchasing power of each country's currency over a basket of goods that is the same for all the countries.

The wide range of sources of financing and sectors in which research is performed generates a complex set of interrelated flows. Therefore, according to conventional practice, sources of financing are divided into the following categories: central and local public administration, firms, non-profit sectors, abroad.

A large amount of financing comes from the European Union; it stimulates collaborations among countries,

not only within the EU, and aims at enhancing each country's expertise. Venture capital is another source of financing and it is used by firms especially for the development of new products and new technologies.

The statistics on human resources involved in R&D essentially mirror those on financial resources.

The value that should be attributed to each fragment of new original knowledge produced by research activities (their main, but not their only, result, which also includes the training of qualified personnel) is measured in quantitative and objective terms by broad knowledge aggregates, by giving it a weight that is proportional to the number of scientific publications.

A natural extension of the quantitative analysis on publications concerns discoveries with practical applications and, in particular, those inventions whose economic value is appropriable by the discoverer through the legal instrument of patent.

Furthermore, the series of indicators gathered here includes some magnitudes aimed at measuring activities that are usually downstream from R&D, regarding technological innovations and the expenses borne by firms to introduce them. These data are collected by following the methodologies and guidelines suggested by the OECD in the Oslo Manual[2]. Lastly, since technology is the object of ever more intense international trade, this work also presents information on the technology balance of payments.

Maurizio Rocchi
Responsible for the Targeted Project
"Science and Innovation"

[2] OECD, *Oslo Manual*, Paris, 2005. The first version was released in 1992.

Glossary

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 this stock of knowledge to devise new applications.

> *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 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 for research and/or practical experience that is directed to produce new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

R&D expenditures are all expenditures for R&D performed within a research unit or sector of the economy, whatever the source of funds. They include both current and capital expenditures.

Public funding of R&D includes the financing by the government of the R&D performed in universities, state agencies and research institutes, other public bodies, non-profit institutions, the business sector, abroad and in international agencies.

R&D appropriations include the funds allocated by central and local governments to R&D performing units.

Research personnel include three groups of personnel: researchers, technicians and other supporting staff:

- *Researchers* are scientists or engineers engaged in the conception or creation of new knowledge, products, processes, methods and systems. They include university teachers and researchers, researchers employed by government and state agencies, by non-profit institutions and by the business sector.

- *Technicians* participate in R&D projects by performing scientific and technical tasks, normally under the supervision of a researcher.

- *Other supporting staff* participate in R&D projects or related activities, performing clerical, secretarial or various supporting tasks.

Full-time equivalent (FTE): the number of research personnel that are not performing R&D activity on a part time basis is reduced to the number of full-time equivalent personnel.

Human resources in science and technology (HRST) identify the number of people employed or qualified for a job in R&D, and fulfil one of the following conditions: they have successfully completed education at the third level or are not formally qualified as above but employed in a S&T occupation where the above qualifications are normally required.

The *public sector* includes:

- ministries and agencies which depend directly from the central Government;

- public research agencies and institutes with budget autonomy;

- local authorities and other public bodies which fund or perform R&D.

The number of teachers, university students and doctoral students in Italy always refer to an academic year, the numbers reported by OECD and other international organisations refer to solar years.

Small and medium enterprises (SMEs) are considered the companies employing up to 249 persons and satisfy specific financial parameters.

Scientific publications. They are those ones included in data bases used by the NSF and consist of scientific and engineering articles published in the set of 5,266 journals covered by the Thomson Reuters Science Citation Index (SCI) and Social Science Citation Index (SSCI) in 2008.

The *patent* for industrial invention represents the right of the inventor to the exclusive industrial and commercial use for a limited period and a given geographical area.

The *Technological Balance of Payments (TBP)* measures the "invisible" technological transactions in a country's balance of payments. They are related to the purchase and sale of technological know-how and information, such as patents, licences, trademarks, designs, know-how and closely related technical services (including technical assistance) and for industrial R&D carried out abroad.

The *Community Innovation Survey (CIS)* data are the main source of information for studying innovation drivers and company behaviour towards innovation. The *innovation* is a new or significantly improved product (good or service) introduced to the market or a new or significantly improved process introduced within an enterprise. Innovations are based on the results of new technological developments, new combinations of existing technology or utilisation of existing technology and other knowledge acquired by the enterprise. Data on technological innovation refer to the three-year 2004-2006.

The *Gross Domestic Product (GDP)* includes the total production of goods and services of a country's economy in

a given year, less intermediate consumption and plus indirect taxation on imports.

The *GDP deflator* is the ratio between GDP at current prices and GDP at constant prices. The basis year is 2000.

Purchasing Power Parities (PPP) are exchange rates measuring the ratio of purchasing power in terms of a basket of goods and services between two currencies. In this data-book the OECD purchasing power parities have been used.

The *Purchasing Power Standard* (PPS) is an artificial currency unit, defined by EUROSTAT, in which National Accounts are expressed when they are adjusted for price level differences using PPP. Thus, PPPs can be interpreted as the exchange rate of PPS against the euro.

ABBREVIATIONS

AIFI	Italian Association of the Private Equity e Venture Capital
CNR	Consiglio nazionale delle ricerche (National Research Council)
CNVSU	Comitato nazionale per la valutazione del sistema universitario (National Committee for the Evaluation of the Research System)
EPO	European Patent Office
EUROSTAT	Istituto statistico delle comunità europee (Statistical Office of the European Communities)
ISTAT	Istituto nazionale di statistica (National Institute of Statistics)
JPO	Japanese Patent Office
MIUR	Ministero dell'istruzione, dell'università e della ricerca (Ministry of Education, University and Research)
NSF	National Science Foundation
OECD	Organisation for Economic Cooperation and Development
PCT	Patent Cooperation Treaty
EU	European Union
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization

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1. R&D data

The data presented in this section are fundamental to estimate the size of R&D activities in Italy and to place them in an international context. The sources for Italy are the National Institute of Statistics, which carries out a survey on R&D each year. Eurostat and OECD data are used for international comparisons.

This section analyses the institutional R&D expenditure sectors since 1975 (table 1.1) and the sources of financing since 1997 (table 1.2). Figure 1.1 displays the trend of R&D expenditure as a whole and in relation to the GDP of the country since 1980. Figure 1.2 shows the evolution of expenditure in the last 12 years, broken down by main institutional sectors, whereas figure 1.3 breaks down the investments made by the various institutional sectors into basic research, applied research, and experimental development. The financial and human resources for scientific activities used by the different Italian regions are also shown (figures 1.4, 1.5 and 1.6).

The ratio of R&D expenditure over GDP indicates the magnitude of R&D expenditure in relation to the wealth generated by a country in the year in question and it is the most commonly adopted indicator in international comparisons (table 1.3). China, Israel and the Russian Federation have been added to the OECD countries selected for the comparison, since these three nations display a particularly remarkable development in scientific activities and they comply with the OECD survey criteria from a methodological point of view.

Also in international comparisons we analyse both the institutional sectors of R&D expenditure (figures 1.7, 1.8 and 1.9) and the sectors that finance scientific activities (figure 1.10). Figures 1.11 and 1.12 refer to 2007 and illustrate the financial resources (over GDP and as expenditure per researcher) and human resources (in relation to the workforce) invested by several countries in research and development activities.

Figures 1.13 and 1.14 provide indications on how much the various countries rely on new technologies for their development.

Table 1.1 - R&D expenditure in Italy, 1975-2009

(million current euros)

Institutional sectors	*1975*	*1980*	*1985*	*1990*	*1995*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008(a)*	*2009(a)*
Government	135	371	1,126	1,839	1,949	2,356	2,493	2,565	2,582	2,722	2,701	2,897	2,644	2,463	2,883
Research agencies					*1,618*	*1,886*	*1,923*	*2,115*	*2,113*	-	-	-	-	-	-
Other public institutions					*331*	*470*	*570*	*450*	*469*	-	-	-	-	-	-
University	132	241	904	1,821	2,349	3,865	4,418	4,792	5,000	5,005	4,712	5,098	5,495	6,053	-
Private non-profit institutions								186	208	233	330	630	637	618	739
Business	336	883	2,686	5,120	4,928	6,239	6,661	7,057	6,979	7,293	7,856	8,210	9,455	9,453	9,972
Total	603	1,496	4,717	8,780	9,226	12,460	13,572	14,600	14,769	15,253	15,599	16,835	18,231	18,587	-
Total (2000 constant prices)	5,257	5,900	9,571	12,738	10,555	12,460	13,182	13,732	13,472	13,556	13,583	14,395	15,198	15,080	-

Notes: Since 1995 only intramural R&D expenditure is considered and the estimate procedure of R&D university's expenditure has been changed; (a) ISTAT estimate on provisional data released by the various subjects.

Source: ISTAT.

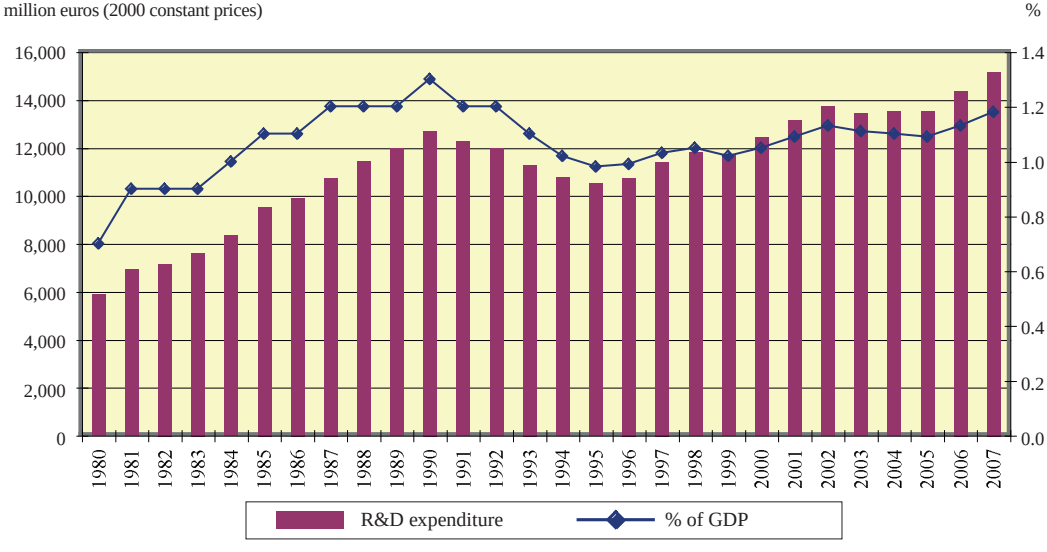
Table 1.2 - R&D expenditure by source of funds in Italy, 1997-2007

(percentages)

Source of funds	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
					Government sector expenditure						
Business enterprise sector	1.4	1.1	1.1	1.7	3.5	3.4	1.2	2.9	2.4	4.1	4.4
Government	93.3	94.6	94.8	93.3	87.0	90.5	92.2	88.2	90.8	86.7	86.9
University	0.1	0.0	0.1	0.1	0.3	0.3	0.1	0.1	0.3	0.1	0.2
Private non-profit sector	2.7	1.2	1.3	1.1	5.2	1.6	1.7	3.0	2.1	2.0	2.2
Abroad	2.5	3.0	2.8	3.8	4.0	4.3	4.9	5.8	4.4	7.1	6.3
Total million euros (2000 constant prices)	2,220	2,394	2,258	2,356	2,422	2,413	2,355	2,419	2,352	2,477	2,204
					University expenditure						
Business enterprise sector	-	-	-	-	-	-	-	-	1.4	1.2	1.4
Government	-	-	-	-	-	-	-	-	94.6	89.5	90.8
University	-	-	-	-	-	-	-	-	0.0	4.4	4.0
Private non-profit sector	-	-	-	-	-	-	-	-	0.9	1.0	1.1
Abroad	-	-	-	-	-	-	-	-	3.1	3.9	2.7
Total million euros (2000 constant prices)						-	-	-	4,103	4,359	4,581
					Business sector expenditure						
Business enterprise sector	77.5	80.8	78.7	80.5	78.2	77.4	76.1	75.1	76.8	80.2	78.6
Government	13.1	11.0	13.0	11.0	14.9	12.2	14.1	13.8	11.0	8.1	6.6
University	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Private non-profit sector	0.4	0.2	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.2
Abroad	9.0	8.1	8.1	8.2	6.6	10.3	9.6	11.0	12.0	11.6	14.6
Total million euros (2000 constant prices)	5,702	5,719	5,799	6,239	6,469	6,637	6,366	6,482	6,841	7,020	7,882
					Private non-profit institutions expenditure						
Business enterprise sector	-	-	-	-	-	12.7	9.5	9.7	7.1	6.2	6.5
Government	-	-	-	-	-	44.1	36.0	34.5	41.3	27.3	24.8
University	-	-	-	-	-	0.5	0.3	0.2	0.5	0.4	0.2
Private non-profit sector	-	-	-	-	-	36.8	48.2	48.8	43.9	60.7	62.8
Abroad	-	-	-	-	-	5.9	6.0	6.8	7.2	5.4	5.7
Total million euros (2000 constant prices)						175	190	207	287	539	531

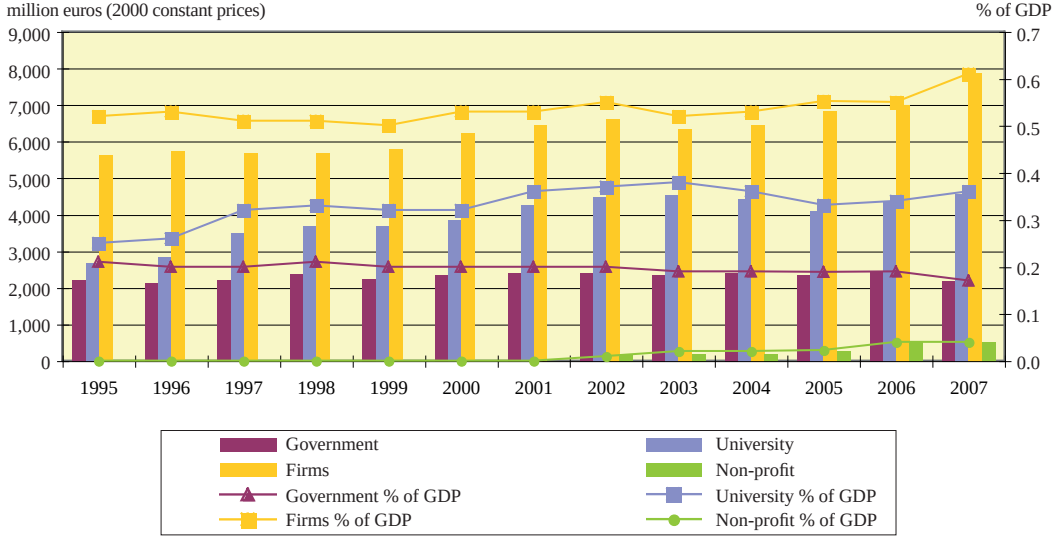
Note: Data for private non-profit sector are available from 2002 onwards and those concerning university from 2005.
Source: ISTAT.

Figure 1.1 - R&D expenditure over GDP in Italy, 1980-2007



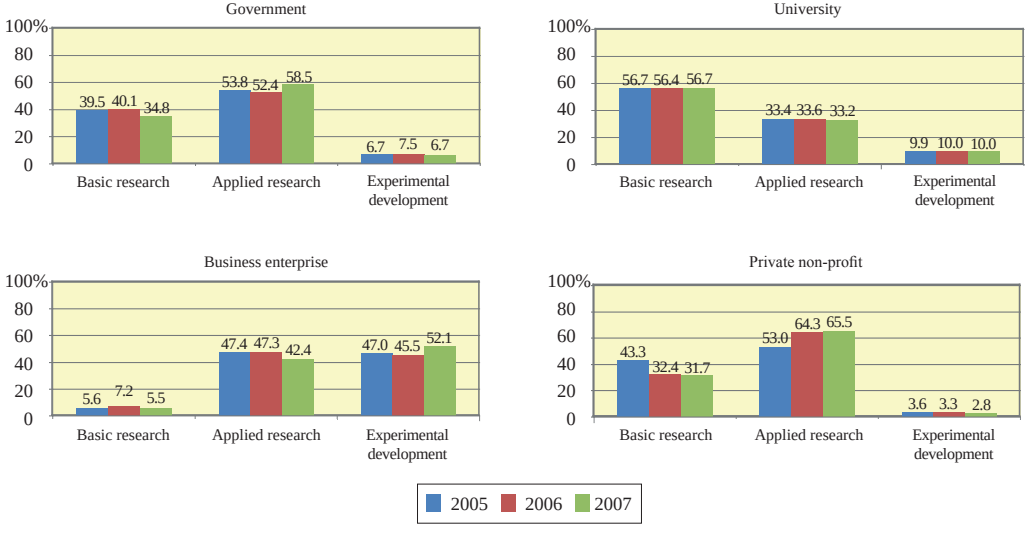
Note: Since 1995 only intramural R&D expenditure is considered.
Source: CERIS-CNR elaboration on ISTAT data.

Figure 1.2 - R&D expenditure by institutional sector on GDP in Italy, 1995-2007



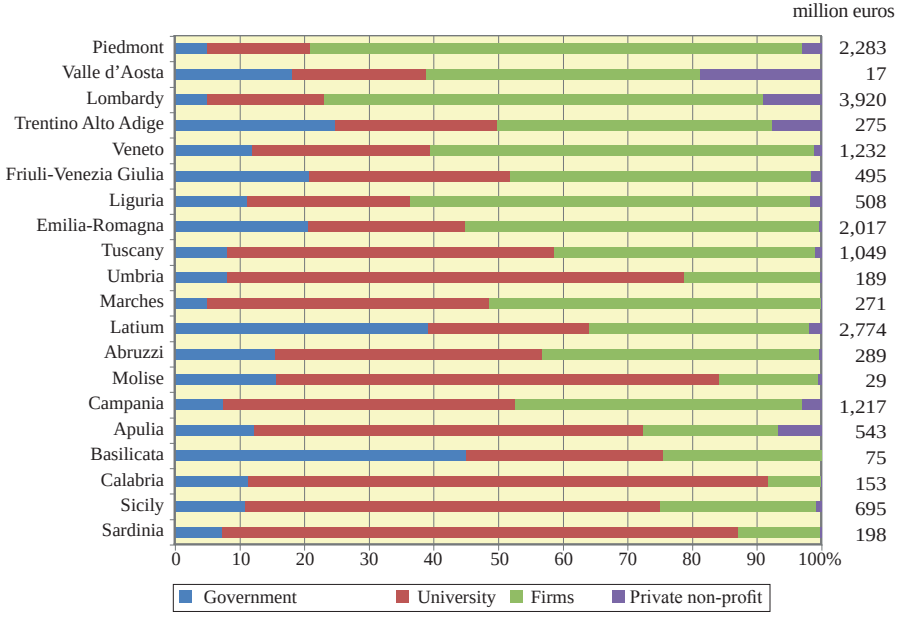
Source: CERIS-CNR elaboration on ISTAT data.

Figure 1.3 - R&D expenditure by institutional sector and type of research in Italy, 2005-2007



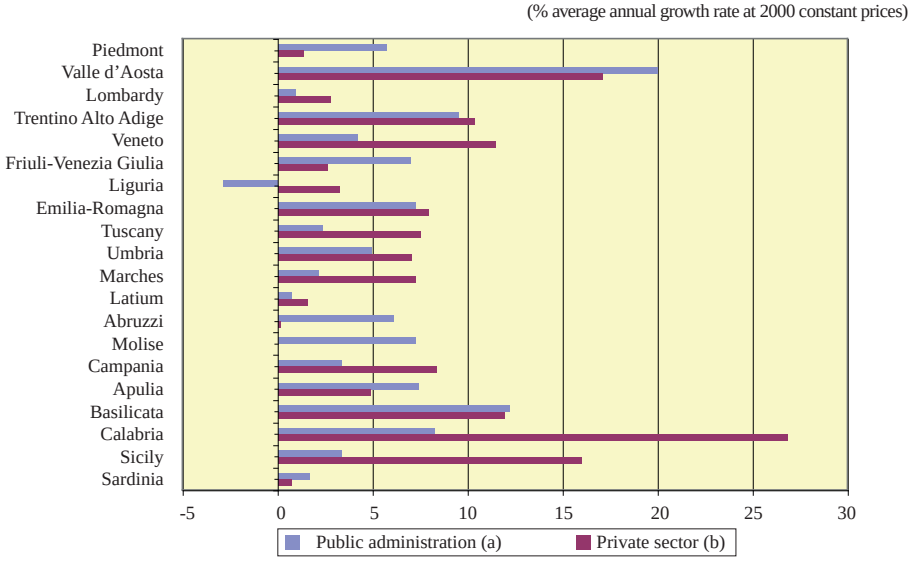
Source: CERIS-CNR elaboration on ISTAT data.

Figure 1.4 - R&D expenditure by institutional sector and region in Italy, 2007



Source: ISTAT.

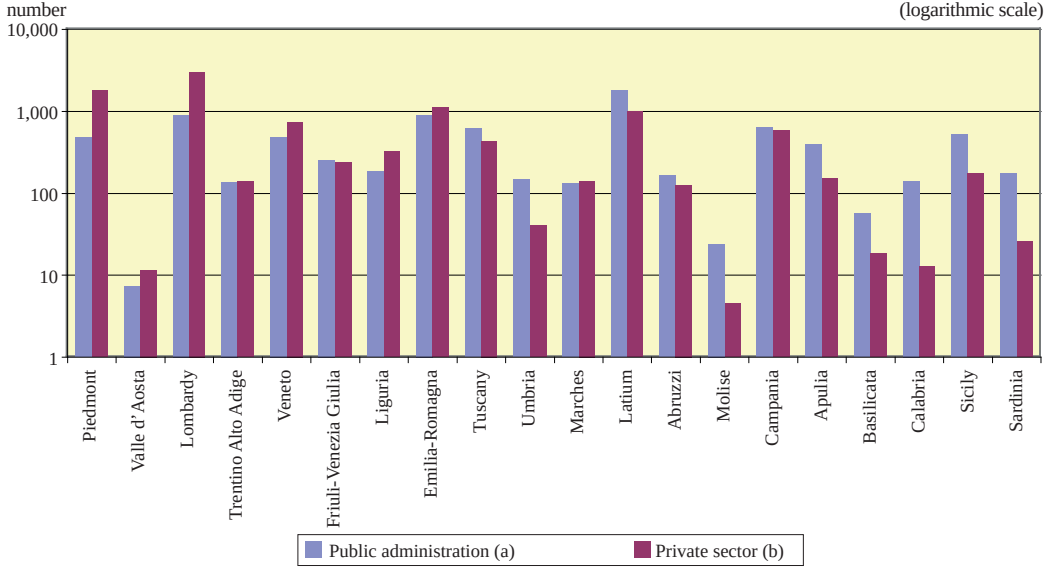
Figure 1.5 - Trends in R&D government and company expenditure by region in Italy, 1997-2007



Notes: (a) sum of university and public administrations; (b) sum of firms and private non-profit institutions.

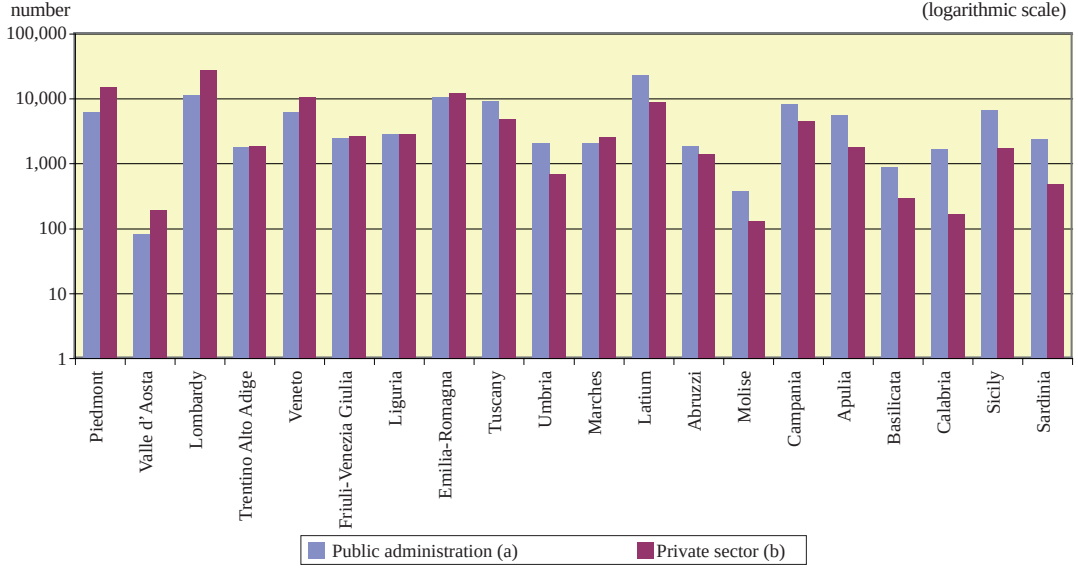
Source: CERIS-CNR elaboration on ISTAT data.

Figure 1.6a - R&D expenditure by main institutional sector and region in Italy, 2007



Notes: (a) sum of public administrations and university; (b) sum of firms and private non-profit institutions.
Source: ISTAT.

Figure 1.6b - Research personnel by main institutional sector and region in Italy, 2007



Notes: (a) sum of public administrations and university; (b) sum of firms and private non-profit institutions.
Source: ISTAT.

Table 1.3 - R&D expenditure in some OECD and non-OECD countries, 1981-2007

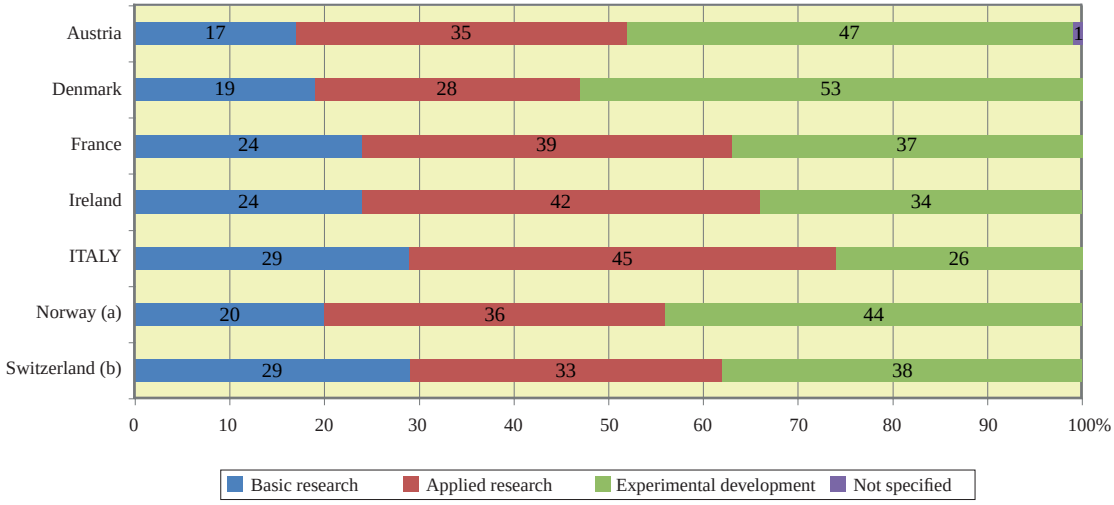
(million US dollars - 2000 constant prices and PPP)

	1981	*1985*	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*
Australia	2,622	..	4,724	..	7,931	..	13,156	..
Austria	1,589	1,879	2,447	3,075	4,469	6,108	6,358	6,769
Belgium	..	3,079	..	4,101	5,564	5,606	5,854	6,140
Canada	6,289	8,071	9,879	12,101	16,669	20,265	20,091	19,864
Korea	..	..	..	14,765	18,494	28,014	31,759	35,612
Denmark	998	1,315	1,839	2,428	..	4,018	4,190	4,393
Finland	949	1,420	2,010	2,376	4,440	5,234	5,436	5,706
France	19,079	23,297	29,231	30,505	32,919	34,943	35,708	35,559
Germany	29,974	35,326	41,591	42,217	52,281	54,549	57,229	58,732
Japan	46,634	62,781	85,802	90,253	98,774	115,087	120,316	124,567
Ireland	266	330	448	869	1,221	1,779	1,877	2,036
ITALY	8,500	11,702	15,571	12,903	15,229	16,601	17,590	18,606
Norway	1,048	1,492	..	1,982	..	2,885	3,094	3,412
Netherlands	4,772	5,741	7,084	7,547	8,533	8,922	9,170	9,149
United Kingdom	21,180	22,310	25,106	24,787	27,823	29,942	31,224	33,266
Spain	1,949	2,718	5,218	5,566	7,780	11,297	12,572	13,747
United States	123,591	165,984	187,056	200,152	268,121	286,224	298,478	311,377
Sweden	3,536	4,859	..	6,807	..	10,056	10,879	10,756
Switzerland	3,508	..	..	..	5,758	6,870 (a)	..	..
EU-27	..	..	..	151,297	183,334	201,891	212,331	220,240
China	..	..	..	10,809	26,870	60,657	70,220	87,088
Russian Federation				31,760	7,846	10,481	14,334	15,479
Israel	..	..	..	2,967	6,381	7,183	7,625	8,667

Note: (a) 2004.

Source: OECD, *Main Science and Technology Indicators*, 2009-2.

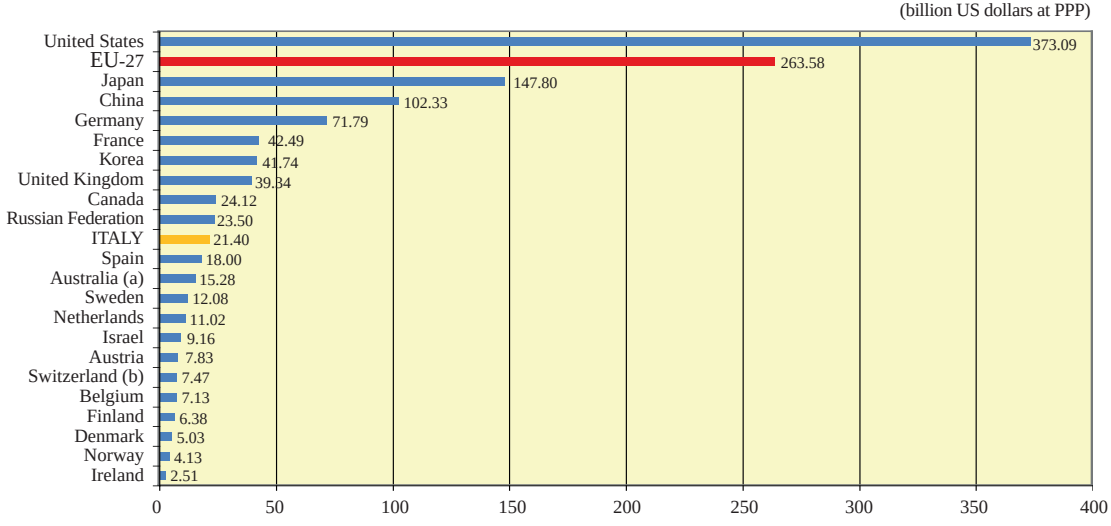
Figure 1.7 - R&D expenditure by type of R&D activity in some European countries, 2006



Notes: (a) 2005; (b) 2004.

Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

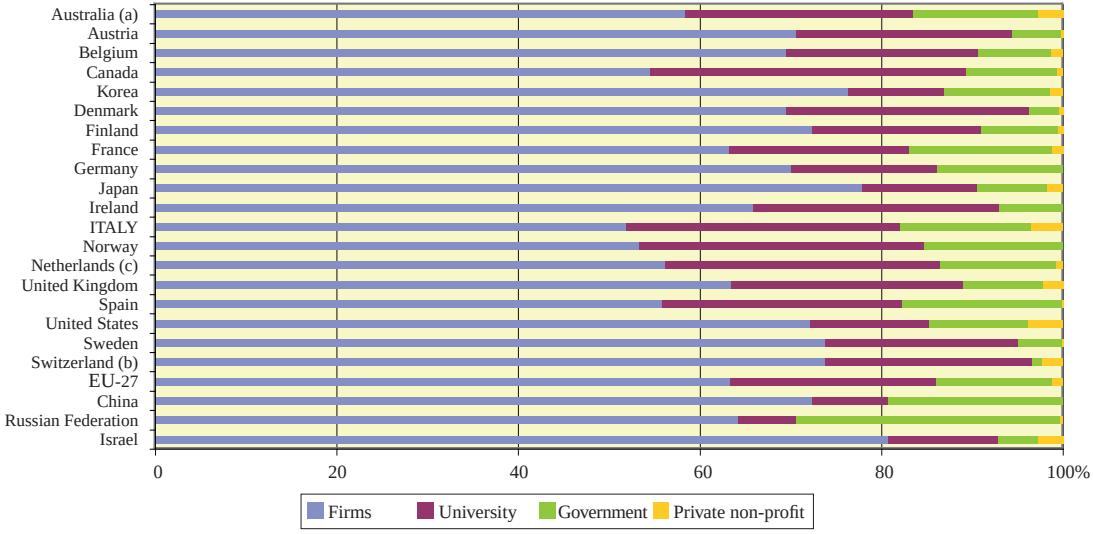
Figure 1.8 - R&D expenditure in some OECD and non-OECD countries, 2007



Notes: (a) 2006; (b) 2004.

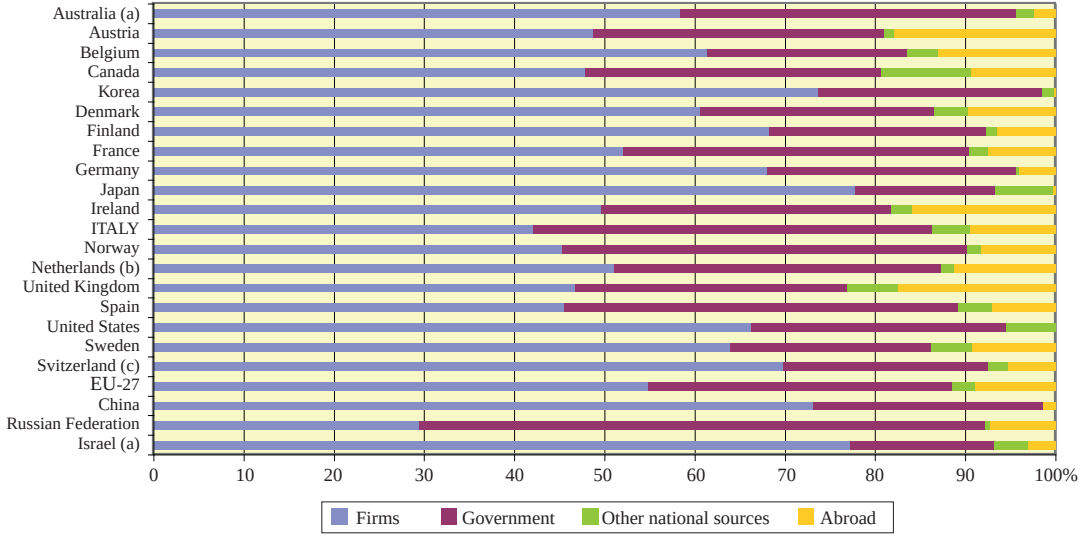
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 1.9 - Intramural R&D expenditure by institutional sector in some OECD and non-OECD countries, 2007



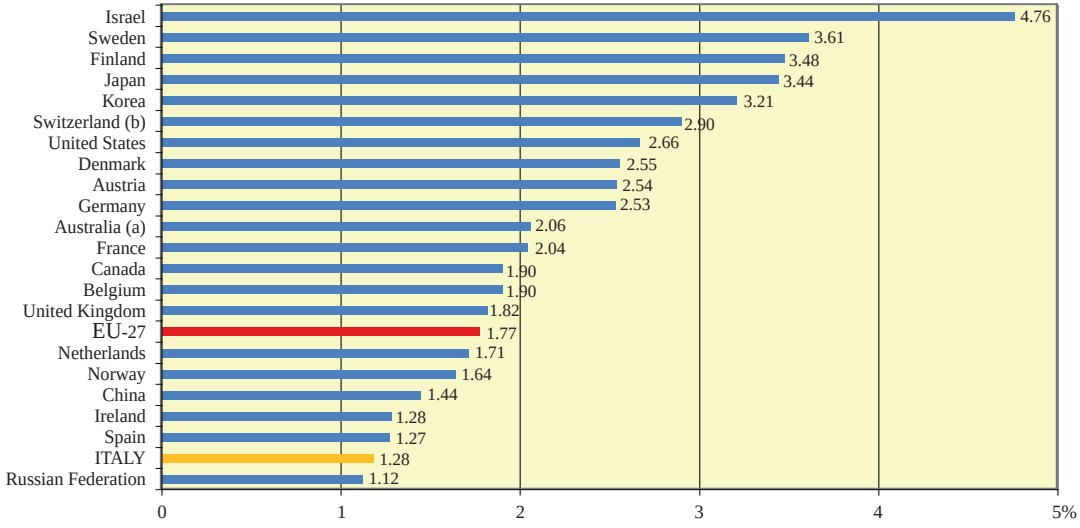
Notes: (a) 2006; (b) 2004; (c) Private non-profit datum refers to 2002.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 1.10 - R&D expenditure by financing sector in some OECD and non-OECD countries, 2007



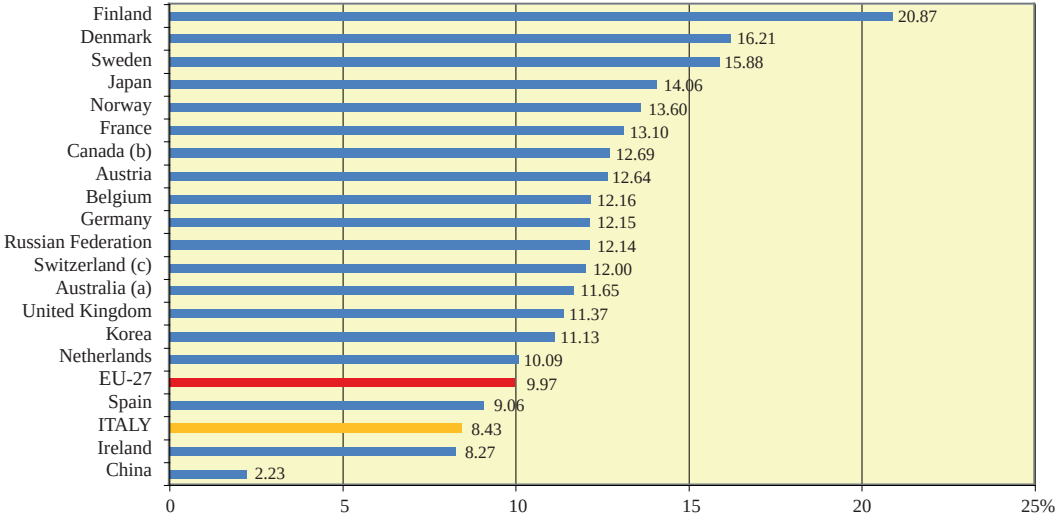
Notes: (a) 2006; (b) 2003; (c) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 1.11 - R&D expenditure on GDP in some OECD and non-OECD countries, 2007



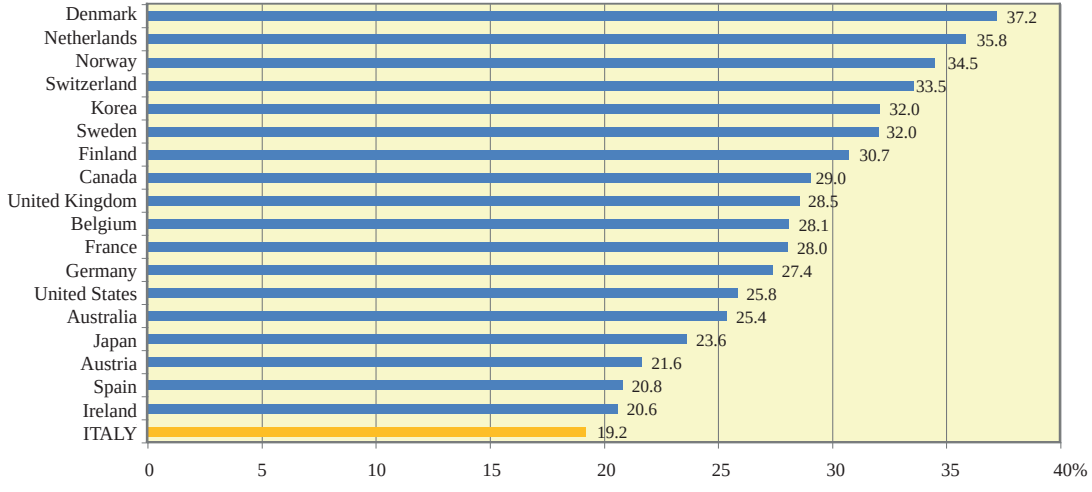
Notes: (a) 2006; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 1.12 - Total R&D personnel on thousand labour force in some OECD and non-OECD countries, 2007



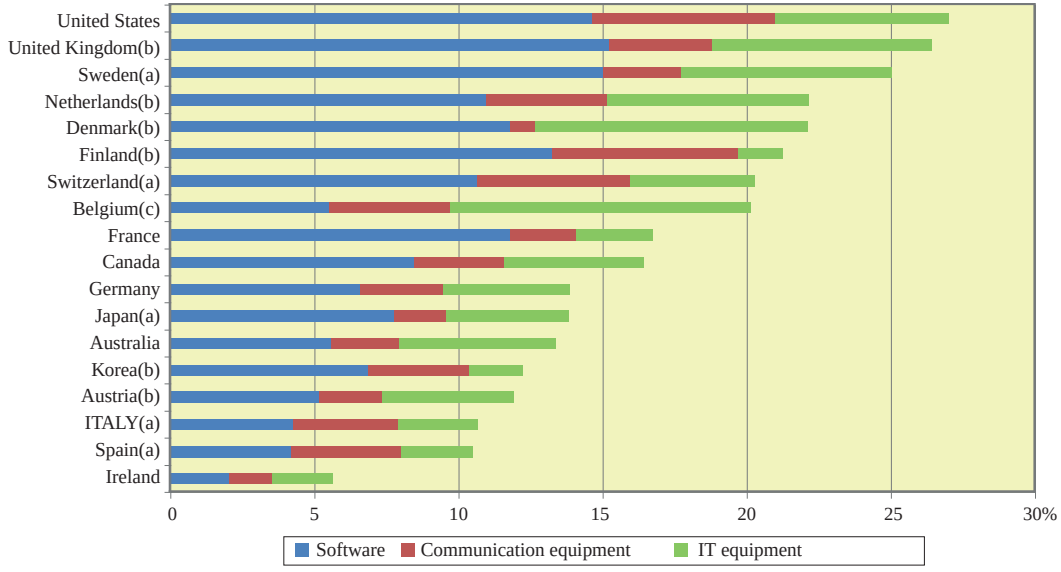
Notes: (a) 2006; (b) 2006 provisional; (c) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 1.13 - Broadband subscribers per 100 inhabitants in some OECD countries, 2008



Note: Different broadband connections are included: DSL (Digital Subscriber Lines), cable, fiber/LAN (Local Areas Networks), other.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 1.14 - ICT investment by asset on total economy in several OECD countries, 2007



Notes: (a) 2006; (b) 2005; (c) 2004.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

2. Government sector

This section is devoted to both government appropriations and to the expenditure incurred by public administrations.

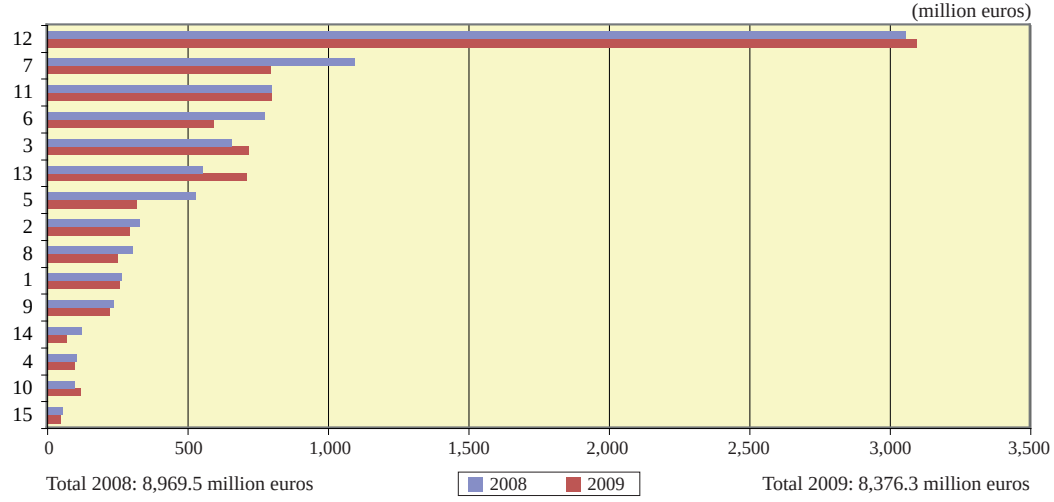
The data sources are the Statistical Office of the Ministry of Education, University and Research (which collaborates with ISTAT in collecting and estimating government appropriations to R&D) for Italy and the OECD for international comparisons.

Figure 2.1 breaks down Italy's government appropriations by socio-economic objectives in 2008 and 2009.

The next figures display international comparisons and present government appropriations to R&D in some OECD countries and in the rest of the world. In particular, figure 2.2 shows the share of appropriations over GDP for the listed countries; figure 2.3 presents some early data on appropriations in 2008; figure 2.4 refers to civil appropriations and highlights the remarkable differences in the allocation of public investments across various countries; figure 2.5 provides information about the share of defence R&D over total public appropriations in the different countries.

The other figures illustrate the research investments made by public administrations. Figure 2.6 describes the R&D expenditure by public administrations in some industrialised countries and figure 2.7 presents the discipline sectors in which the different countries invest. Figures 2.8 and 2.9 display financial resources over gross domestic product and research personnel as a percentage of total employees in the listed countries.

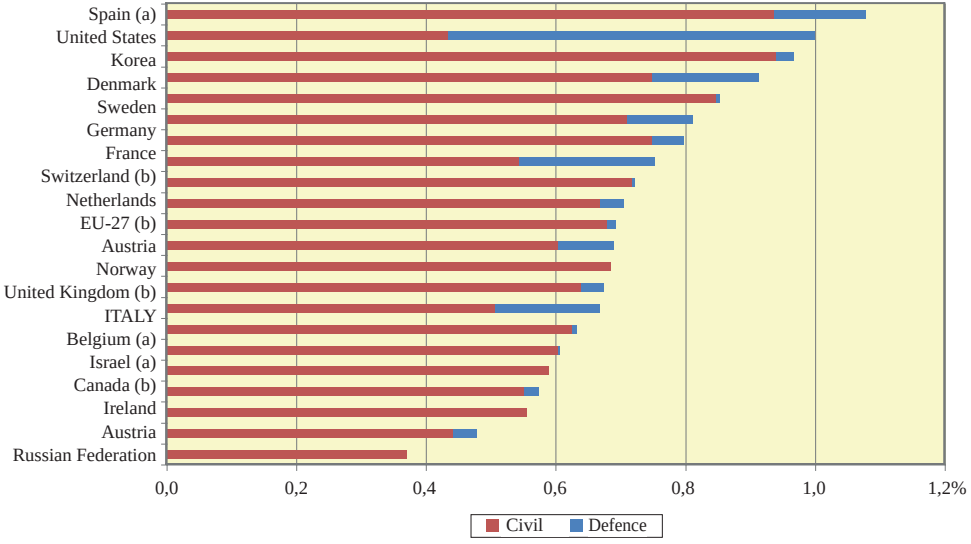
Figure 2.1 - Government budget appropriations for R&D by socio-economic objectives in Italy, 2008-2009



Legenda: 12) General University Funds; 7) Protection and improvement of human health; 11) Social structures and relationships; 6) Industrial production and technology; 3) Exploration and exploitation of space; 13) Non-oriented research; 5) Production, distribution and rational utilisation of energy; 2) Control and conservation of the environment; 8) Agriculture; 1) Esploration and exploitation of the earth; 9) Education and training; 14) Defence; 4) Transports, telecommunications and other infrastructures; 10) Culture, leisure time, religion and mass media; 15) Other.

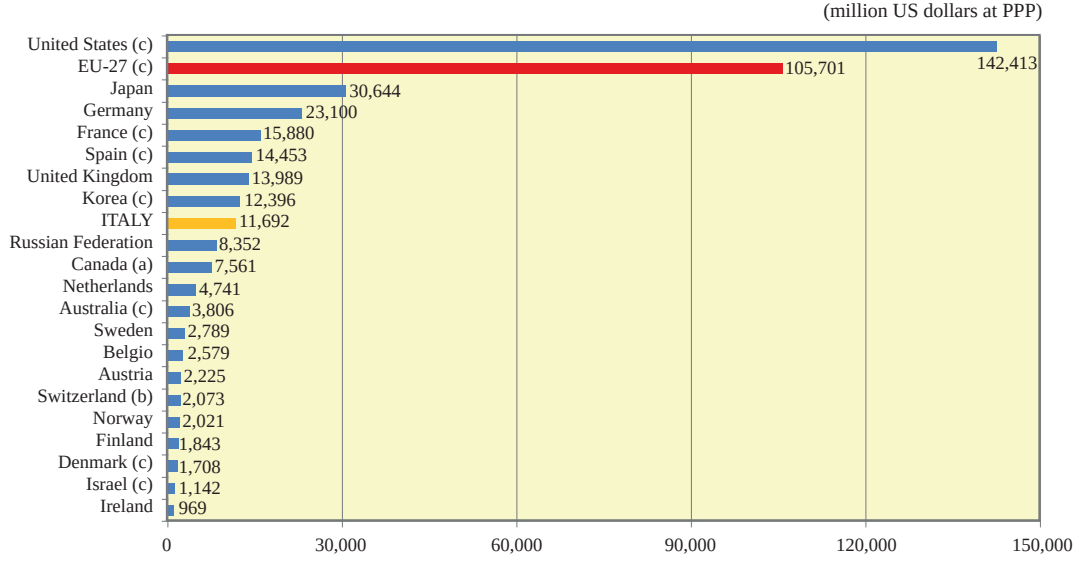
Source: MIUR - Ufficio di Statistica, *Notiziario Statistico*, 1/2010, 2/2010.

Figure 2.2 - Government budget appropriations for R&D on GDP in some OECD and non-OECD countries, 2008



Notes: (a) 2007; (b) 2006.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

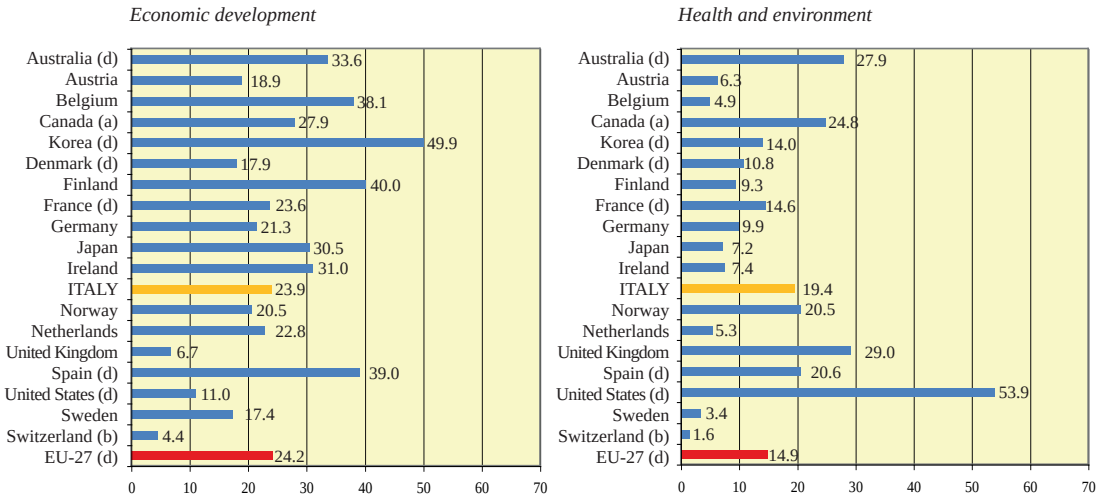
Figure 2.3 - Government budget appropriations for R&D in some OECD and non-OECD countries, 2008



Notes: (a) 2007; (b) 2006; (c) provisional data.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.4 - Government appropriations for R&D on civil budget by large socio-economic objectives in some OECD countries, 2008

(percentages)

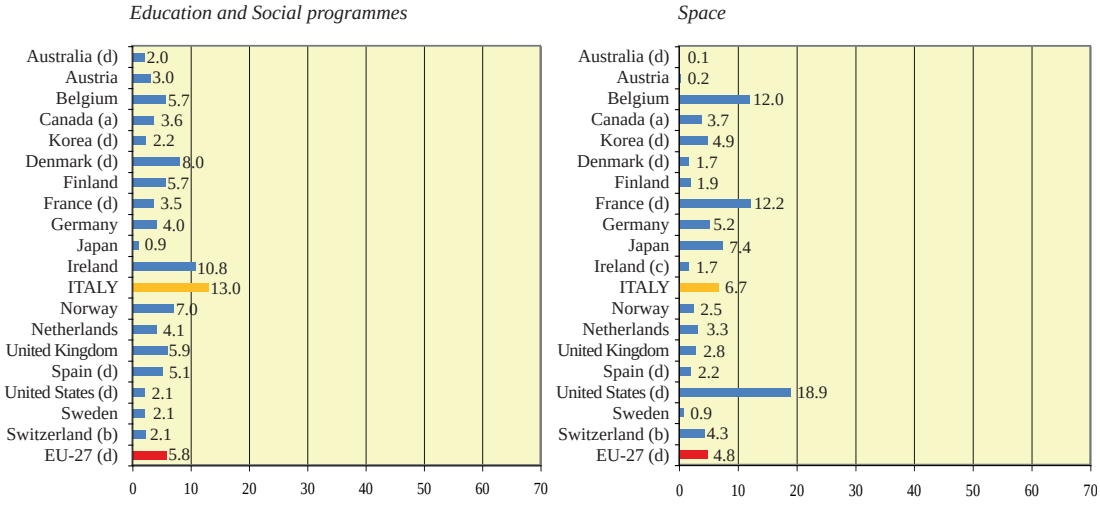


Notes: (a) 2007; (b) 2006; (c) 2004; (d) provisional data.

Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.4 (cont.) - Government appropriations for R&D on civil budget by large socio-economic objectives in some OECD countries, 2008

(percentages)

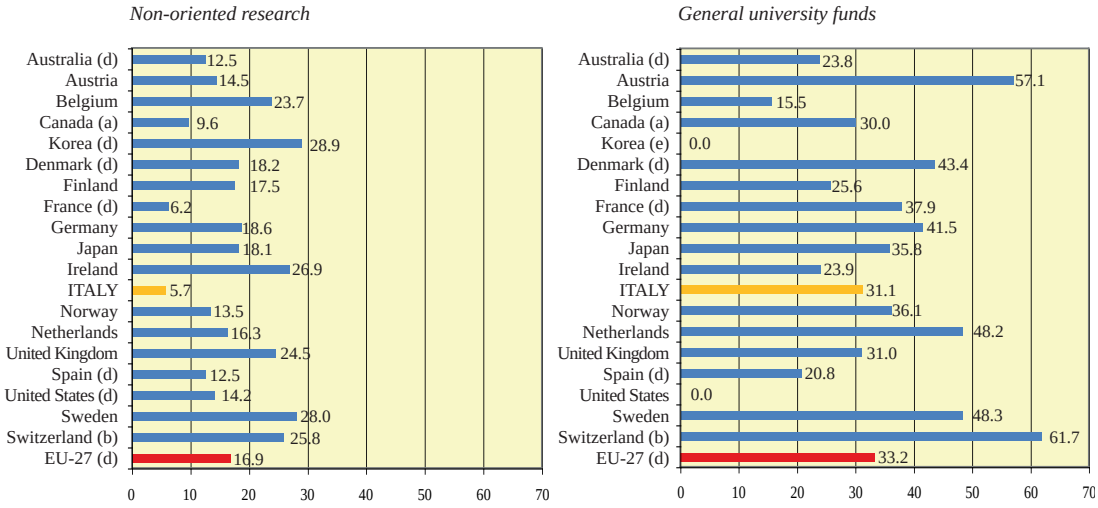


Notes: (a) 2007; (b) 2006; (c) 2004; (d) provisional data.

Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.4 (cont.) - Government appropriations for R&D on civil budget by large socio-economic objectives in some OECD countries, 2008

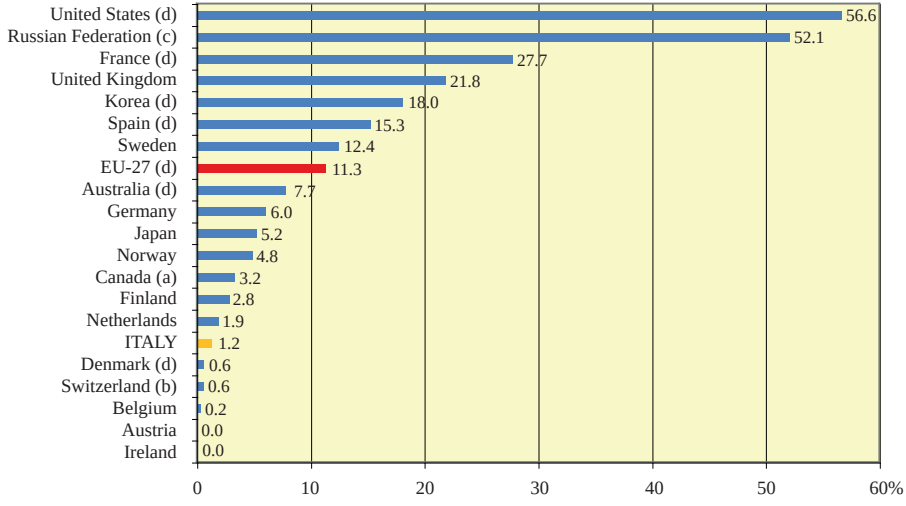
(percentages)



Notes: (a) 2007; (b) 2006; (c) 2004; (d) provisional data; (e) included in other objectives.

Source: OECD, *Main Science and Technology Indicators*, 2009-2.

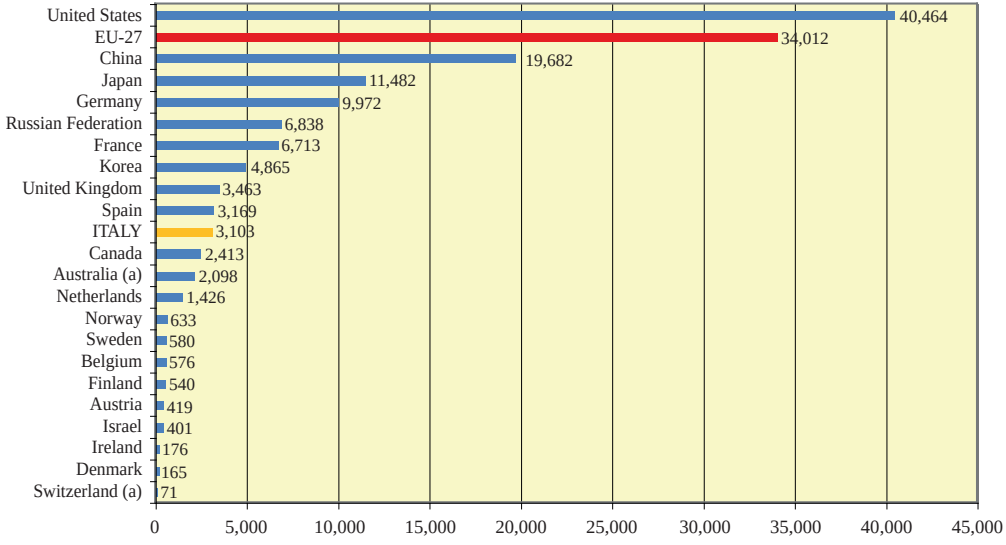
Figure 2.5 - Government budget appropriations for R&D in the defence sector on total appropriations in some OECD and non-OECD countries, 2008



Notes: (a) 2007; (b) 2006; (c) 2003; (d) provisional data.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.6 - Government intramural R&D expenditure in some OECD and non-OECD countries, 2007

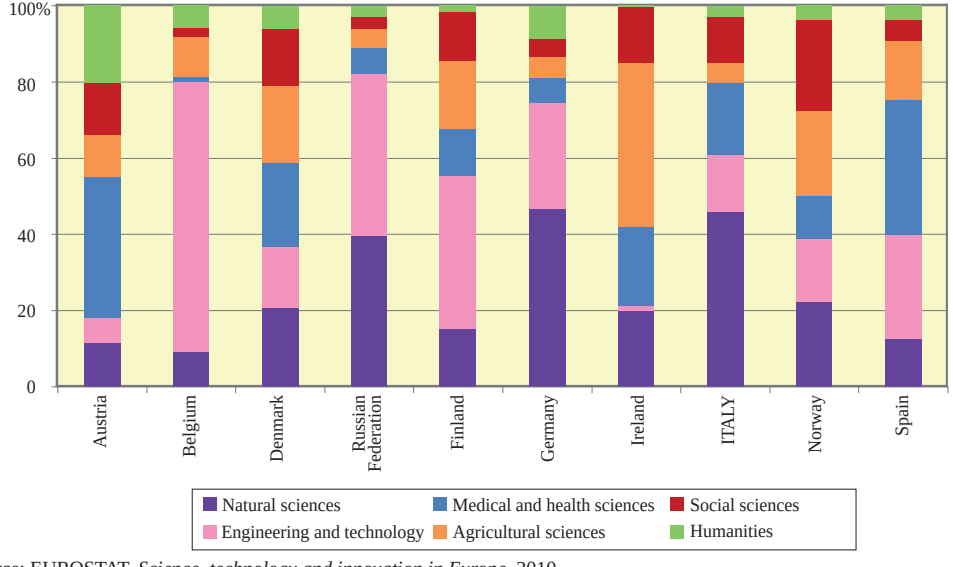
(million US dollars at PPP)



Note: (a) 2006.

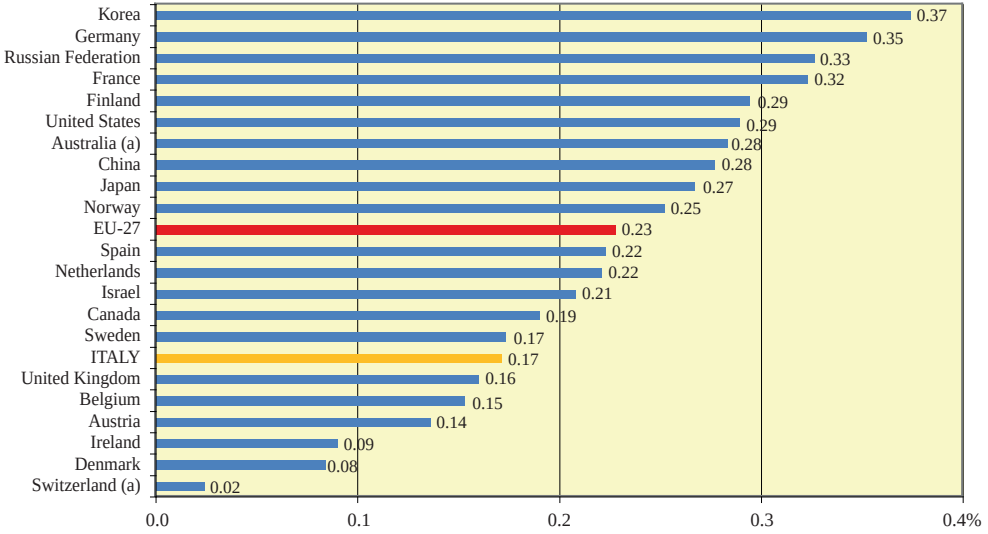
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.7 - Government R&D expenditure by fields of science on government R&D expenditure in some OECD countries and Russian Federation, 2006



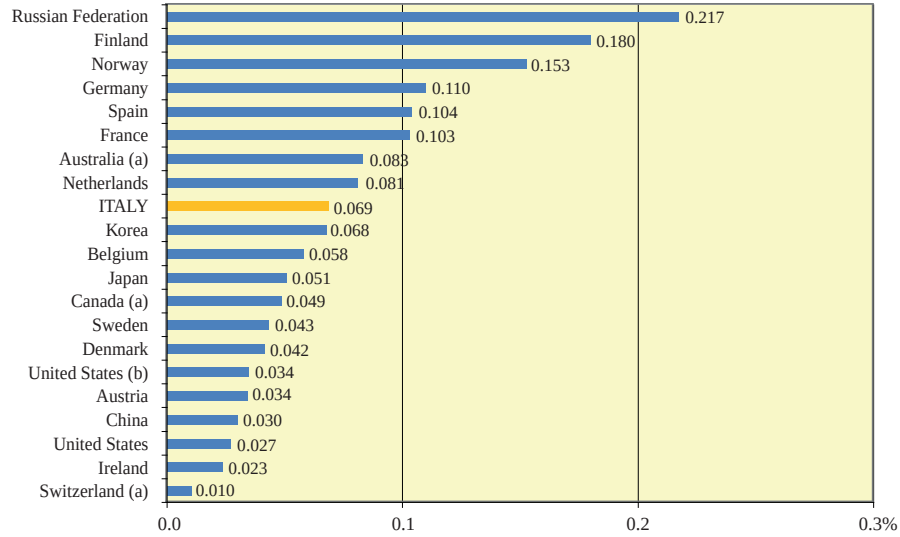
Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

Figure 2.8 - Government intramural R&D expenditure on GDP in some OECD and non-OECD countries, 2007



Note: (a) 2006.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 2.9 - Research personnel in public administration on total employees in some OECD and non-OECD countries, 2007



Notes: (a) 2006; (b) 2002.

Source: CERIS-CNR elaboration on OECD, *Main Science and Technology Indicators*, 2009-2, data.

3. University

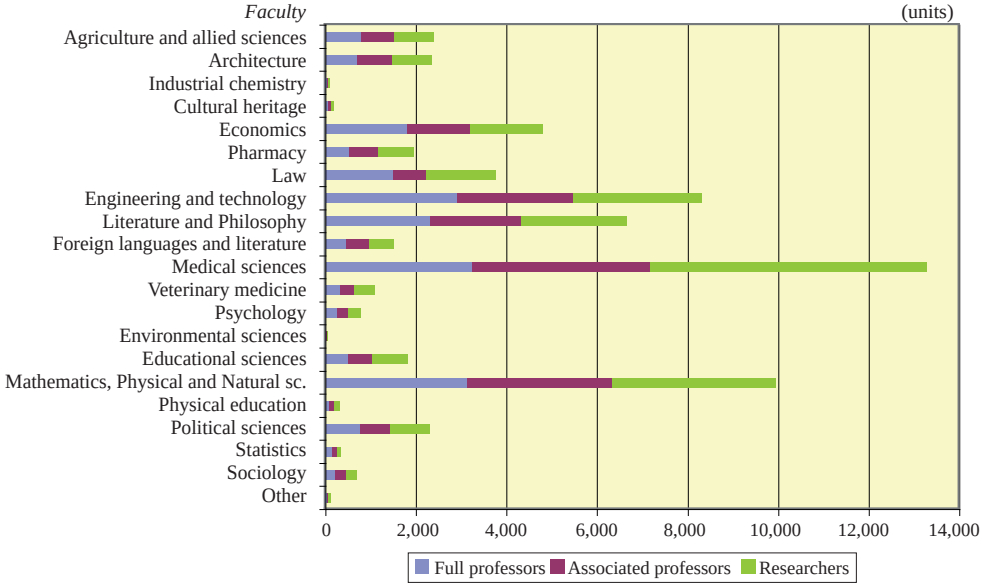
This section presents input and output data regarding the national university system (professors, students, graduates, PhDs), including some indicators on academic research expenditure, as well as a series of international comparisons. Highly qualified researchers play a key role in scientific and technical activities.

The data on professors, students and graduates are taken from Italian national statistics on education (ISTAT) and from OECD and Eurostat statistics, whereas the data on the universities' financial situation are provided by the National Committee for the Evaluation of the University System (CNVSU).

Figures 3.1 and 3.2 display teaching and research personnel by faculty and qualification. Figures 3.3 to 3.6 show data about university students and graduates in Italy, broken down according to the new academic regulations which were fully implemented in the 2001-2002 academic year: students in degree courses regulated by the pre-2001 system, students in bachelor's degree courses (3-year duration), students in master's degree courses, and foreign university students by geographical area of provenience. Figure 3.7 presents data on students enrolled in PhD courses and it is useful to assess the attraction capability of Italian universities. Figure 3.8 displays the scientific disciplines in which the need for high specialisation is most strongly felt. As for research expenditure by Italian universities, table 3.1 lists incomes broken down by source of financing for the years 2001-2007.

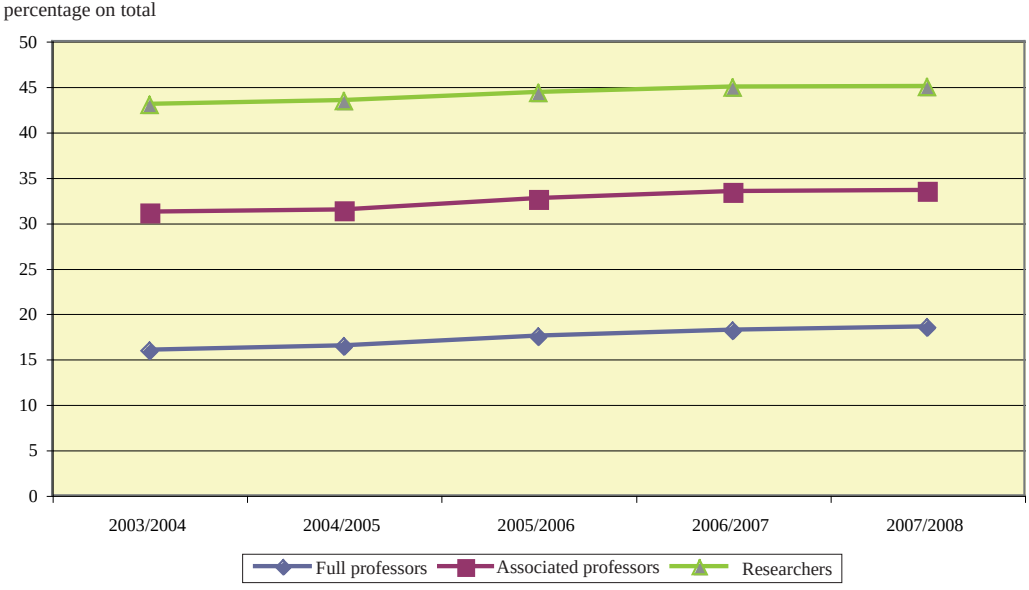
Next, we provide figures that refer to international comparisons. Figure 3.9 analyses degrees in scientific and technological subjects earned by female students; figures 3.10, 3.11 and 3.12 regard PhDs, in particular PhDs in scientific-technical subjects. The considered indicators make it possible to assess and compare absorption capacity, development and knowledge diffusion across the listed countries, as well as the availability of highly qualified personnel in the labour market. As an example, figure 3.13 describes the growing ability of American universities to attract scholars from all over the world. Figures 3.14 and 3.15 show the total investments in research (financial and human resources) made by Italian universities compared to wealth produced and total employees, respectively. Lastly, figure 3.16 highlights the broad disciplinary sectors that the various countries tend to concentrate on the most.

Figure 3.1 - University teaching and research personnel by faculty in Italy, academic year 2007-2008



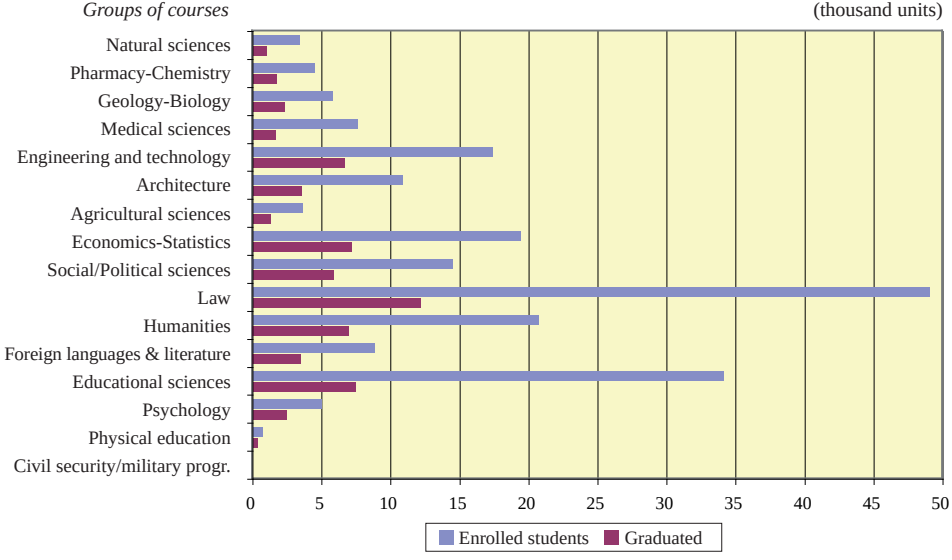
Source: ISTAT.

Figure 3.2 - Female university teaching and research personnel in Italy, 2003-2008



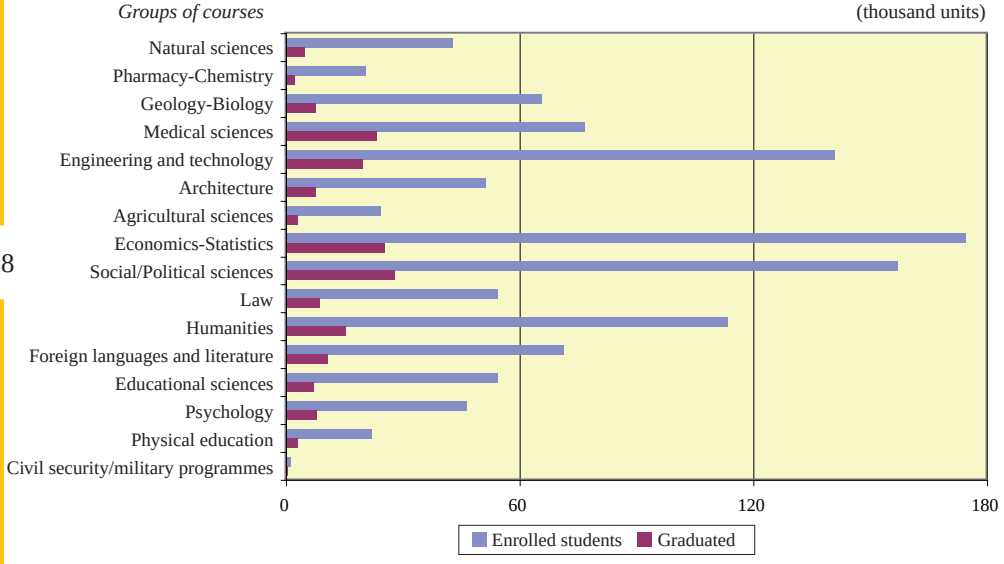
Source: ISTAT.

Figure 3.3 - University students and graduated from courses under previous regulations by groups of courses in Italy, academic year 2007-2008



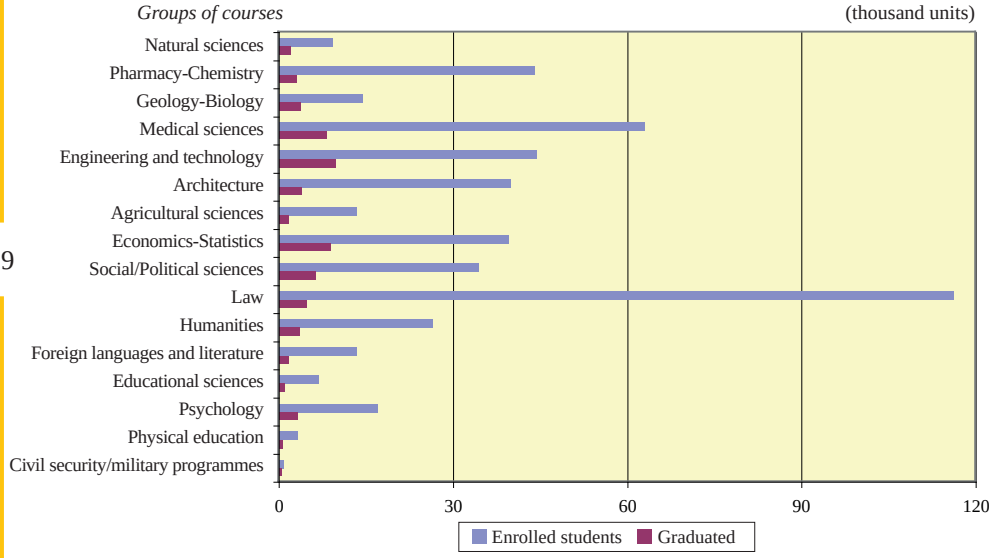
Source: ISTAT.

Figure 3.4 - University students and graduated in the new triennial degree courses by groups of courses in Italy, academic year 2007-2008



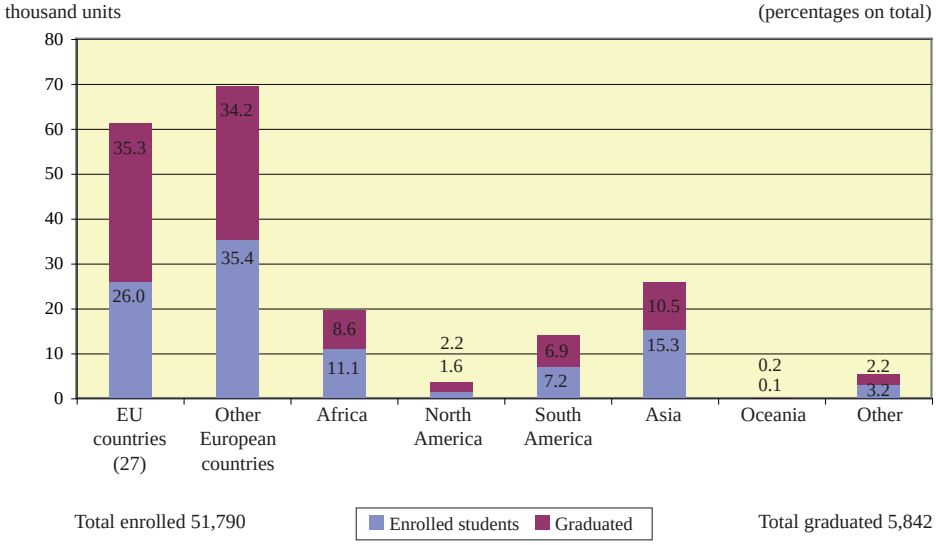
Source: ISTAT.

Figure 3.5 - University students and graduated in specialising degree courses by groups of course in Italy, academic year 2007-2008



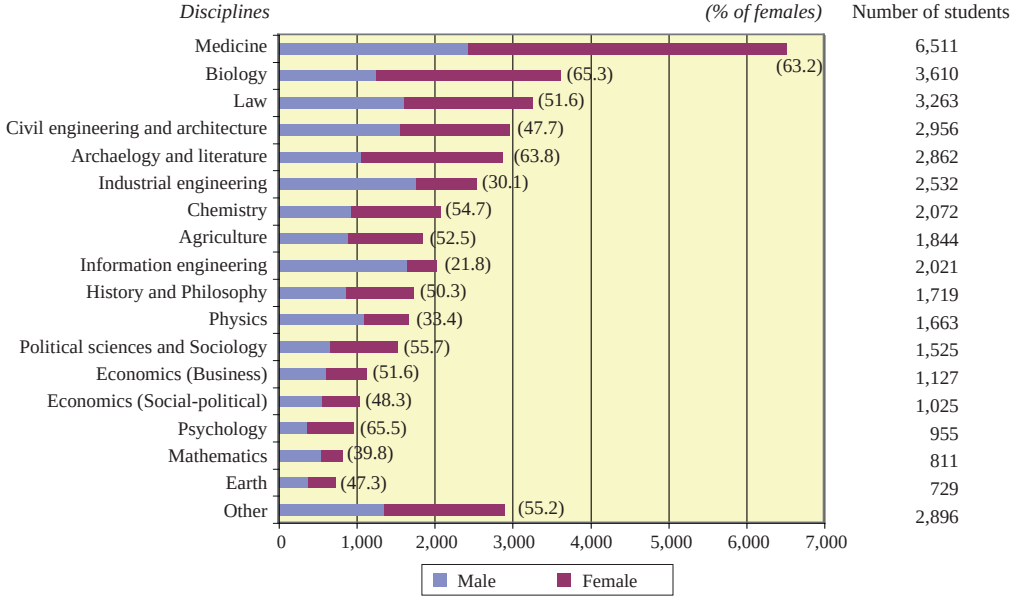
Source: ISTAT.

Figure 3.6 - Foreign university students in Italy by geographical area of origin, academic year 2007-2008



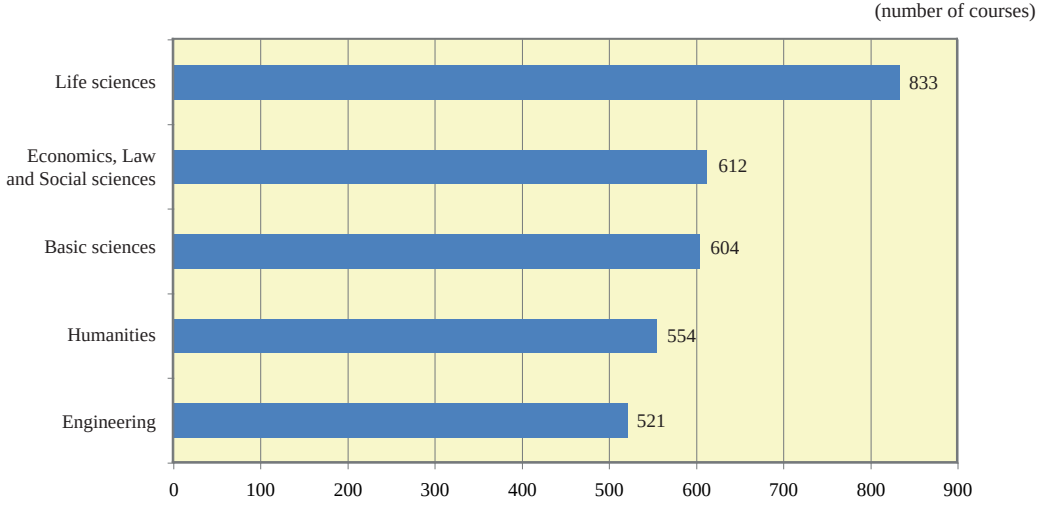
Note: Data on graduated students refer to 2007.
Source: MIUR - Ufficio di statistica, *L'università in cifre*, 2008.

Figure 3.7 - Students in PhD courses by discipline in Italy, academic year 2006-2007



Source: CERIS-CNR elaboration on data from MIUR - Ufficio di statistica, *L'università in cifre*, 2008.

Figure 3.8 - PhD courses by wide scientific areas in Italy, academic year 2008-2009



Note: PhD courses can be included in some major areas.
Source: MIUR-CNVSU, *Decimo rapporto sullo stato del sistema universitario*, December 2009.

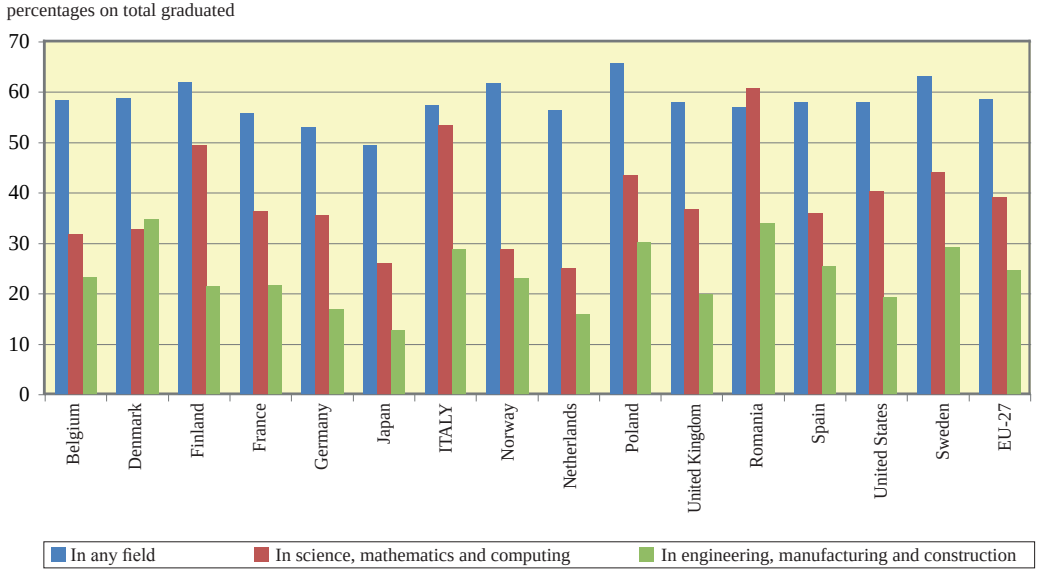
Table 3.1 - Universities' income in Italy, 2001-2007

(million euros)

	2001	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
MIUR, ordinary fund	6,011	6,210	6,268	6,452	6,894	7,008	7,109
Finalised funds from MIUR	1,111	1,013	1,045	1,044	1,082	924	1,122
Finalised funds from other subjects	1,160	1,315	1,407	1,464	1,431	1,940	2,178
Funds coming from enrolment fees	1,044	1,143	1,269	1,371	1,434	1,514	1,602
Patrimonial estate alienation and loans	209	436	201	303	418	397	436
Other funds	230	269	284	323	583	466	353
Total	9,765	10,386	10,474	10,955	11,841	12,249	12,799
Total (2000 constant prices)		9,768	9,554	9,736	10,309	10,474	10,687

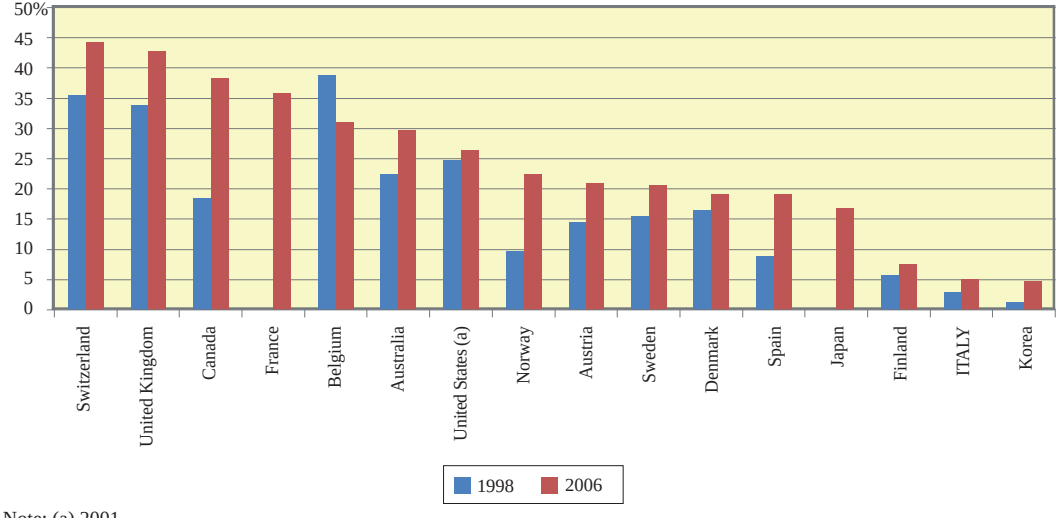
Source: MIUR-CNVSU, *Decimo rapporto sullo stato del sistema universitario*, December 2009.

Figure 3.9 - Female graduated in science and engineering in some OECD countries, 2005



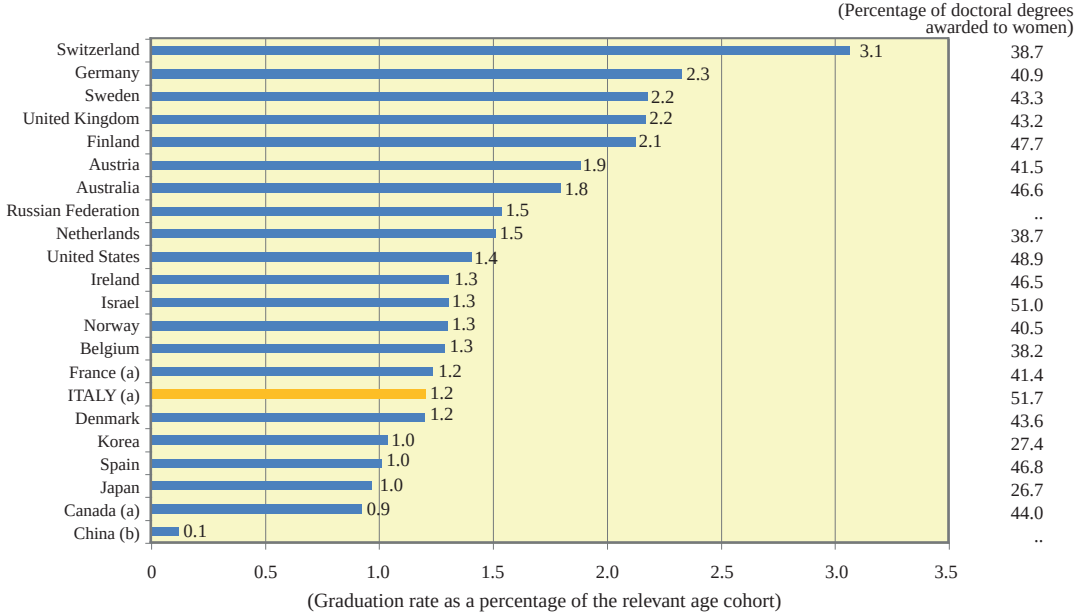
Source: EUROSTAT, *Science, technology and innovation in Europe*, 2009.

Figure 3.10 - Foreign students in PhD courses in some OECD countries, 1998 and 2006



Note: (a) 2001.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

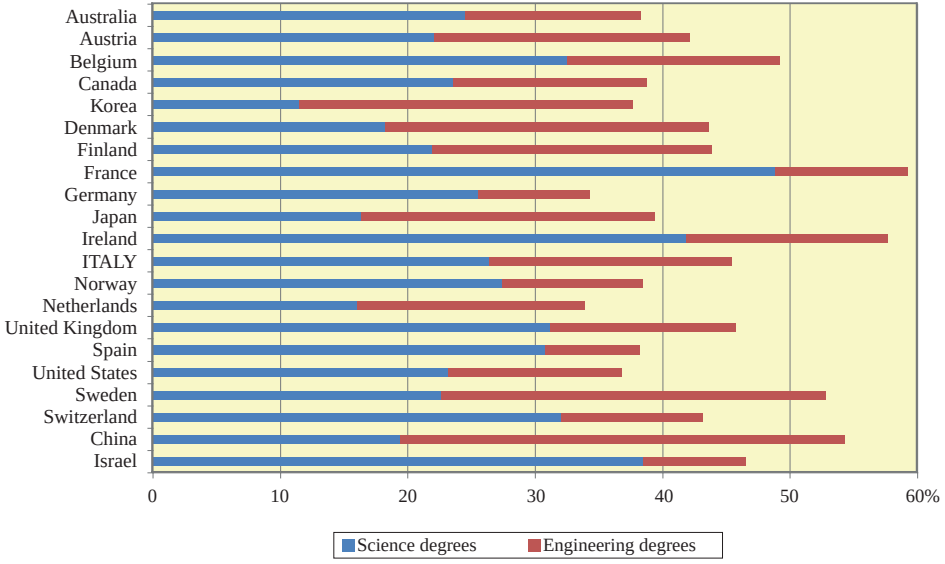
Figure 3.11 - Graduation rate at doctoral level in some OECD and non-OECD countries, 2006



Notes: (a) 2005; (b) 2004.

Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

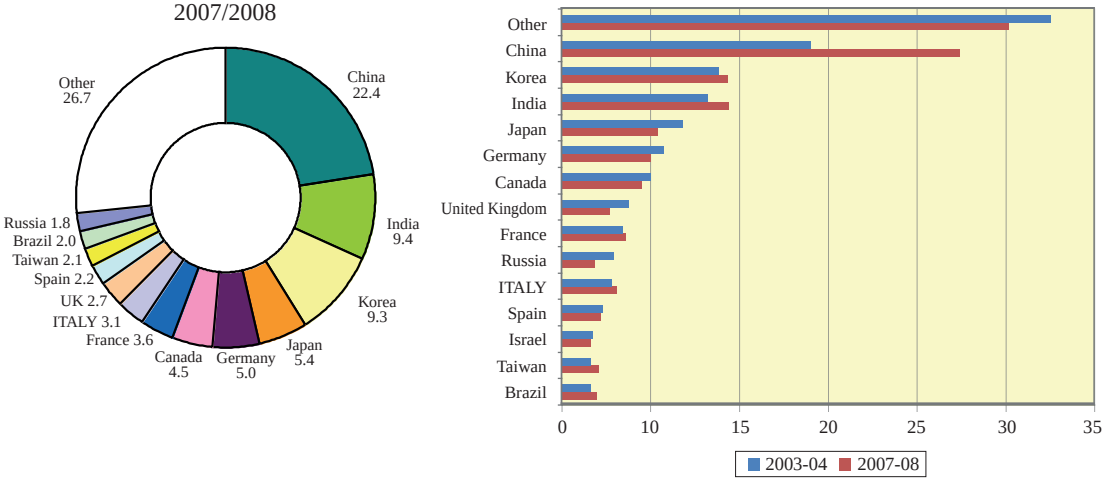
Figure 3.12 - Science and engineering degrees at doctoral level on all new degrees at doctoral level in some OECD and non-OECD countries, 2006



Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 3.13 - Foreign scholars working in the United States by country of origin, 2003-2004 and 2007-2008

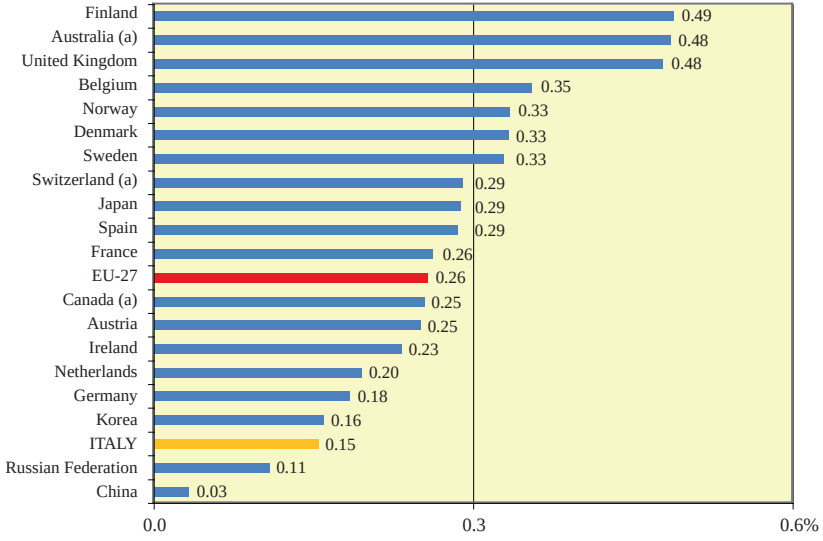
(percentages)



Total foreign scholars 2003-04 82,905
Total foreign scholars 2007-08 106,123

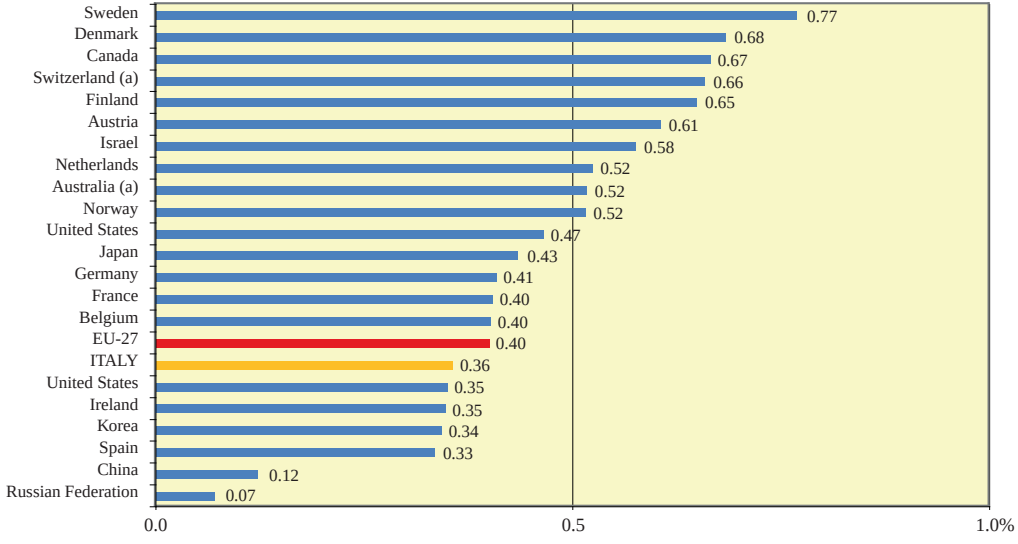
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 3.14 - University research personnel on total employees in some OECD and non-OECD countries, 2007



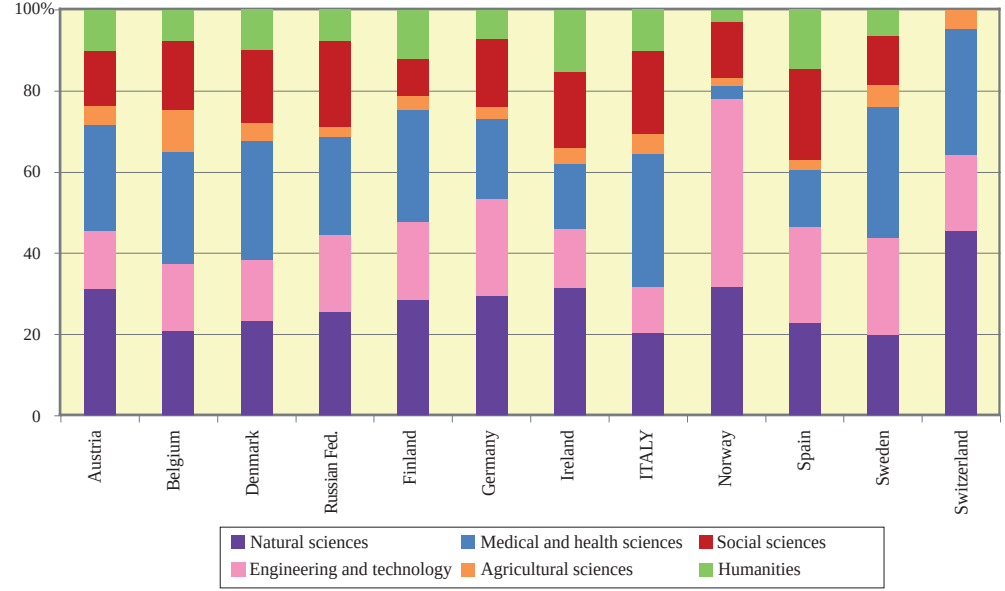
Note: (a) 2006.
Source: CERIS-CNR elaboration on OECD data.

Figure 3.15 - University R&D expenditure on GDP in some OECD and non-OECD countries, 2007



Note: (a) 2006.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 3.16 - University R&D expenditure by fields of science on total in some OECD and non-OECD countries, 2006



Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

4. Business enterprise sector

This section analyses R&D activities carried out by enterprises as a whole and, in particular, by high knowledge intensity enterprises.

The yearly survey on R&D by ISTAT is the source for data on Italy, whereas OECD and Eurostat data are used for the international comparisons.

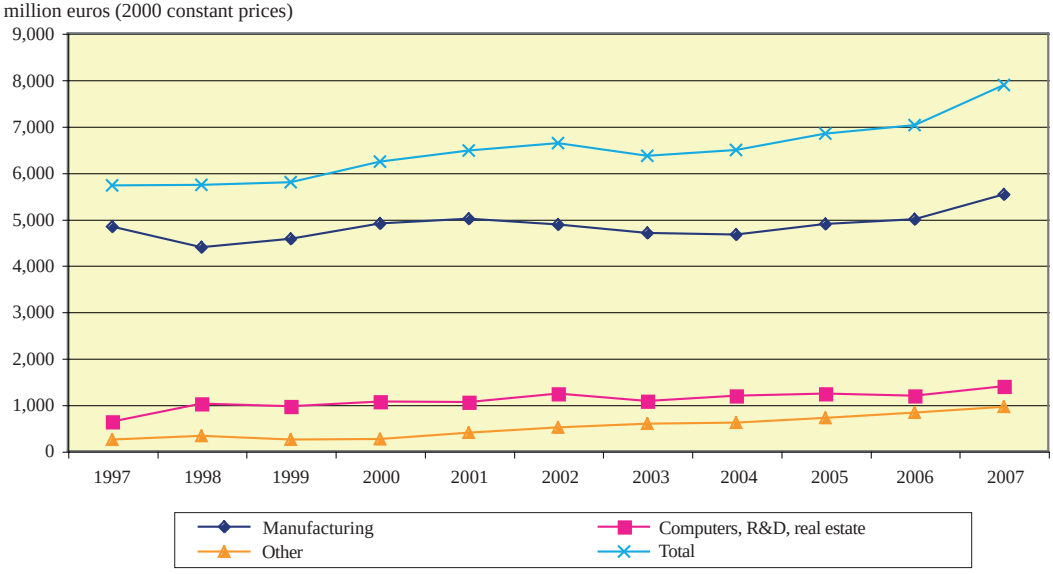
The quantitative information on enterprises in Italy refers to research carried out in various business sectors over a decade (figures 4.1 and 4.2). Moreover, we also provide data on sources of financing (figure 4.3), expenditure by firm size (figure 4.4), and research personnel by business sector (figure 4.5). The following figures allow for comparisons with other countries in relation to firms' R&D financing (figure 4.6) and ratio of R&D expenditure over gross domestic product (fig. 4.7). This ratio is a key indicator of how research-oriented a country is and it contributes to measuring its commitment. Figure 4.8 presents the ratio between research expenditure and value added in a given industry, thus providing information on the intensity of industrial expenditure. The ratio between research personnel and total employees in a given sector is illustrated in figure 4.9.

Figures 4.10 and 4.11 focus on the descriptive analysis of small and medium enterprises (defined on the basis of number of employees – less than 50 for small enterprises and between 50 and 249 for medium enterprises – and financial parameters) in OECD member countries. Hence, these figures are particularly relevant for Italy, whose industrial sector is characterised by the presence of a large number of small-sized firms. R&D expenditure by the foreign branches of companies with headquarters in industrialised countries (figure 4.12) as well as direct investment flows by firms (fig. 4.13) are indicators of how internationalised R&D investments are. Figure 4.14 shows one of the methods used by governments to promote R&D activities in enterprises.

Figures 4.15 to 4.19 regard high technology and high knowledge intensity industries and services.

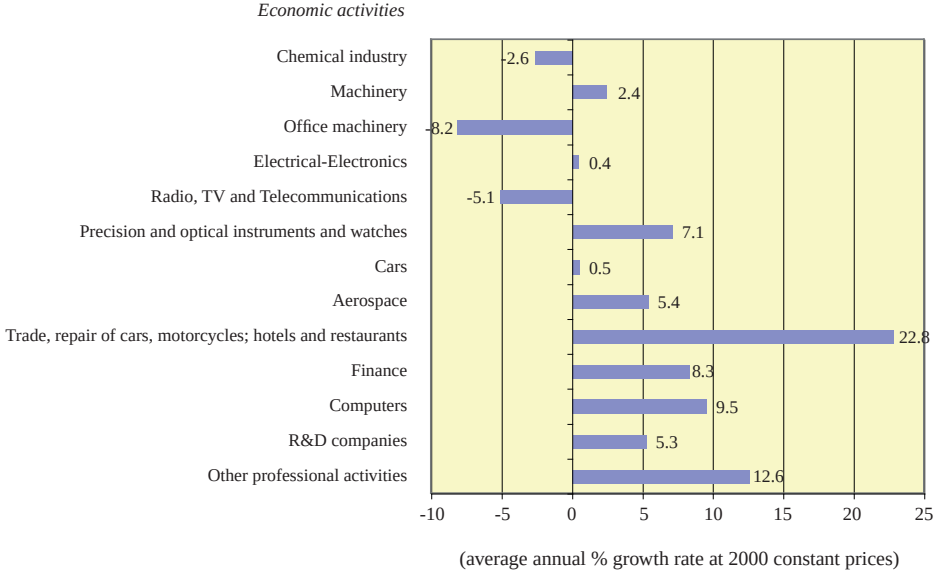
To provide a complete overview of the state of research in enterprises, figure 4.20 describes the situation of firms in different countries in relation to Internet access.

Figure 4.1 - Company R&D expenditure by groups of economic activities in Italy, 1997-2007



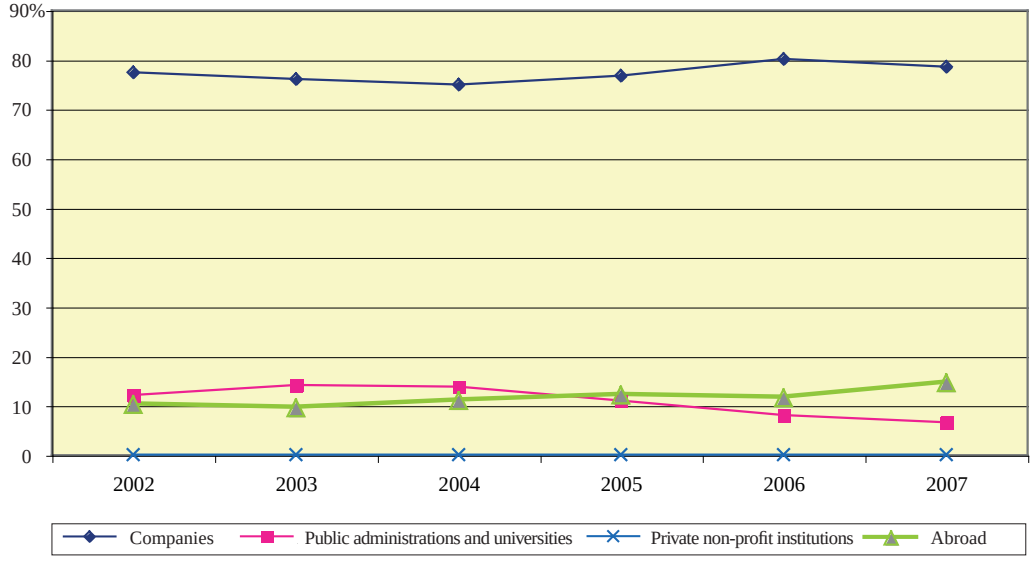
Source: ISTAT.

Figure 4.2 - Trends of R&D expenditure in some economic activities in Italy, 1997-2007



Source: CERIS-CNR elaboration on ISTAT data.

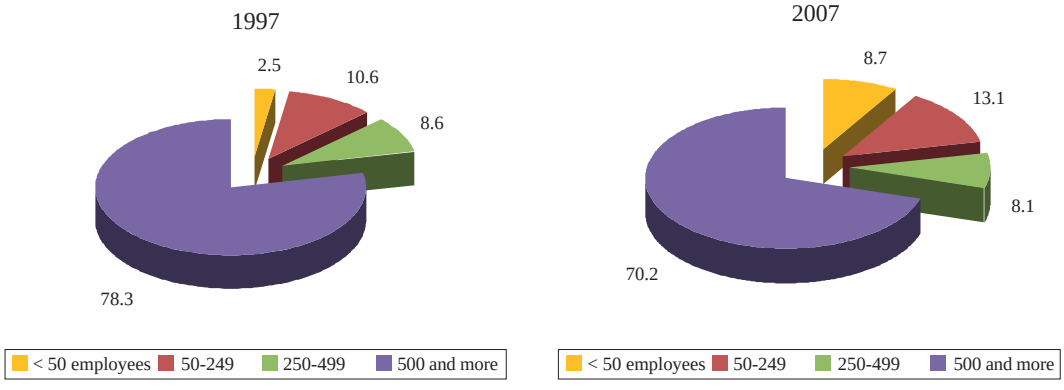
Figure 4.3 - Financing sources for company R&D in Italy, 2002-2007



Source: ISTAT.

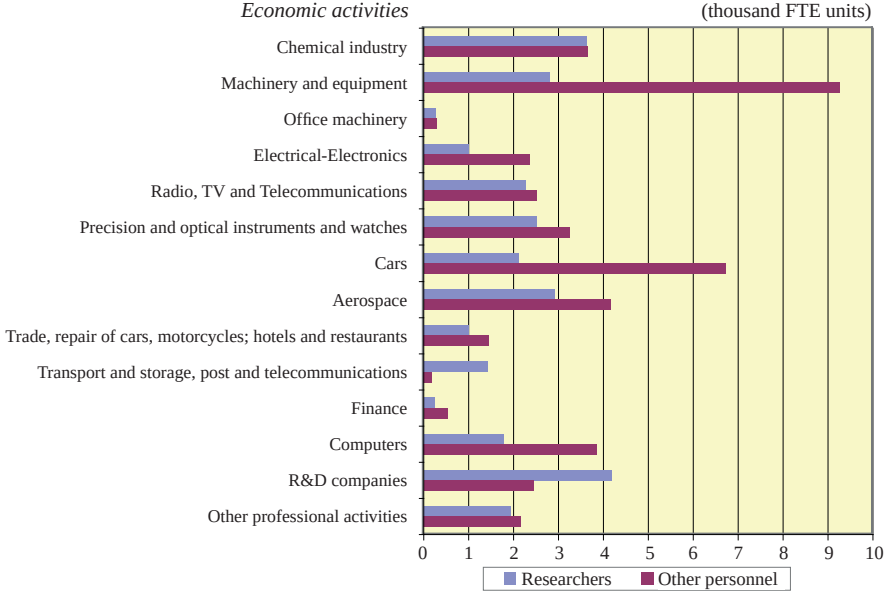
Figure 4.4 - Company intramural R&D expenditure by number of employees in Italy, 1997 and 2007

(percentages)



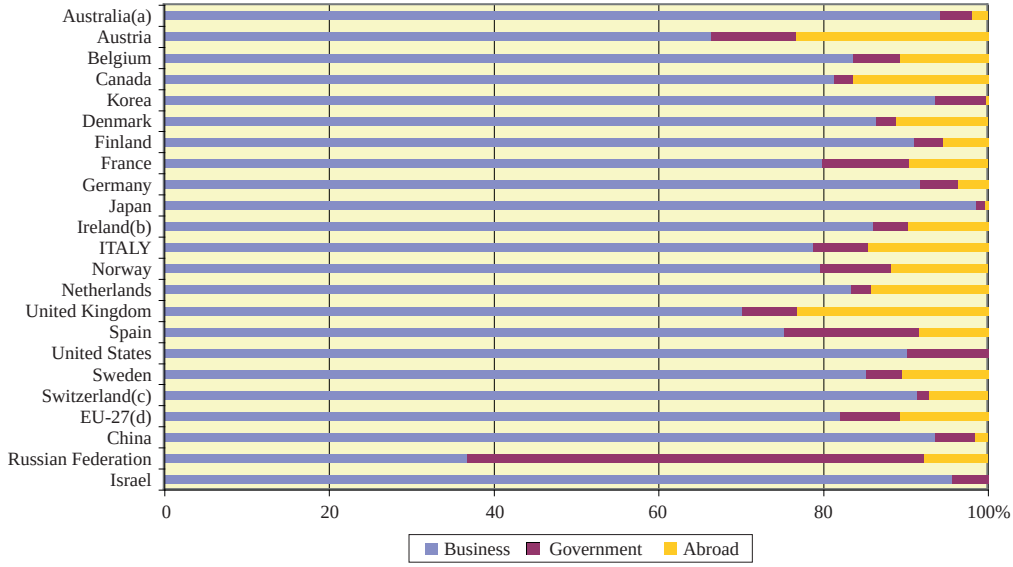
Source: ISTAT.

Figure 4.5 - Company R&D personnel in some economic activities in Italy, 2007



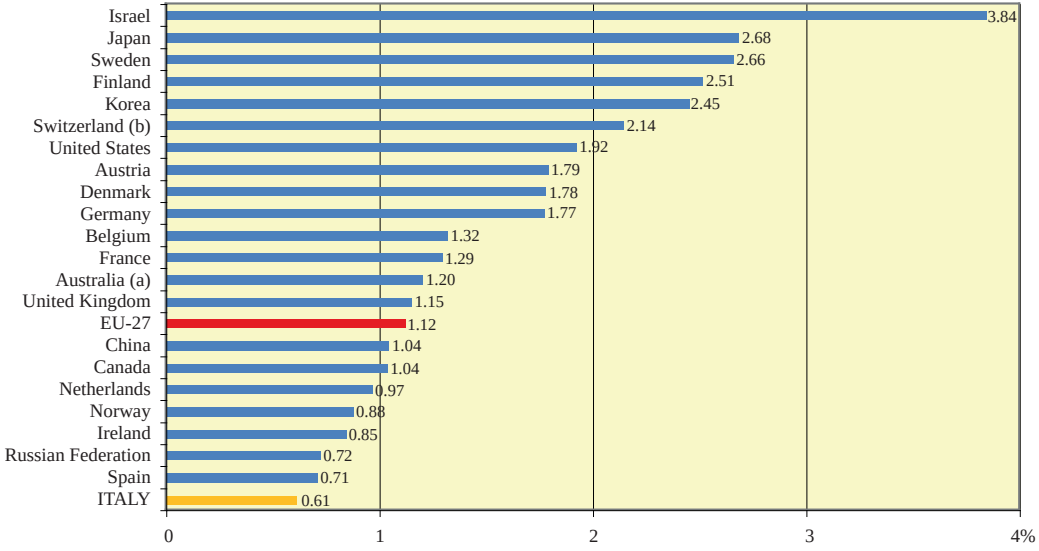
Source: ISTAT.

Figure 4.6 - Funding to company R&D in some OECD and non-OECD countries, 2007



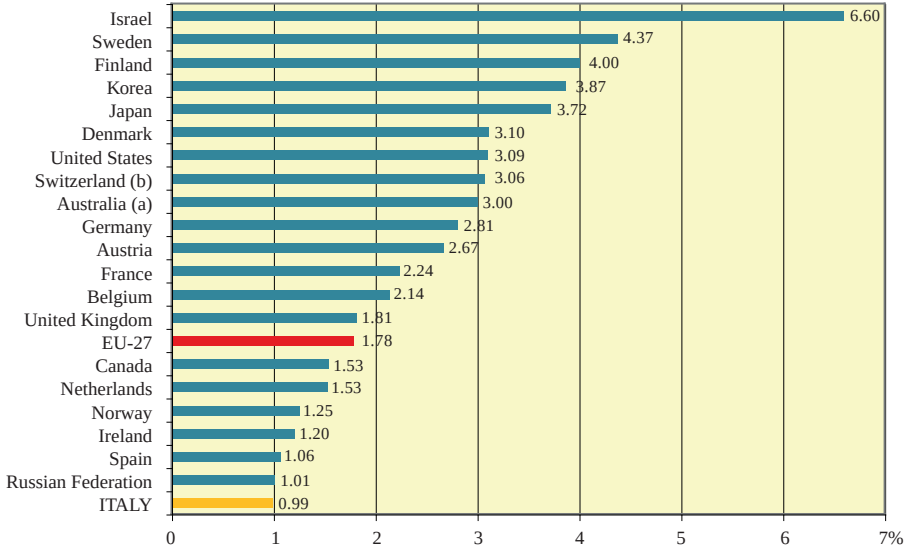
Notes: (a) 2006; (b) 2005; (c) 2004; (d) EU-27 datum for Government is 2006.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.7 - Company R&D expenditure on GDP in some OECD and non-OECD countries, 2007



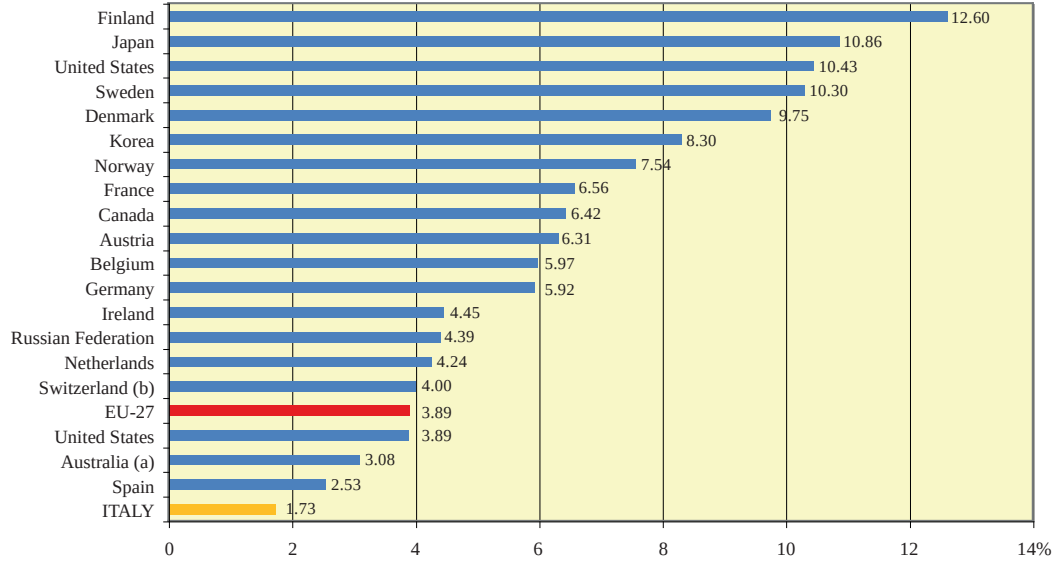
Notes: (a) 2006; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.8 - Company R&D expenditure on industry's value added in some OECD and non-OECD countries, 2007



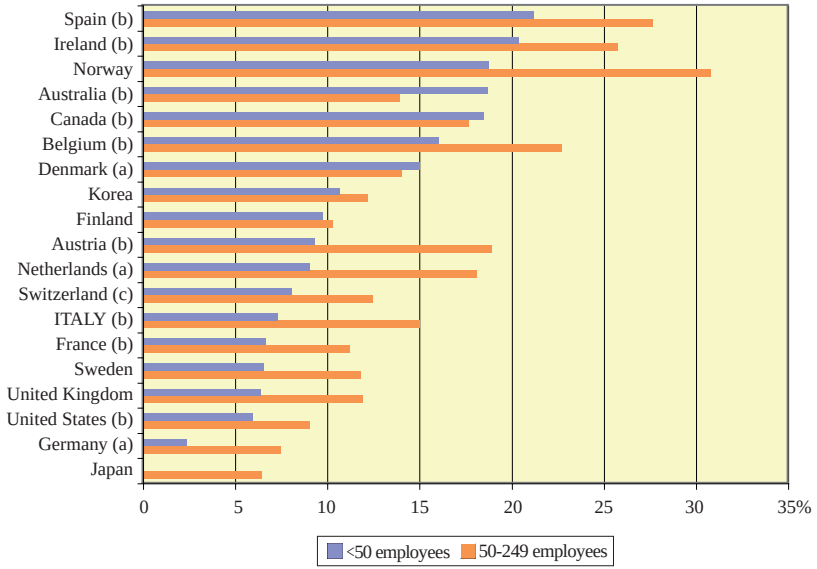
Notes: (a) 2006; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.9 - Business enterprise researchers per thousand employees in industry in some OECD countries and Russian Federation, 2007



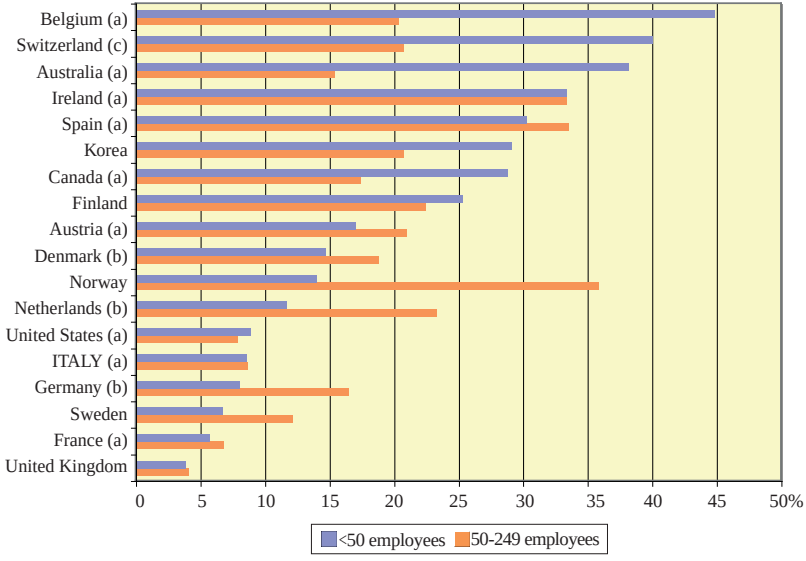
Notes: (a) 2006; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.10 - SMEs' R&D expenditure on total industrial expenditure in some OECD countries, 2007



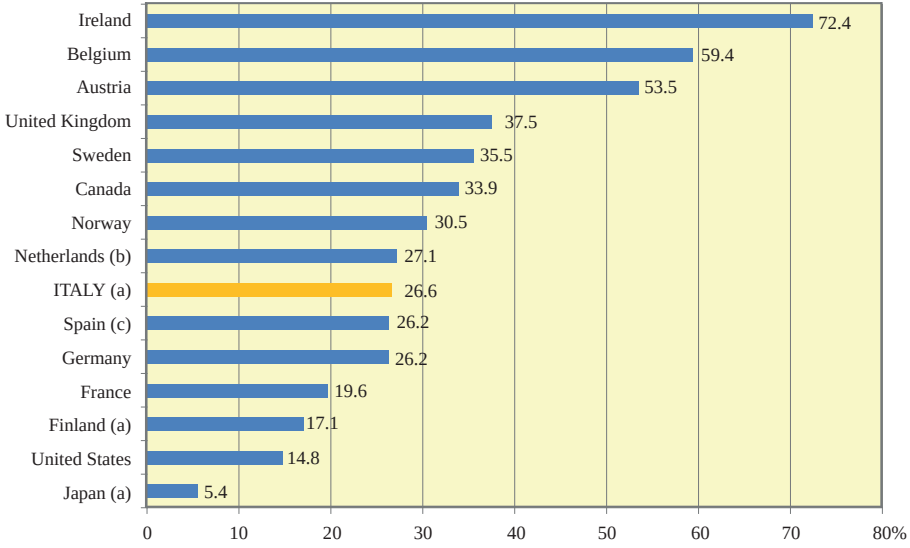
Notes: (a) 2005; (b) 2006; (c) 2004.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 4.11 - Public funding to SMEs' R&D on total industrial expenditure in some OECD countries, 2007



Notes: (a) 2006; (b) 2005; (c) 2004.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

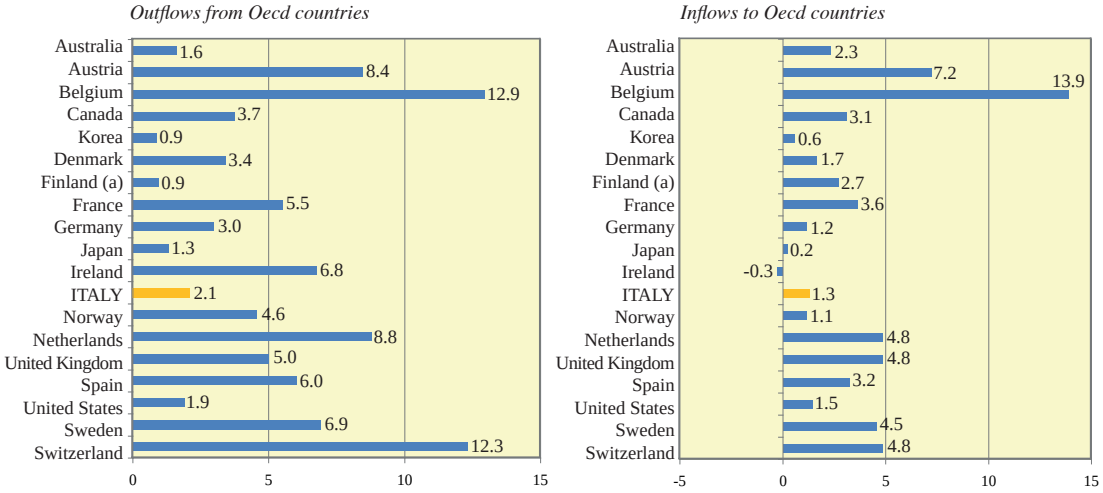
Figure 4.12 - R&D expenditure by companies' foreign affiliates on total industrial expenditure in some OECD countries, 2007



Notes: 2007 data are provisional; (a) 2006; (b) 2003; (c) 2005.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

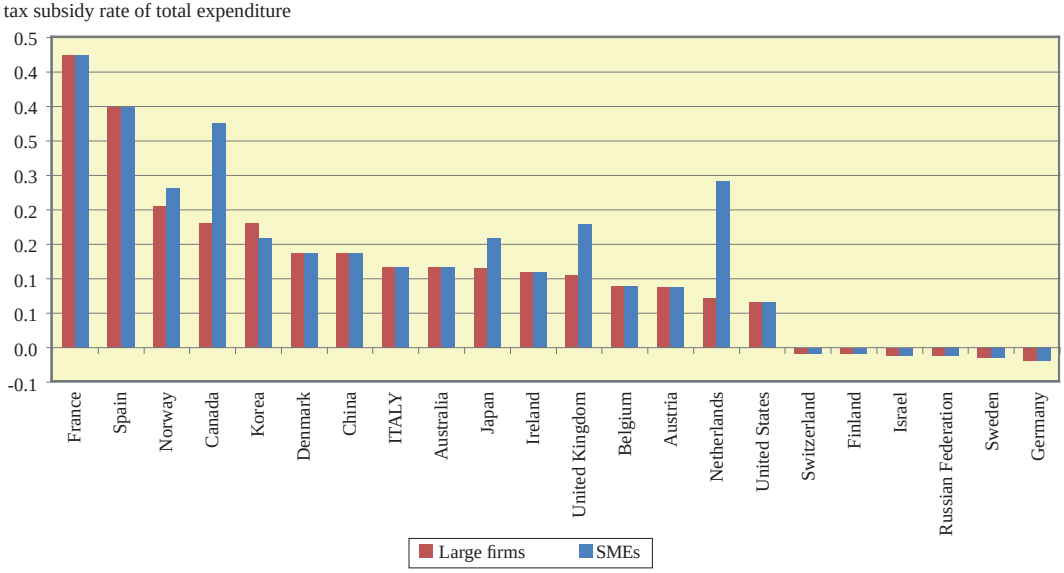
Figure 4.13 - Foreign direct investment flows as a percentage of GDP in some OECD countries, 2003-2008 average

(percentages)



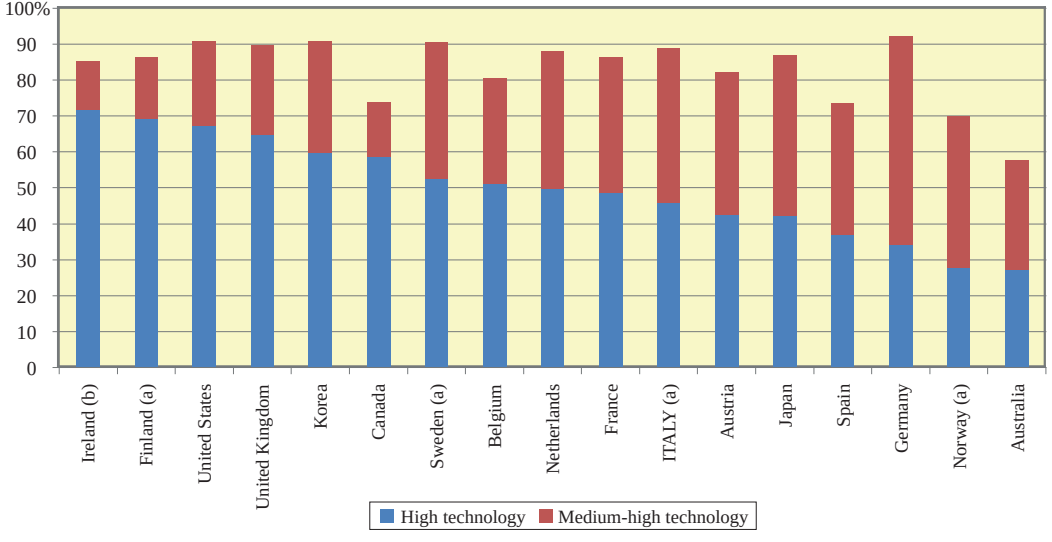
Notes: (a) 2003-2007.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 4.14 - Rate of tax subsidy on R&D in large enterprises and SMEs, in some OECD and non-OECD countries, 2008



Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

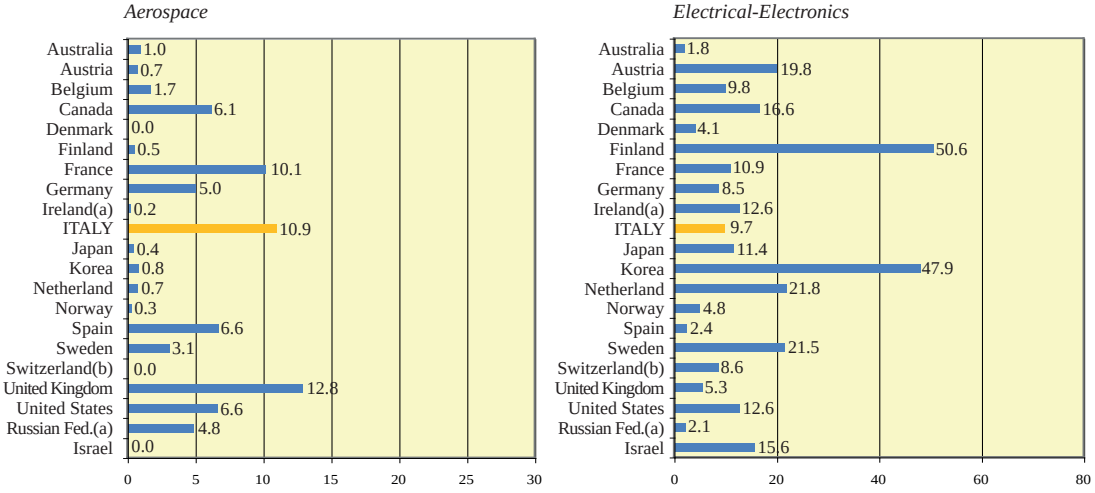
Figure 4.15 - Manufacturing industries' R&D expenditure by technological intensity on manufacturing R&D expenditure in some OECD countries, 2006



Notes: (a) 2007; (b) 2005.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 4.16 - Company R&D expenditure in research intensive sectors over company total expenses in some OECD and non-OECD countries, 2006

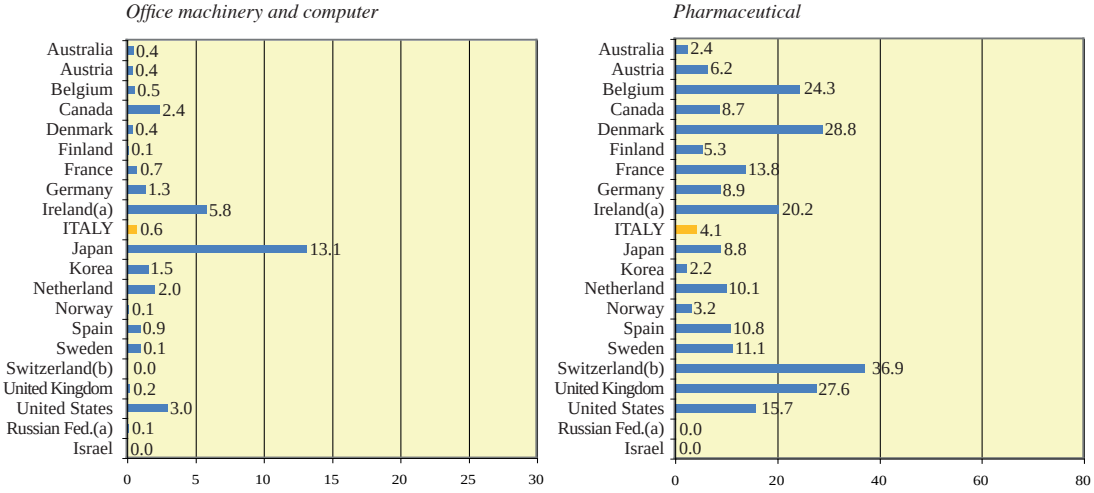
(percentages)



Notes: Secretariat estimate or projection based on national sources; (a) 2005; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.16 (cont.) - Company R&D expenditure in research intensive sectors over company total expenses in some OECD and non-OECD countries, 2006

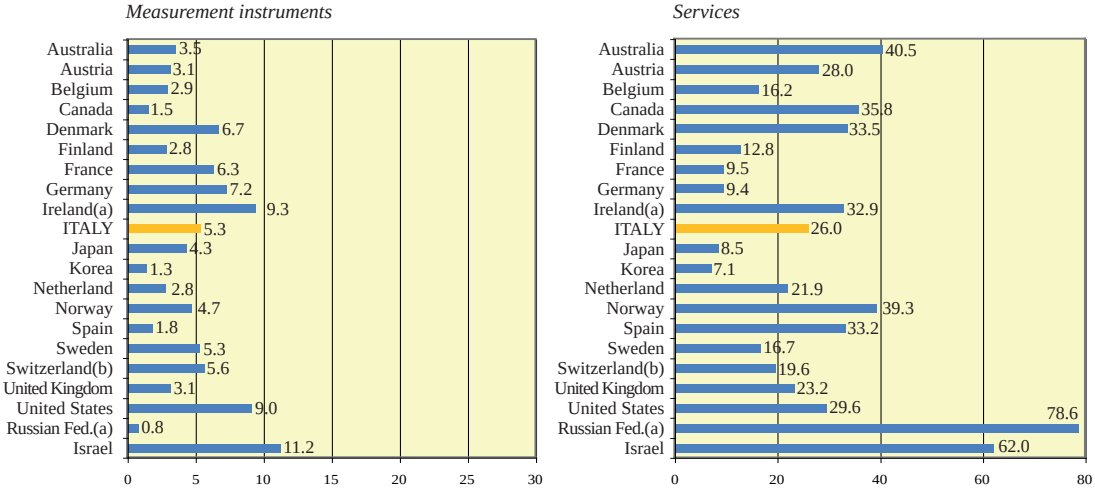
(percentages)



Notes: Secretariat estimate or projection based on national sources; (a) 2005; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

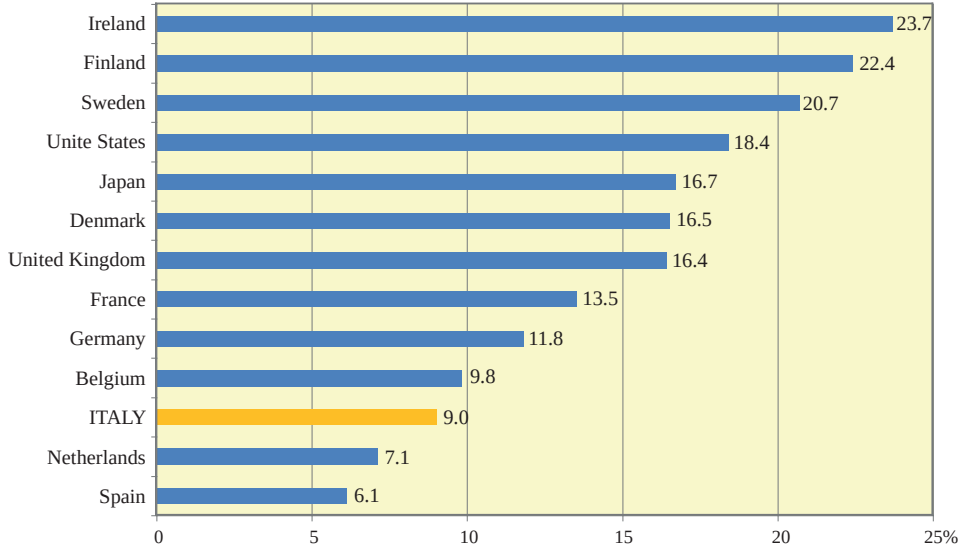
Figure 4.16 (cont.) - Company R&D expenditure in research intensive sectors over company total expenses in some OECD and non-OECD countries, 2006

(percentages)



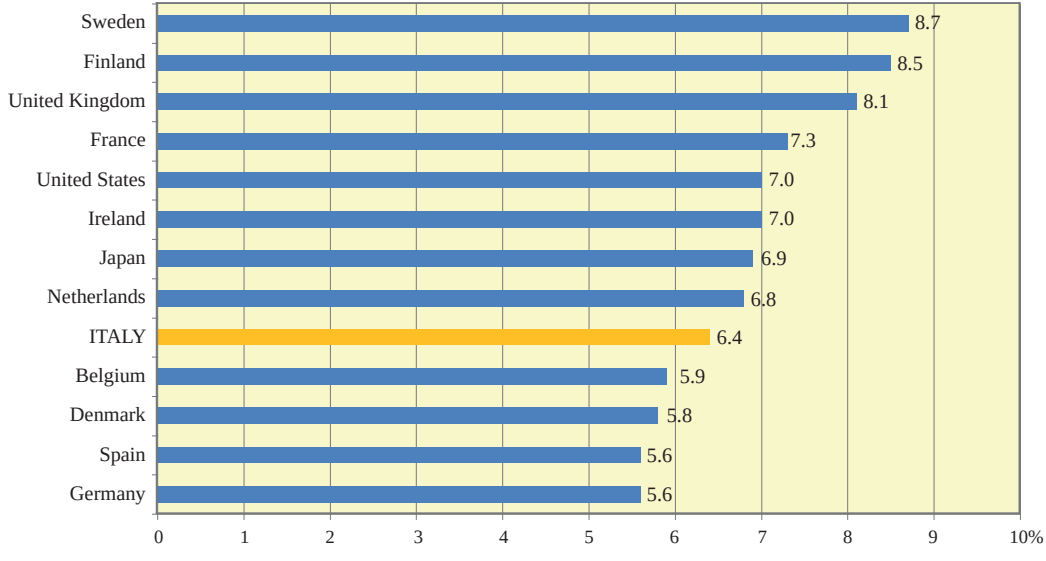
Notes: Secretariat estimate or projection based on national sources; (a) 2005; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 4.17 - Value added of high-tech manufacturing sectors on total value added of industry in some OECD countries, 2005



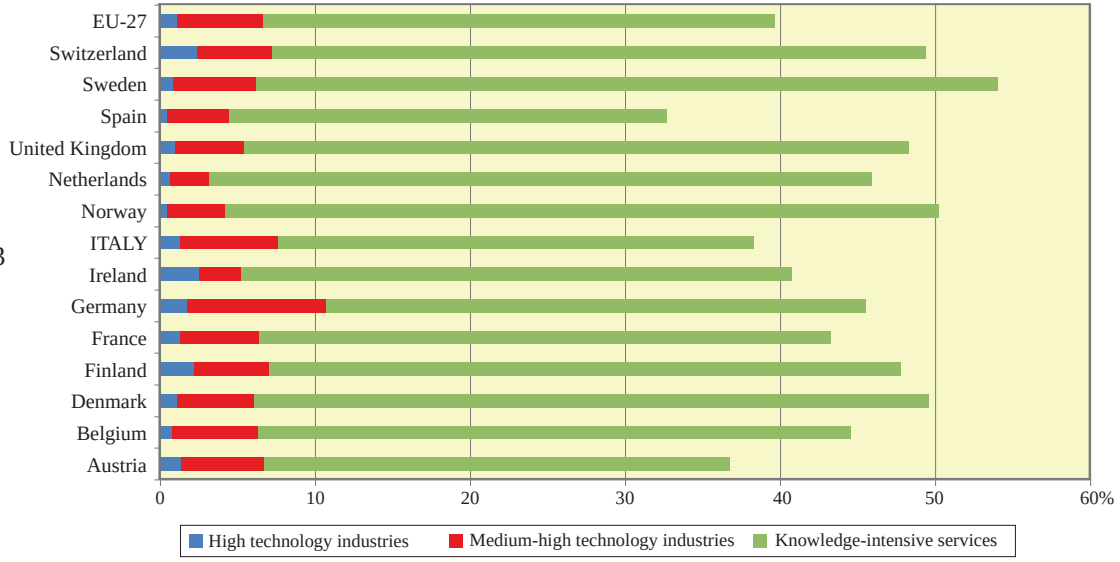
Source: European Commission, *A more research-intensive and integrated European Research Area, STC key figures report 2008/2009*.

Figure 4.18 - Value added of knowledge intensive services on total value added of services in some OECD countries, 2005



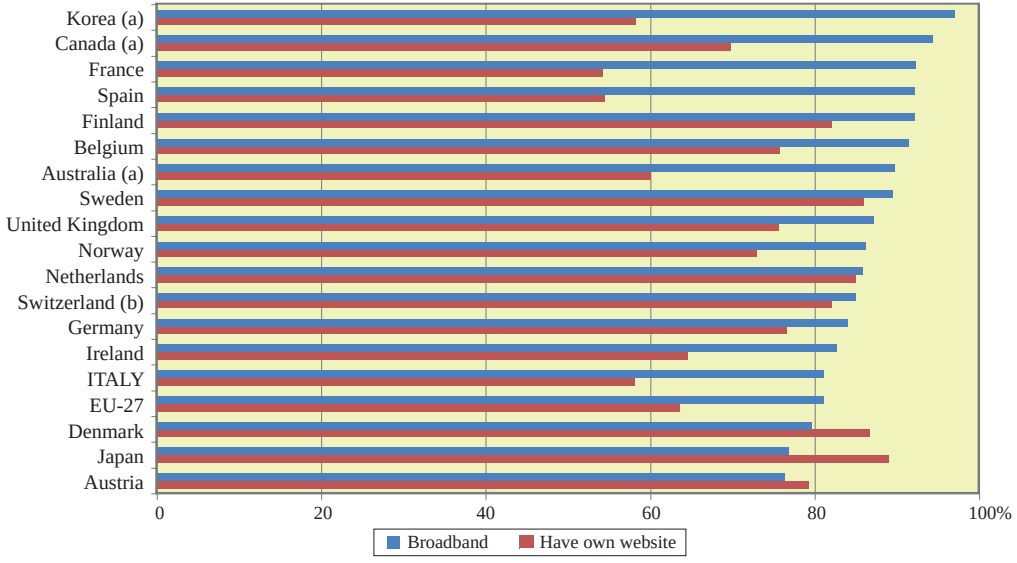
Source: European Commission, *A more research-intensive and integrated European Research Area, STC key figures report 2008/2009*.

Figure 4.19 - Employment in high-tech and medium-high-tech industrial sectors and in knowledge intensive services over total employment in some European countries, 2007



Source: EUROSTAT.

Figure 4.20 - Business use of broadband and websites over total enterprises in some OECD countries, 2008



Notes: include firms with ten or more employees; (a) 2007; (b) 2005.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

5. Policy and financial measures for science and technology

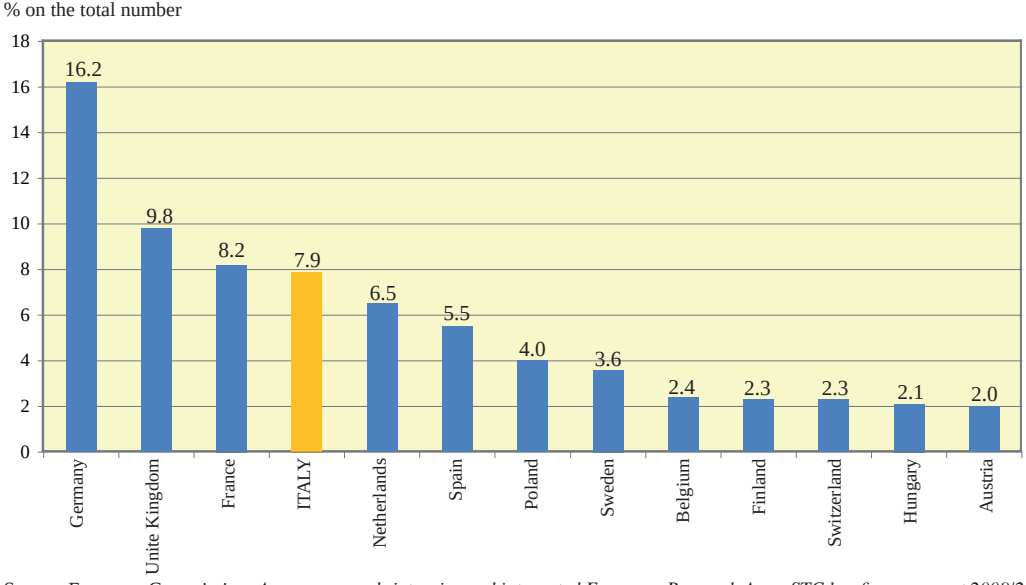
Science and technology financing in European countries mainly comes from the European Union through: Framework Programmes (FP) (which Italian researchers participate in with national research groups or, much more frequently, by joining research projects in collaboration with groups from other countries), competitiveness and innovation programmes, and structural funds. The latter provide key support to research infrastructures at a national and regional level. We wish to note that the EU budget has increased considerably for all the above-mentioned types of interventions, reaching a staggering 15 billion Euros a year for the 2007-2013 period. The source of these data is Eurostat.

A type of investment which is not very substantial from a financial point of view but which offers good development opportunities is that of *venture capital*. Funds are gathered on international markets - as well as in Italy - by dedicated financial sectors, acting as intermediaries between primary sources of financing (banks, pension funds) and small enterprises (recently set up and highly technological). *Venture capital* aims at covering enterprise costs in the early stages of a firm's development as well as at consolidating and speeding up the growth of an emerging firm. The sources for these figures are the Italian Private Equity and Venture Capital Association and the OECD.

Figure 5.1 as well as tables 5.1 and 5.2 describe the position of different countries - and Italy, in particular - within the context of European scientific activities, their participation in research programmes, and the use of common R&D infrastructures.

Figures 5.2 to 5.5 focus on the ability to take advantage of the opportunities offered by *venture capital*.

Figure 5.1 - Institutional participations in the 959 research infrastructure projects funded by FP6 in some European countries



Source: European Commission, *A more research-intensive and integrated European Research Area, STC key figures report 2008/2009*.

Table 5.1 - Cooperative links between EU countries and selected third countries in FP5 and FP6 funded projects

	Number of links per country											
	Brazil		*China*		*Russian Federation*		*India*		*South Africa*		*United States*	
	FP5	*FP6*	*FP5*	*FP6*	*FP5*	*FP6*	*FP5*	*FP6*	*FP5*	*FP6*	*FP5*	*FP6*
Austria	11	26	57	80	14	155	5	31	-	35	-	49
Belgium	31	60	35	139	8	189	4	56	13	82	1	95
Denmark	3	43	3	121	8	129	2	51	11	54	1	76
Finland	8	18	15	76	34	113	9	21	4	25	-	50
France	61	140	59	298	27	577	5	97	16	174	1	315
Germany	52	179	80	420	75	772	9	138	24	194	2	421
Ireland	3	24	3	36	10	58	-	8	5	18	-	46
ITALY	69	113	63	291	25	423	10	106	35	134	-	236
Netherlands	21	103	23	221	16	286	18	103	22	147	-	183
Spain	55	131	24	200	7	292	4	70	18	96	-	154
Sweden	16	36	25	101	8	190	9	45	23	72	-	122
United Kingdom	-	186	-	405	-	636	-	183	-	261	-	371
Total	373	1,222	435	2,775	253	4,624	79	1,034	192	1,498	5	2,424

Source: European Commission, *A more research-intensive and integrated European Research Area, STC key figures report 2008/2009*.

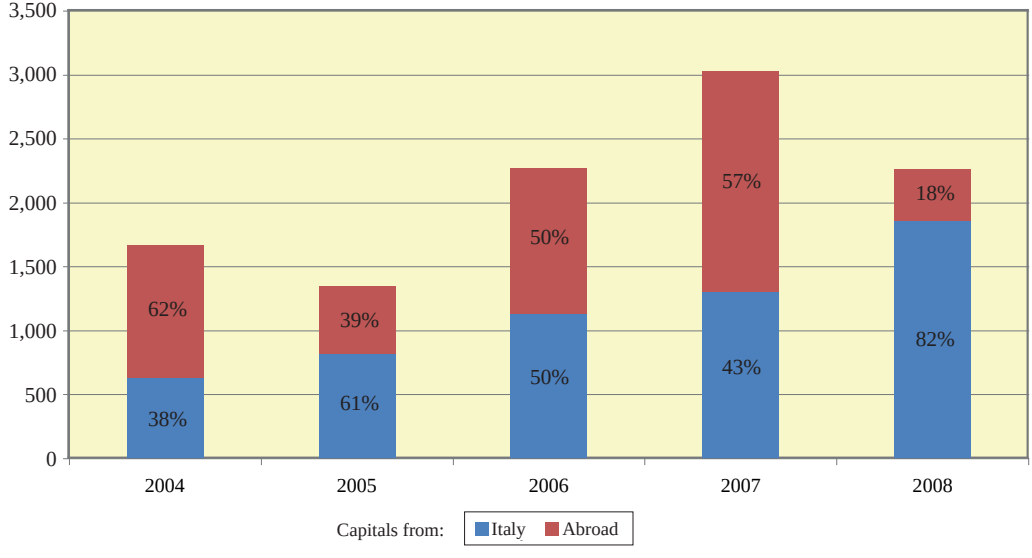
Table 5.2 - Major international users of research infrastructure in EU/FP6

Research infrastructures (RI)		
Country of home RI	*Main country of origin of RI users*	*Number of RI users*
United Kingdom	Germany	614
Germany	Switzerland	605
France	Germany	539
ITALY	Germany	528
Germany	ITALY	528
Belgium	Germany	514
France	ITALY	438
Poland	Germany	436
Germany	Germany(a)	398
ITALY	France	336

Note: (a) non-German users.
Source: European Commission, *A more research-intensive and integrated European Research Area, STC key figures report 2008/2009*.

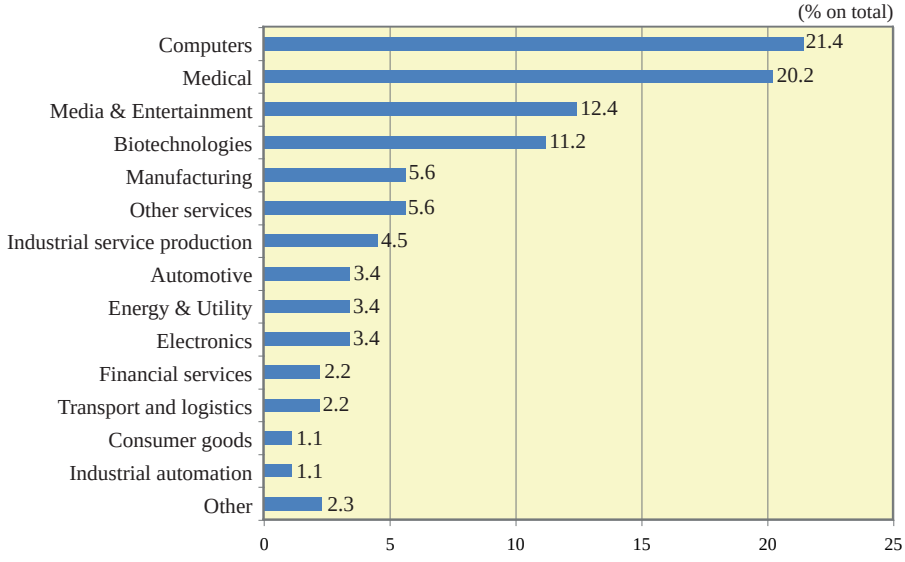
Figure 5.2 - Venture capital funds gathered on the Italian market, 2004-2008

million euros (2000 constant prices)



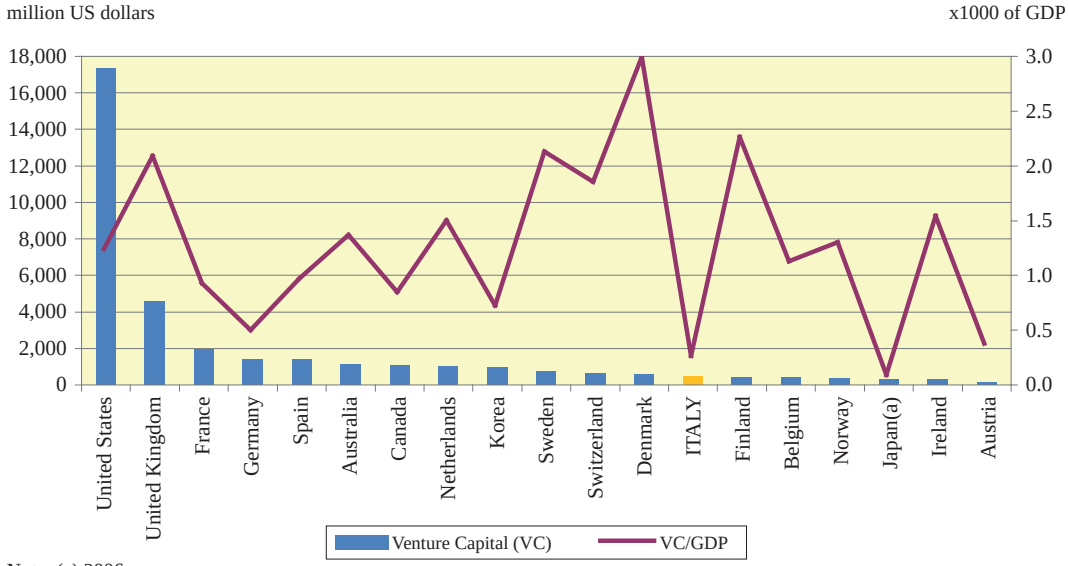
Source: AIFI. *Il mercato italiano del Private Equity e Venture Capital nel 2008. Survey AIFI*. PricewaterhouseCoopers.

Figure 5.3 - Sector distribution of the number of venture capital investments in high-tech industries in Italy, 2008



Source: AIFI. *Il mercato italiano del Private Equity e Venture Capital nel 2008. Survey AIFI*. PricewaterhouseCoopers.

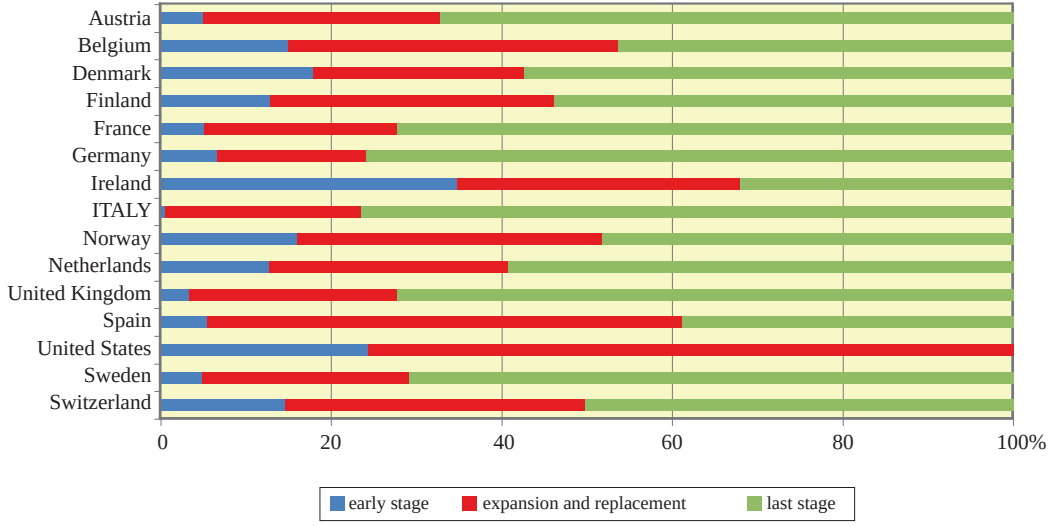
Figure 5.4 - Venture capital investments on GDP in some European countries, 2008



Note: (a) 2006.

Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 5.5 - Venture capital investments in different stages of development in some European countries, 2008



Source: EUROSTAT.

6. R&D personnel in Italy

The table and figures in this section are a selection from overall data about personnel; they provide interesting indicators on gender and on the number of researchers over the total population. The source for Italy is ISTAT, whereas Eurostat and OECD data have been used to draw international comparisons.

R&D personnel in Italy are broken down by: qualification (table 6.1) and institutional research sector (figure 6.1). Next, we provide some figures about international comparisons: the number of researchers in some countries is presented in absolute value (figure 6.2), broken down by sector (figure 6.3), and in relation to the total number of employees (figure 6.4). Figure 6.5 provides an overview of jobs in science and technology in some European countries, while figure 6.6 presents the amount of expenditure per individual researcher.

Table 6.1 - R&D personnel in Italy, 1980-2007

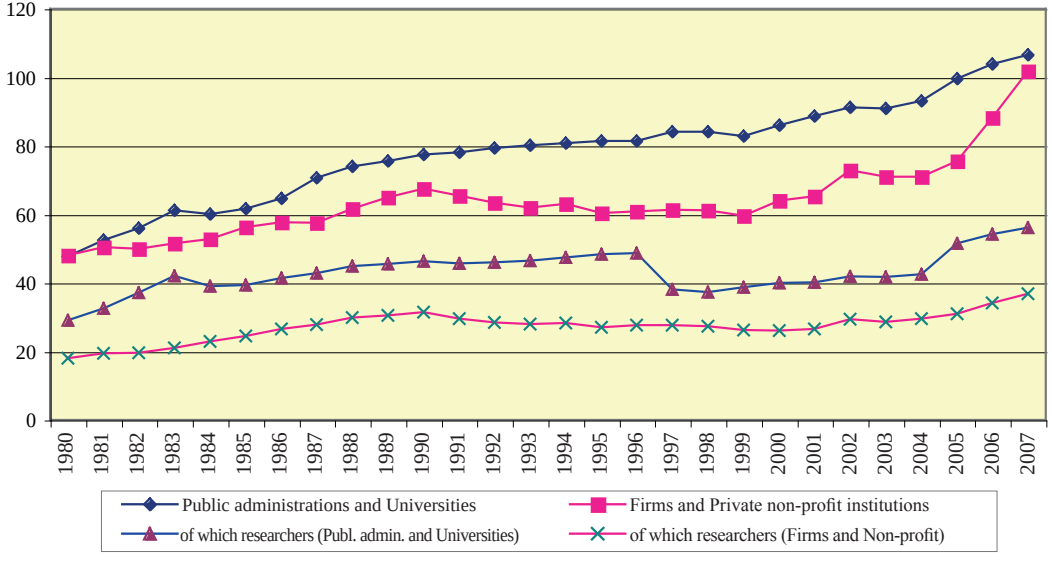
(FTE units)

Research sectors	1980		1990		2000		2005		2006		2007	
	Researchers	*Other personnel*	*Researchers*	*Other personnel*	*Researchers*	*Other personnel*	*Researchers*	*Other personnel*	*Researchers*	*Other personnel*	*Researchers*	*Other personnel*
Public administrations	29,046	18,636	14,502	18,611	14,315	16,916	14,454	18,230	16,590	19,575	17,291	18,183
Universities(a)			31,844	12,464	25,696	29,141	37,073	29,902	37,636	30,052	38,860	32,202
Private non-profit institutions	-	-	-	-	-	-	3,023	1,840	4,198	3,870	3,978	4,102
Companies	17,953	30,168	31,530	35,966	26,099	37,899	27,939	42,786	30,006	50,076	32,871	60,889
Total	46,999	48,804	77,876	67,041	66,110	83,956	82,489	92,759	88,430	103,573	93,000	115,376

Note: (a) From 2005 onwards, the procedure for estimating the research personnel in universities has been changed.
Source: ISTAT.

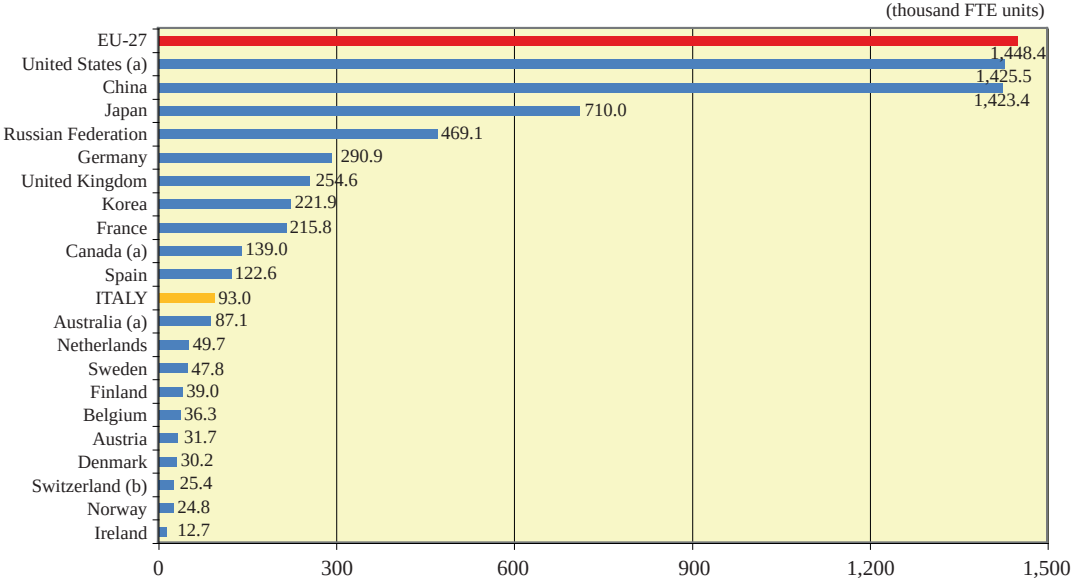
Figure 6.1 - R&D personnel by institutional sector in Italy, 1980-2007

thousand FTE units



Note: From 2005 onwards, the procedure for estimating the research personnel in universities has been changed.
Source: ISTAT.

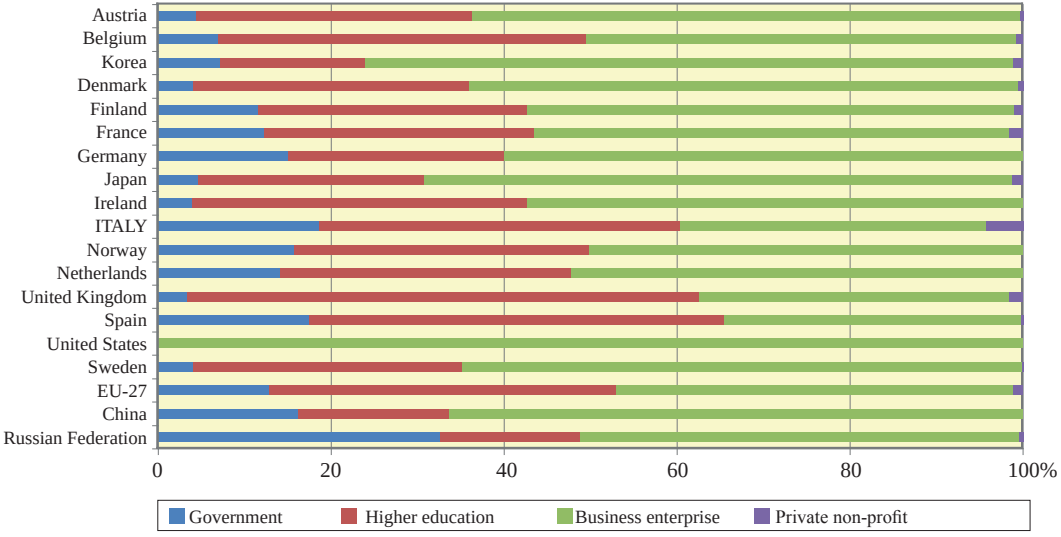
Figure 6.2 - Researchers in some OECD and non-OECD countries, 2007



Notes: (a) 2006; (b) 2004.

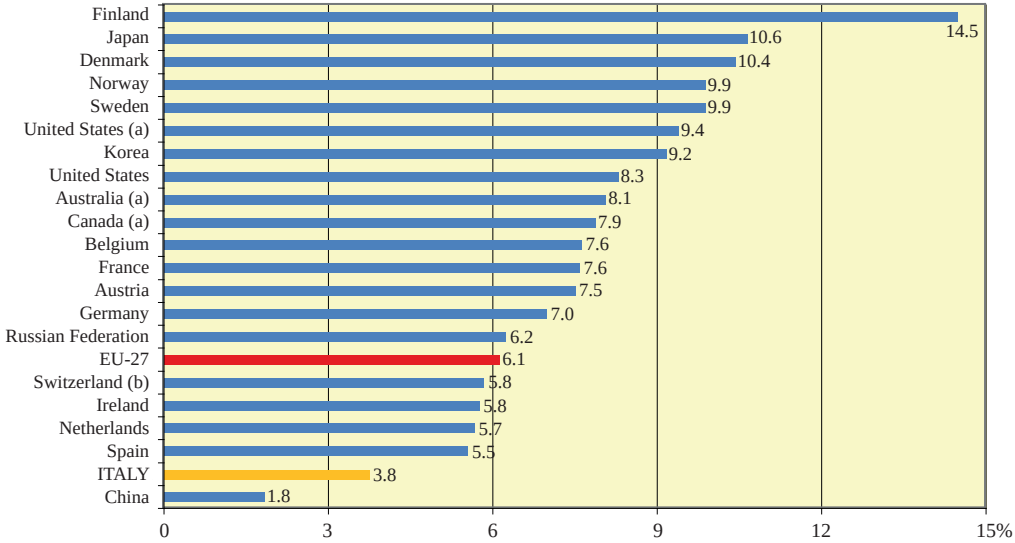
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 6.3 - Researchers by sector of performance in some OECD and non-OECD countries, 2007



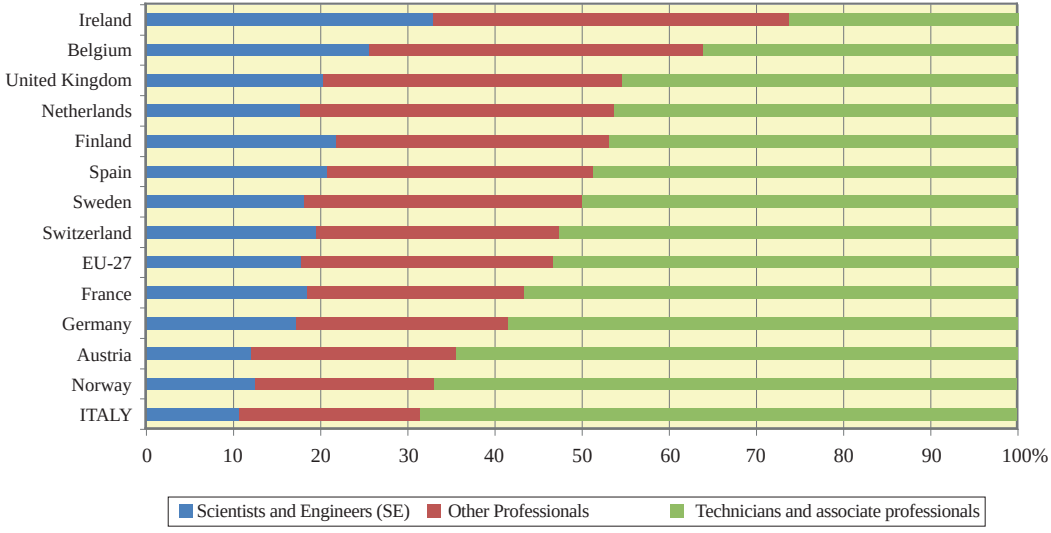
Source: EUROSTAT.

Figure 6.4 - Researchers per 1000 employees in some OECD and non-OECD countries, 2007



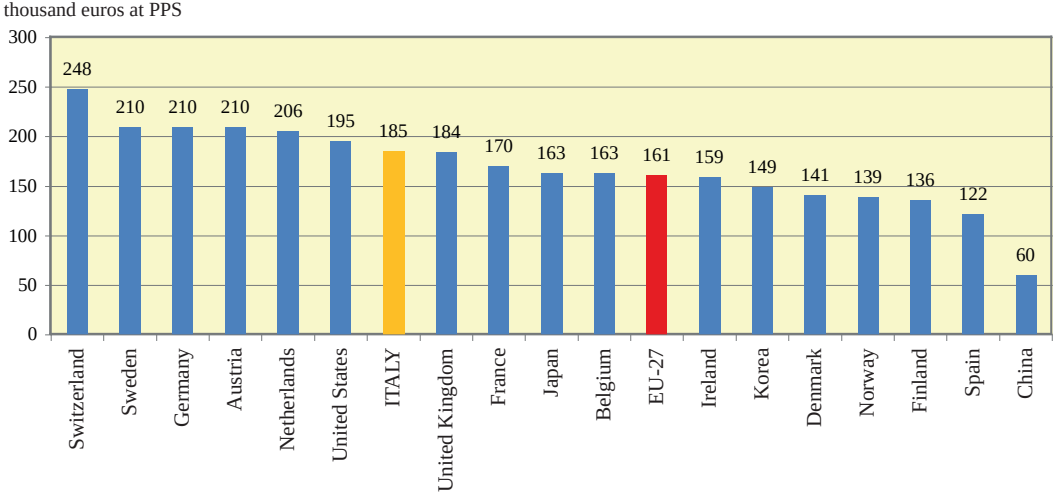
Notes: (a) 2006; (b) 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 6.5 - Distribution of human resources in science and technology aged 25-64 by occupation in some European countries, 2007



Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

Figure 6.6 - R&D expenditure per researcher in some OECD countries and China, 2007



Note: PPS (Purchasing Power Standard).

Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

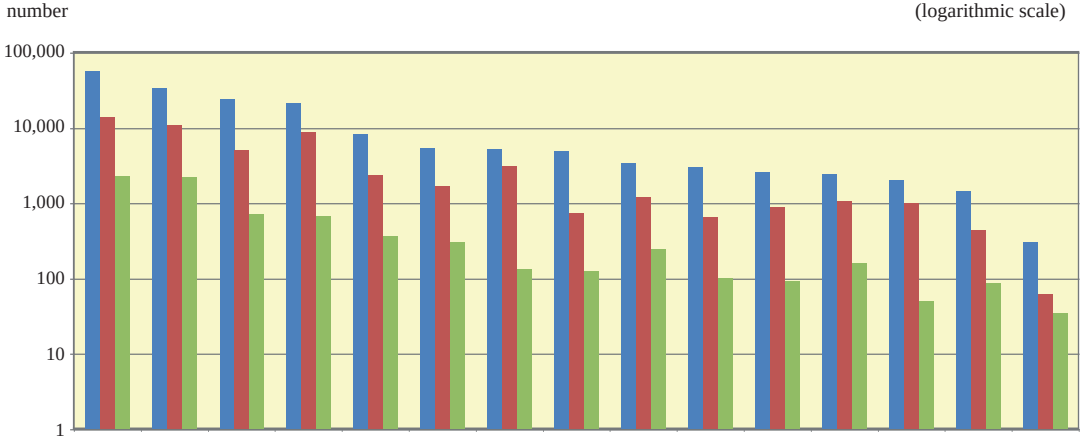
7. Patents

A patent is an exclusive right granted by law to applicants (or to inventors) to make use of their inventions for a limited period of time in a given geographical area. It provides a sound measure of the inventive activity of researchers and laboratories located in the various countries, as well as of technology flows. National patenting systems are not identical across countries, despite the fact that they have been made more homogeneous through international agreements and treaties. The *Patent Cooperation Treaty (PCT)* is an international treaty administered by the *World Intellectual Property Organization (WIPO)* and it makes it possible to seek patent protection for an invention in a large number of countries simultaneously from the very first time an application for an "international" patent is filed.

The sources used for our analysis are OECD and WIPO data and all the figures presented here focus on international comparisons. Figures 7.1 and 7.2 display the number of patents registered with the European Patent Office (EPO) and the number of patents issued by the U.S. Patent Office (USPO). Triadic patents refer to the inventions patented at the three major patenting offices, i.e. the two mentioned above and the Japanese Patent Office (JPO) and they are weighted on total patenting activities in OECD member countries (figure 7.3). The higher protection provided by this threefold patenting method ensures higher commercial revenues.

Figures 7.4, 7.5 and 7.6 prove that patenting activities are becoming more and more international and tend to be carried out jointly by inventors from different countries. Figures 7.7 and 7.8 present the number of patents registered by enterprises; in particular, the first figure shows the amount of firms' R&D financing in relation to the triadic patents filed and granted.

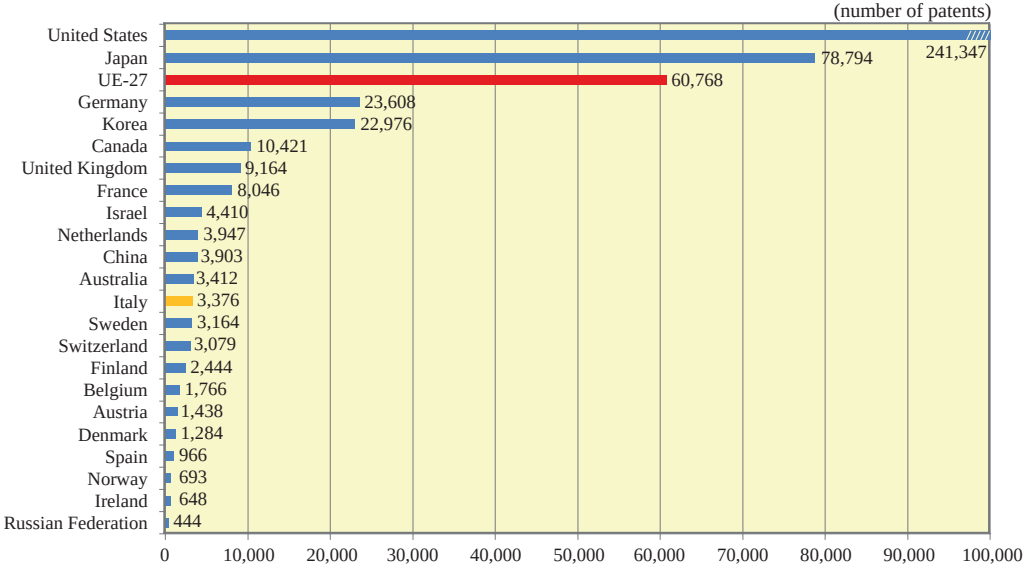
Figure 7.1 - Total patent applications to the EPO and applications in the ICT and biotechnology sectors in some OECD and non-OECD countries, 2006



	EU-27	US	DE	JP	FR	UK	KR	IT	NL	CH	SE	CA	CN	IL	RU
No. applications	57,619	34,671	24,068	21,577	8,363	5,599	5,301	5,045	3,503	3,128	2,611	2,424	2,064	1,478	311
Itc	14,253	10,945	5,154	8,976	2,348	1,718	3,132	751	1,213	657	906	1,098	1,007	444	64
Biotech.	2,335	2,289	723	685	369	307	136	127	250	102	95	163	51	89	35

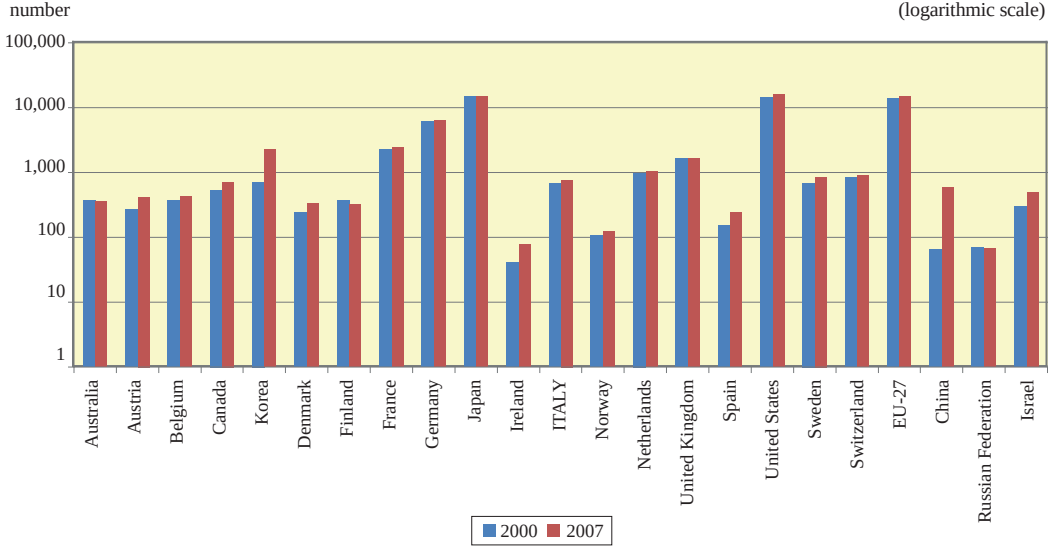
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 7.2 - Total patents granted by USPTO for some OECD and non-OECD countries, 2007



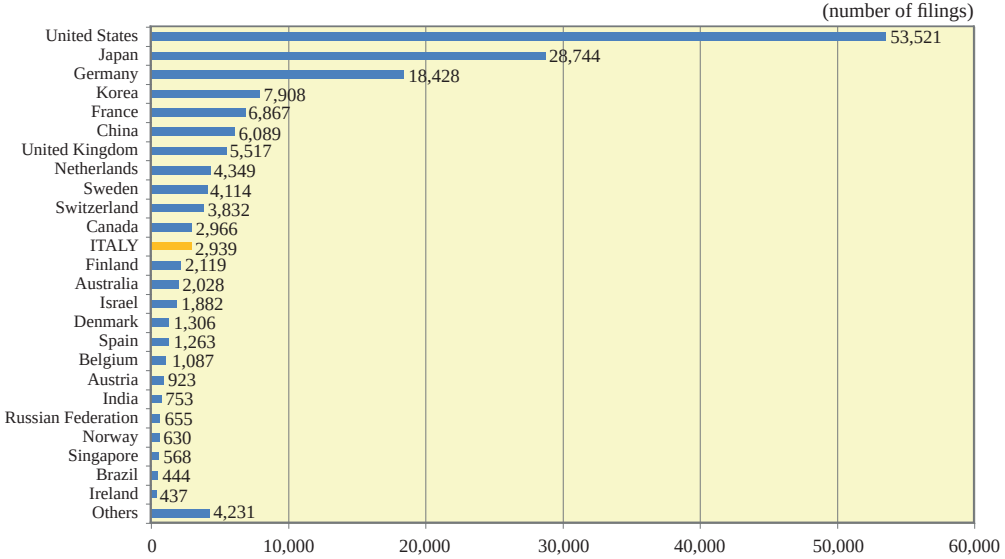
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 7.3 - Triadic patents filed (EPO, JPO) and granted (USPTO) for some OECD and non-OECD countries, 2000 and 2007



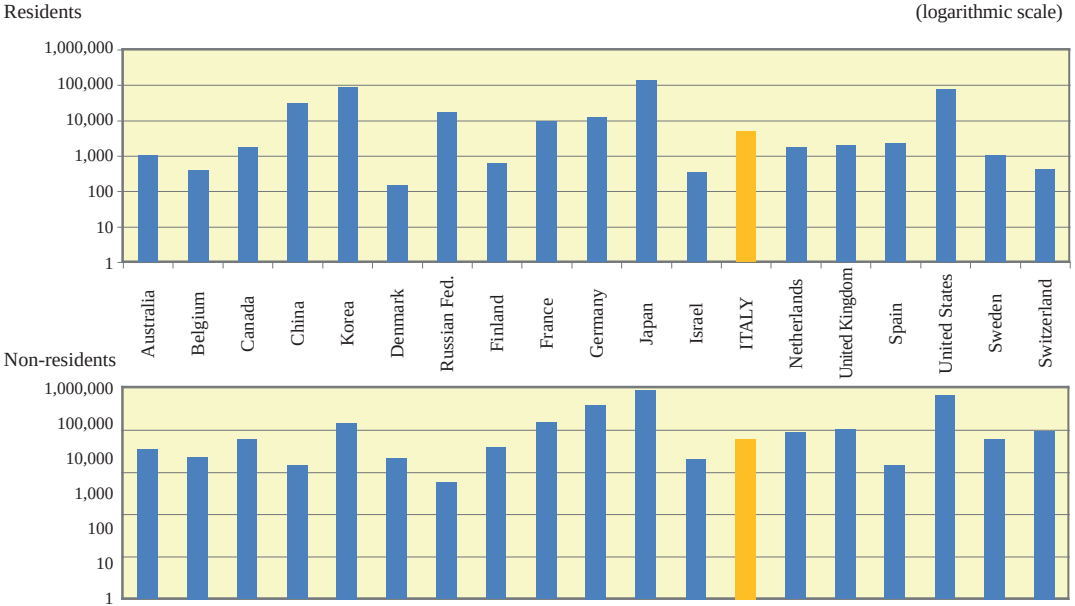
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 7.4 - Applications for international patents filed with the PCT in some OECD and non-OECD countries, 2008



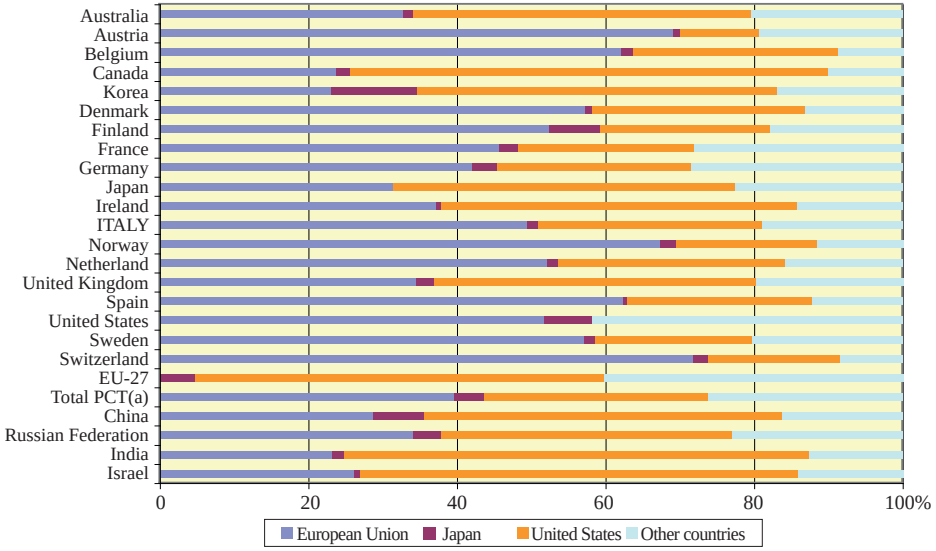
Note: The Patent Cooperation Treaty (PCT) procedure consists of an international phase and a national/regional one. Data reported refer to the international phase of the PCT procedure.
Source: WIPO, *The WIPO Patent Report*, 2009 Edition.

Figure 7.5 - Patents by country of origin in some OECD and non-OECD countries, 2007



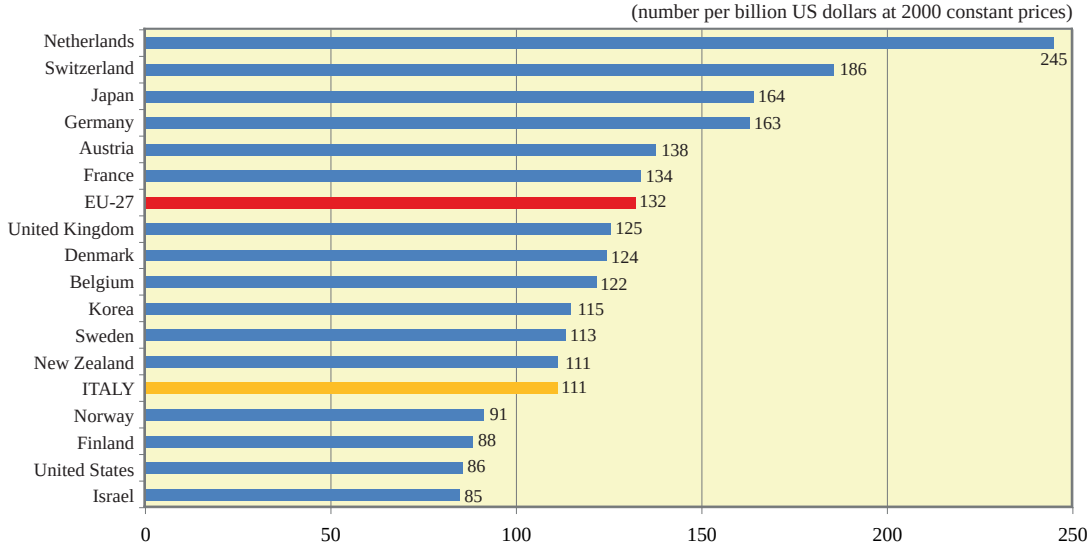
Source: WIPO, *The WIPO Patent Report*, 2009 Edition.

Figure 7.6 - PCT patent applications with co-inventors located abroad in some OECD and non-OECD countries, 2004-2006



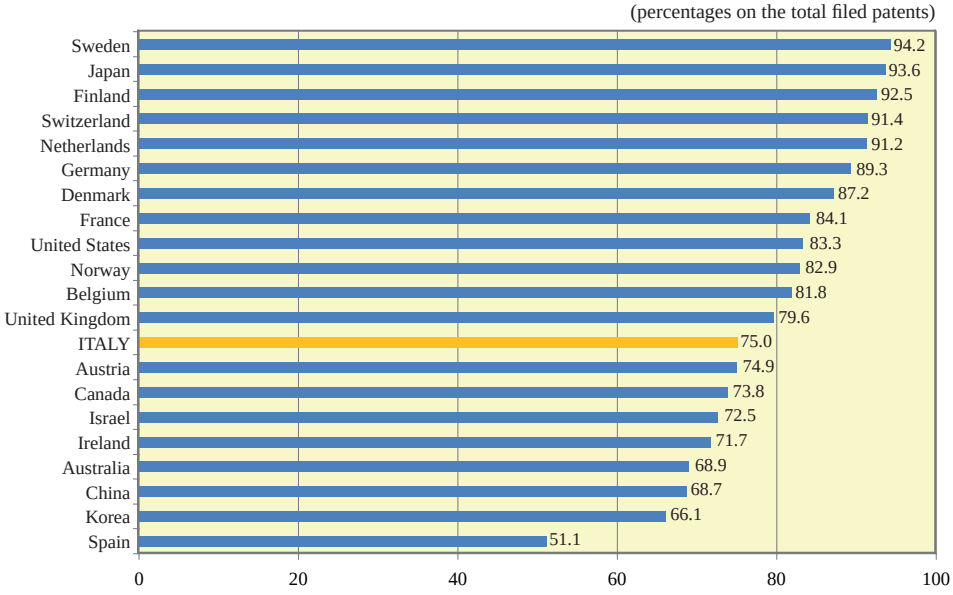
Note: (a) Co-inventions are measured as the share of patent applications filed under the Patent Co-operation Treaty (PCT) with at least one co-inventor located abroad in total patents invented domestically.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 7.7 - Triadic patents on industry-financed R&D in some OECD and non-OECD countries, 2005-2007 average



Source: CERIS-CNR elaboration on OECD, *Science, Technology and Industry Scoreboard*, 2009 data.

Figure 7.8 - International patent applications filed with the PCT by firms in some OECD and non-OECD countries, 2008



Source: WIPO, *The WIPO Patent Report*, 2009 Edition.

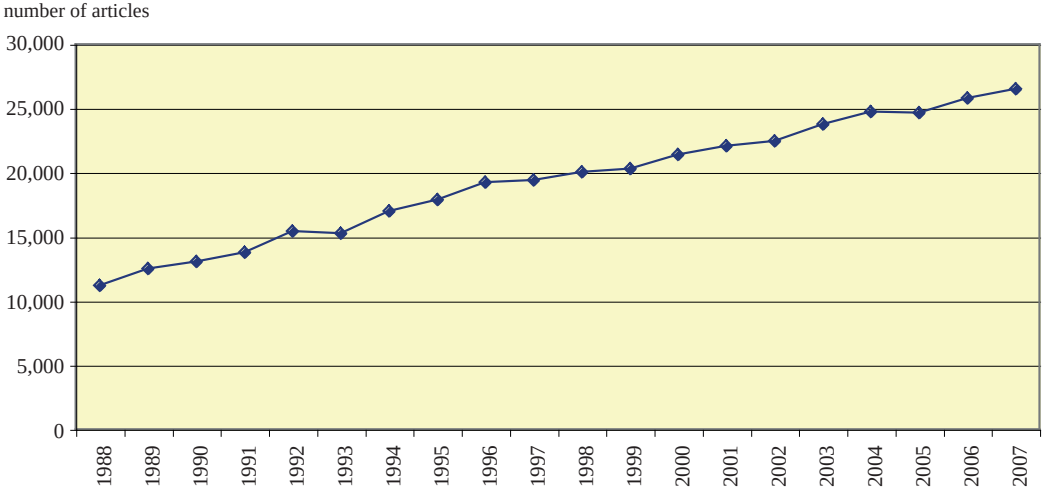
8. Publications

The data about the number of articles presented in this section refer to a set of scientific articles published in a large number of scientific and technical journals, selected by Thomson Reuters, in the Science Citation Index (SCI) and in the Social Sciences Citation Index (SSCI). The source of the data considered here is the U.S. National Science Foundation, which uses data elaborated for this purpose by the Patent Board TM (previously CHI Research, Inc.) within a licence agreement with Thomson Reuters. Some other data have been drawn from the OECD.

The number of journals selected has progressively increased over time and the complete list is updated every year, following the evolution of research and publication activities. Moreover, the analysis has been extended to electronic journals, too.

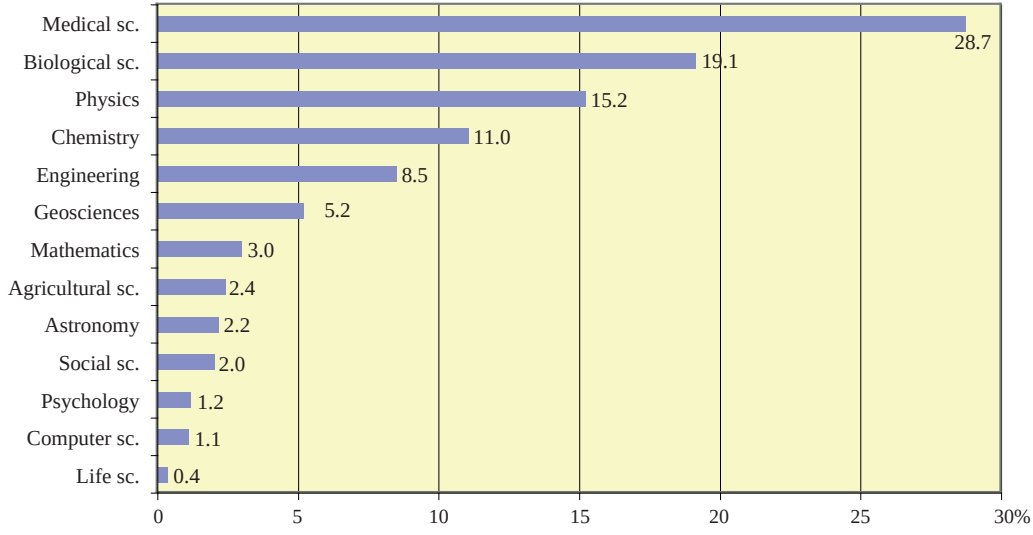
The number of scientific publications in international journals (figures 8.1, 8.2, 8.3, 8.4 and 8.5) represents a proxy of a country's scientific production. Furthermore, it provides a series of indications on the content and priorities of scientific activities within a research system, on the ability to implement the transfer of R&D results to practical applications, as well as on the connections among scientific sectors.

Figure 8.1 - Scientific publications by Italian authors in the most important international journals, 1988-2007



Source: National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01).

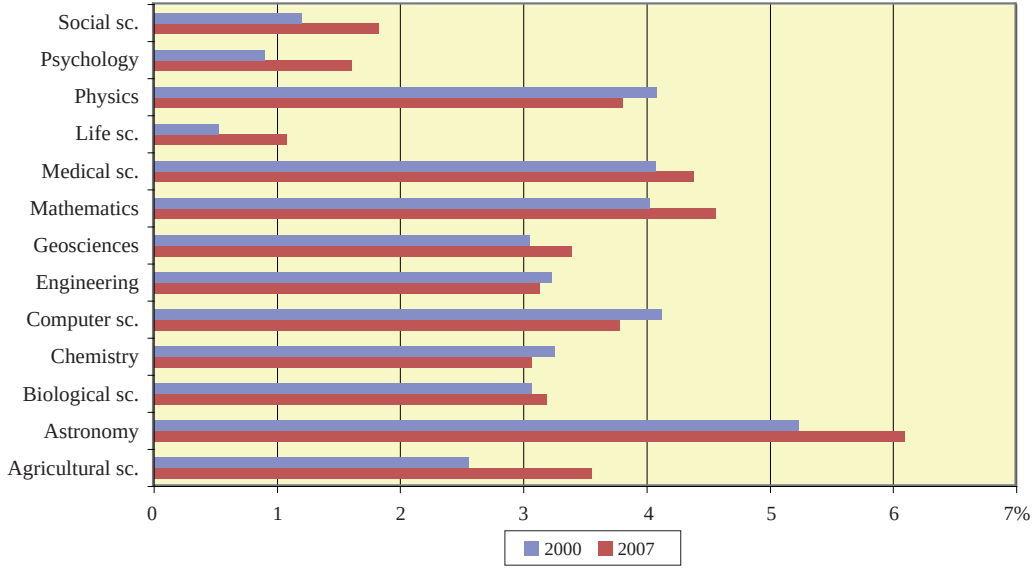
Figure 8.2 - Scientific publications by Italian authors in the most important international journals in several disciplines on the Italian total, 2007



No. of publications: 26,554

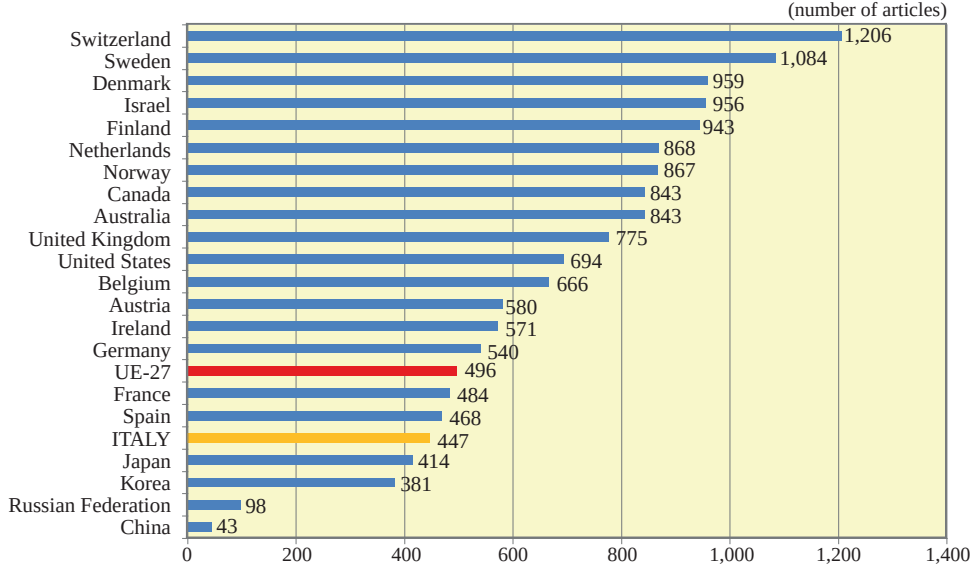
Source: National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01).

Figure 8.3 - Scientific publications by Italian authors in several disciplines on the world total of each discipline, 2007



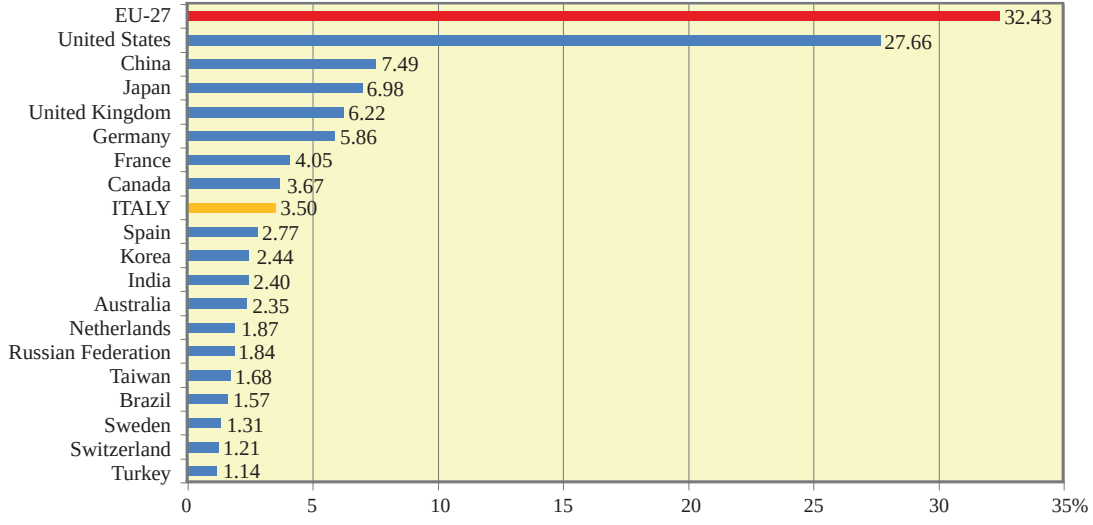
Source: National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01).

Figure 8.4 - Scientific articles by authors in some OECD and non-OECD countries per million inhabitants, 2007



Source: CERIS-CNR elaboration on data from: OECD, *Main Science and Technology Indicators*, 2009-2; National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01).

Figure 8.5 - Scientific articles by authors of some OECD and non-OECD countries on the world total, 2007



Source: National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01).

9. Technological Balance of Payments

The technology balance of payments (TBP) measures transactions with foreign countries concerning technology that is disembodied, i.e. not incorporated in goods. As for the breaking down of TBP items, we follow the presentation standards outlined by the International Monetary Fund and by the OECD. This system comprises the following items: trade in technology (which includes the transfer of patents, inventions, know-how and related exploitation rights); transactions concerning industrial property (in particular trademarks and industrial designs); services with technological content (which, despite not representing an actual transfer of technology, increase its potential through the acquisition of technical skills); research and development carried out abroad or financed from abroad.

The Bank of Italy and ISTAT are the sources of data on Italy, whereas OECD data have been used for international comparisons.

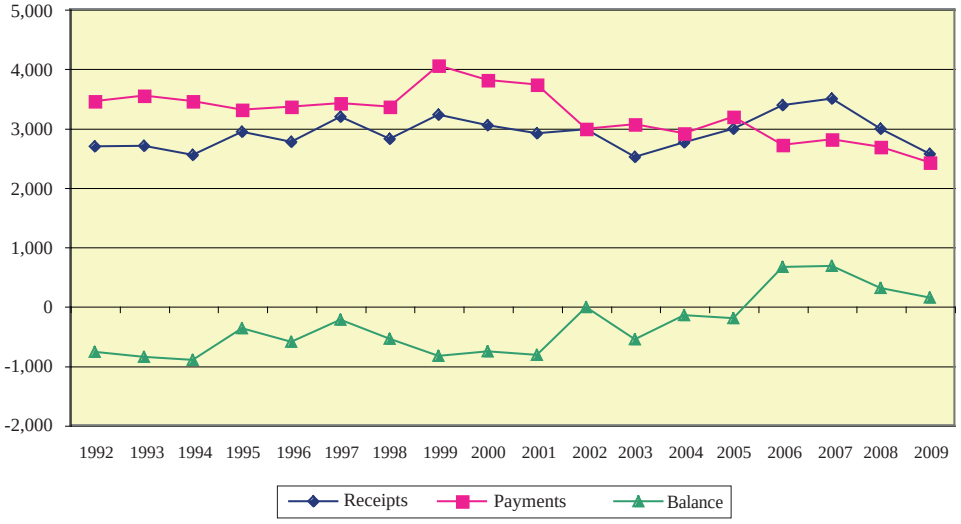
Figures 9.1, 9.2, 9.4 and table 9.1 illustrate the characteristics of the Italian TBP, analysed both in its evolution over time and in its relationship with other countries.

The ratio between payments for the purchase of technology and R&D expenditure (table 9.2) measures the flow of technology purchased over the technology that is produced autonomously. The ratio between TBP balance and R&D expenditure (figure 9.3) indicates the types of transactions in which the technology of a country is more (positive balance) or less (negative balance) competitive.

The international comparisons displayed in figures 9.5, 9.6 and 9.7 show the volume of technology trade of the various countries and their ability to use the different types of technology purchased.

Figure 9.1 - TBP in Italy, 1992-2009

million euros (at 2000 constant prices)



Source: Banca d'Italia - Eurosistema.

Table 9.1 - TBP broken down by different items in Italy, 2009

	Receipts		Payments		Balance
	thousand euros	%	thousand euros	%	thousand euros
Trade in technology	532,850	16.5	590,761	19.4	-57,911
Transfer of patents	*53,172*	*1.6*	*32,257*	*1.1*	*20,915*
Royalties on patents	*441,336*	*13.6*	*510,604*	*16.8*	*-69,268*
Know how	*37,756*	*1.2*	*47,612*	*1.6*	*-9,856*
Transfer of inventions	*586*	*0.0*	*288*	*0.0*	*298*
Transfer of trademarks, models and designs	185,820	5.7	633,423	20.8	-447,603
Royalties on trademarks, models and designs	*172,132*	*5.3*	*550,944*	*18.1*	*-378,812*
Transfer of trademarks, models and designs	*13,688*	*0.4*	*82,479*	*2.7*	*-68,791*
Services with a technical content	1,340,607	41.5	675,149	22.2	665,458
Technical assistance linked to sales and licensing	*32,461*	*1.0*	*60,800*	*2.0*	*-28,339*
Commitment of technicians and experts	*145,441*	*4.5*	*91,188*	*3.0*	*54,253*
Training of personnel	*18,065*	*0.6*	*30,737*	*1.0*	*-12,672*
Technical and engineering studies	*1,144,640*	*35.4*	*492,424*	*16.2*	*652,216*
R&D financed abroad	1,144,454	35.4	563,949	18.5	580,505
R&D services	*1,144,454*	*35.4*	*563,949*	*18.5*	*580,505*
Total	3,203,731	99.1	2,463,282	80.8	740,449
Other	30,048	0.9	584,312	19.2	-554,264
Grand total	3,233,779	100.0	3,047,594	100.0	186,185

Source: Banca d'Italia - Eurosistema.

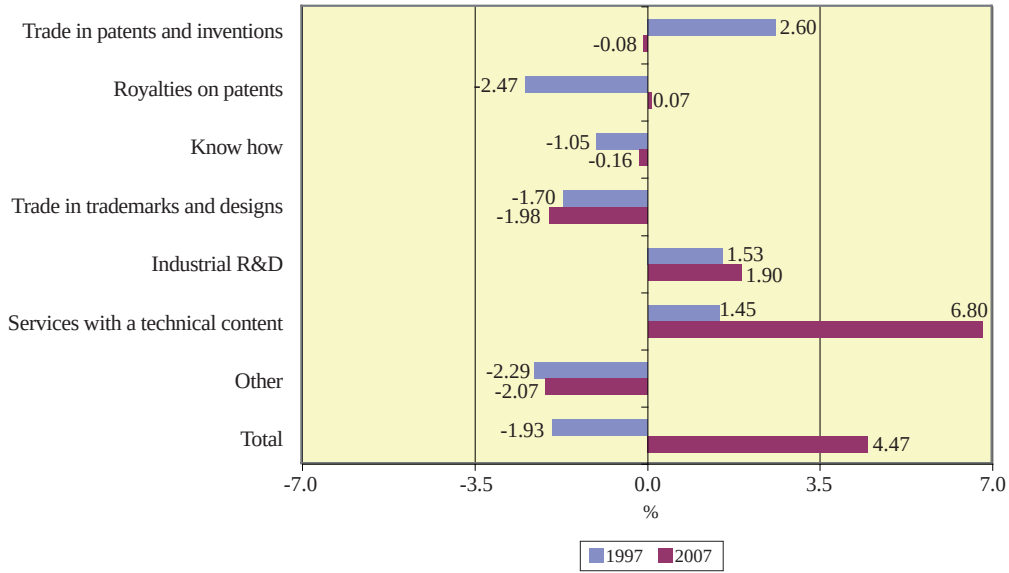
Table 9.2 - Payments for the purchase of technology over R&D expenditure in Italy, 1997 and 2007

(percentages)

	1997	*2007*
Trade in patents and inventions	0.81	0.33
Royalties on patents	4.33	1.74
Know how	2.32	0.45
Trade in trademarks and designs	3.17	3.24
Industrial R&D	3.77	3.73
Services with a technical content	12.57	6.05
Total	26.98	15.87

Source: CERIS-CNR elaboration on Banca d'Italia and ISTAT data.

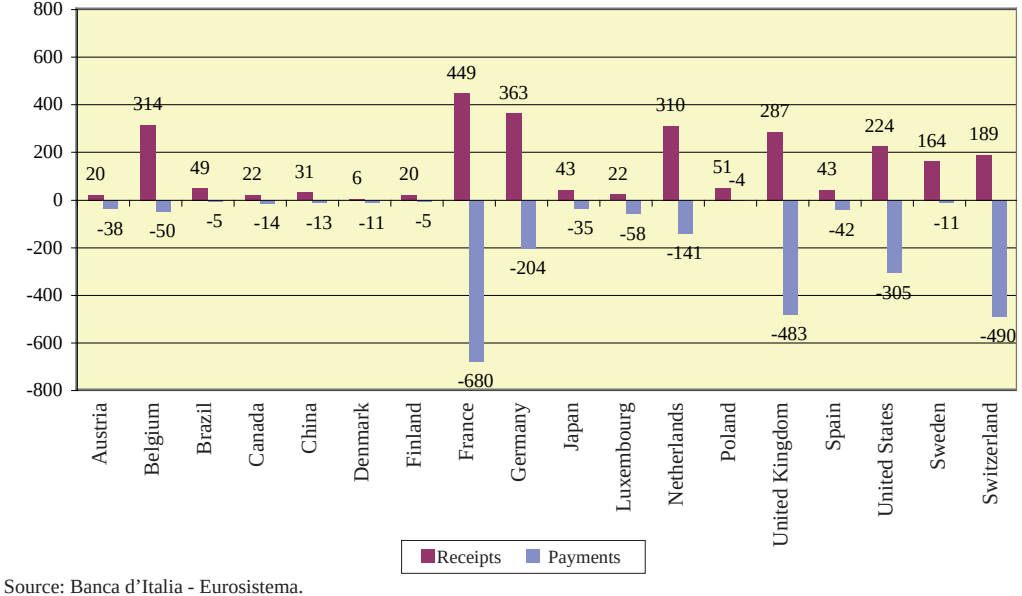
Figure 9.3 - TBP balance over R&D expenditure in Italy, 1997 and 2007



Source: CERIS-CNR elaboration on Banca d'Italia and ISTAT data.

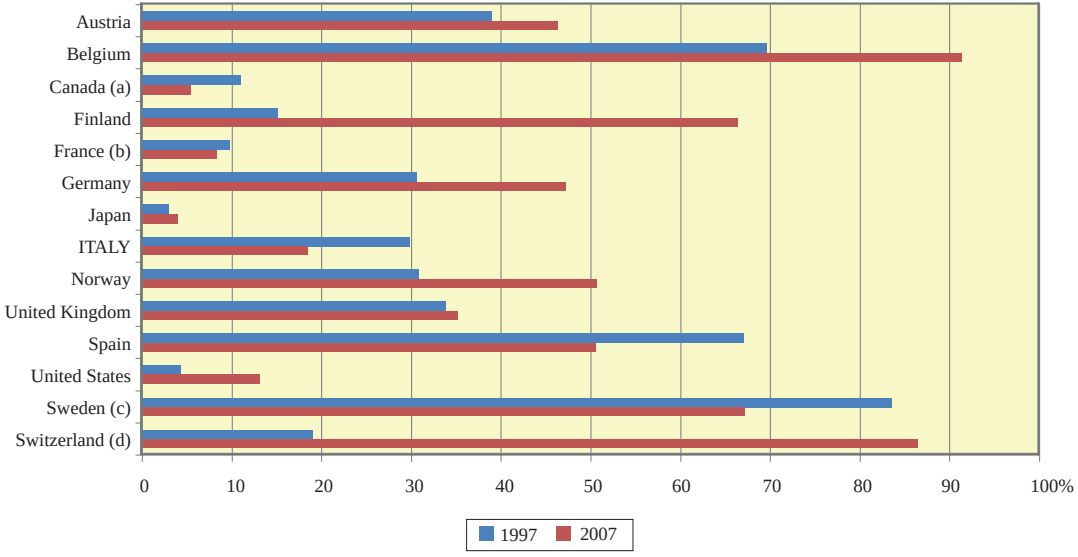
Figure 9.4 - Italy's TBP balance with major partner countries, 2009

million euros



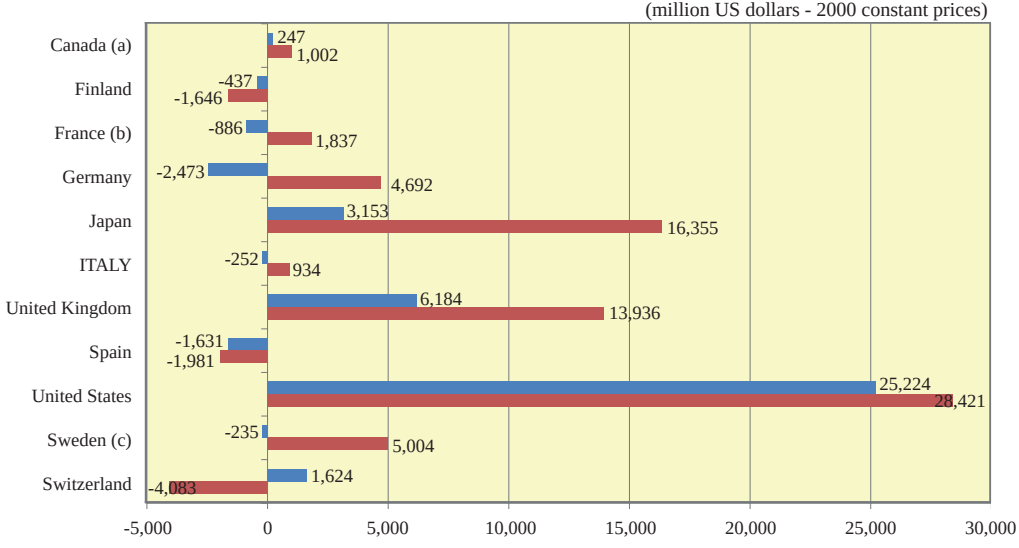
Source: Banca d'Italia - Eurosistema.

Figure 9.5 - TBP payments over R&D expenditure in some OECD countries, 1997 e 2007



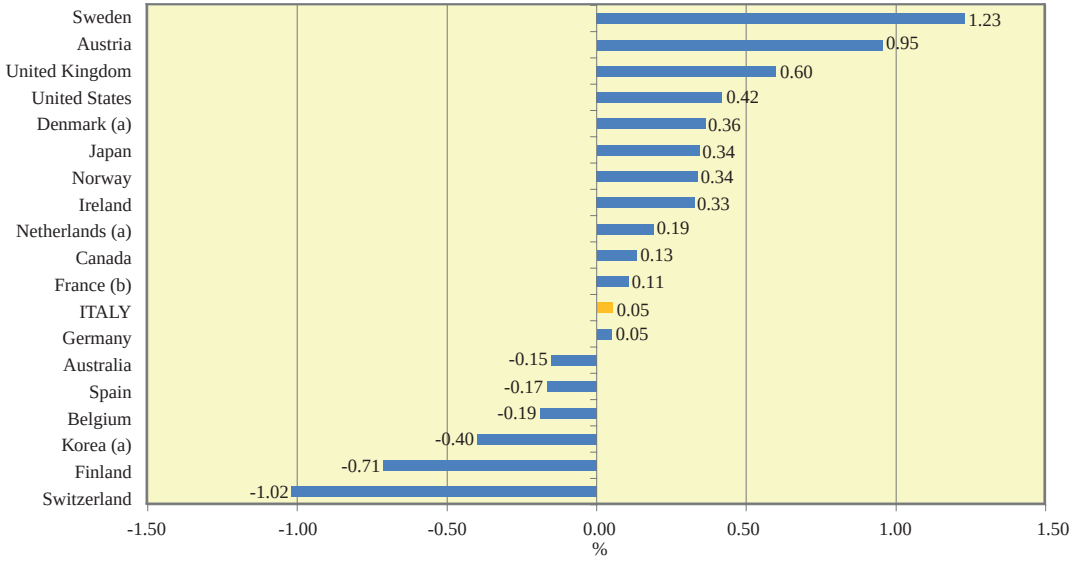
Notes: (a) 2006; (b) 2003; (c) 1999; (d) 1996, 2004.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 9.6 - TBP balance in some OECD countries, 1997 and 2007



Notes: (a) 2006; (b) 2003; (c) 1998.
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 9.7 - TBP as a percentage of GDP in some OECD countries, 2007



Notes: (a) 2006; (b) 2003.
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

10. Trade in high-tech products

The trade of high-tech and medium-high-tech products casts light on the specialisation of different countries in terms of technology and, in particular, on their structural strengths and weaknesses. The ability of a country to produce high-tech goods (which are particularly sought-after on the global market) shows the competitive strength of that portion of an industrial system which lies at the frontier of technology.

ISTAT is the source of data about Italy (figure 10.1), while OECD and Eurostat data have been used in the figures regarding comparisons among countries.

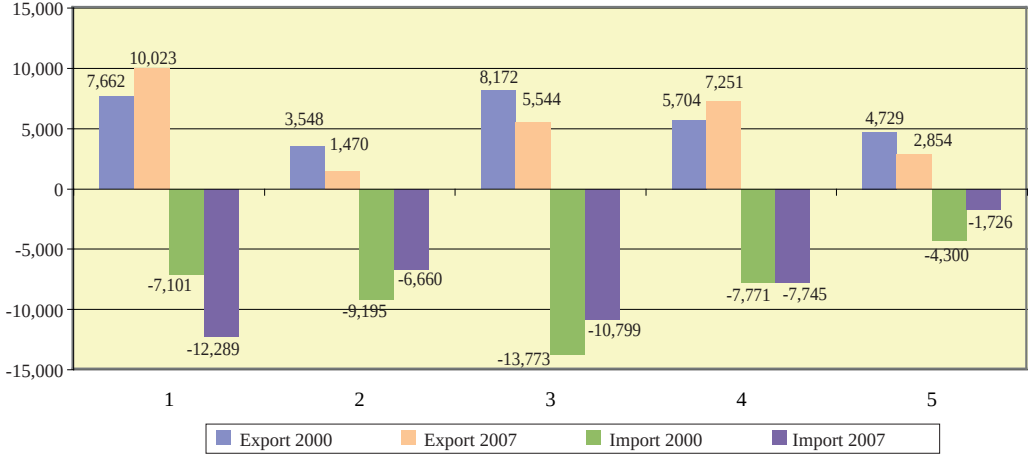
Figures 10.2, 10.3 and 10.4 illustrate some of the characteristic values of high-tech manufacturing industries ("high R&D intensity", according to the definition by the OECD, which elaborated a classification of manufacturing industries based on technology). The industries included in this category are those that manufacture:

- aircrafts and spacecrafts,
- radio and television devices and communication equipment,
- office machines and computers,
- pharmaceutical products,
- medical equipment, precision tools, optical instruments and watches.

Figure 10.5 focuses on the trade of goods in a specific sector, that of telecommunications.

Figure 10.1 - Trade by groups of Italian high-tech products, 2000 and 2007

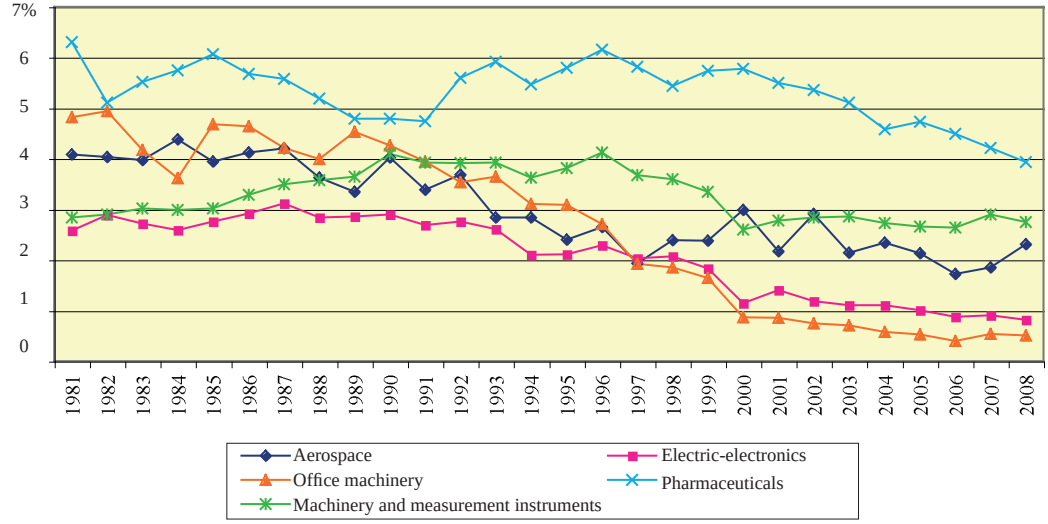
million euros
(2000 constant prices)



Legenda: 1) Pharmaceutical and chemical products; 2) Office machinery and computers; 3) Radio, TV and telecommunications; 4) Medical, precision and optical instruments, watches; 5) Aerospace vehicles.

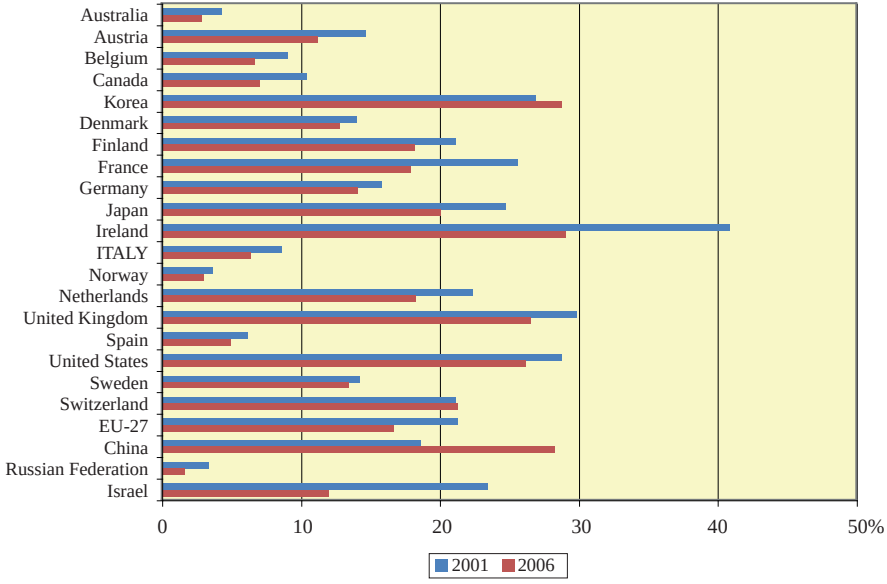
Source: Servizio Statistico Nazionale- Istat-Ice; *Commercio estero e attività internazionali delle imprese*. Annuario Istat-Ice 2008.

Figure 10.2 - Italian export market shares over total OECD exports in some high-tech manufacturing sectors, 1981-2008



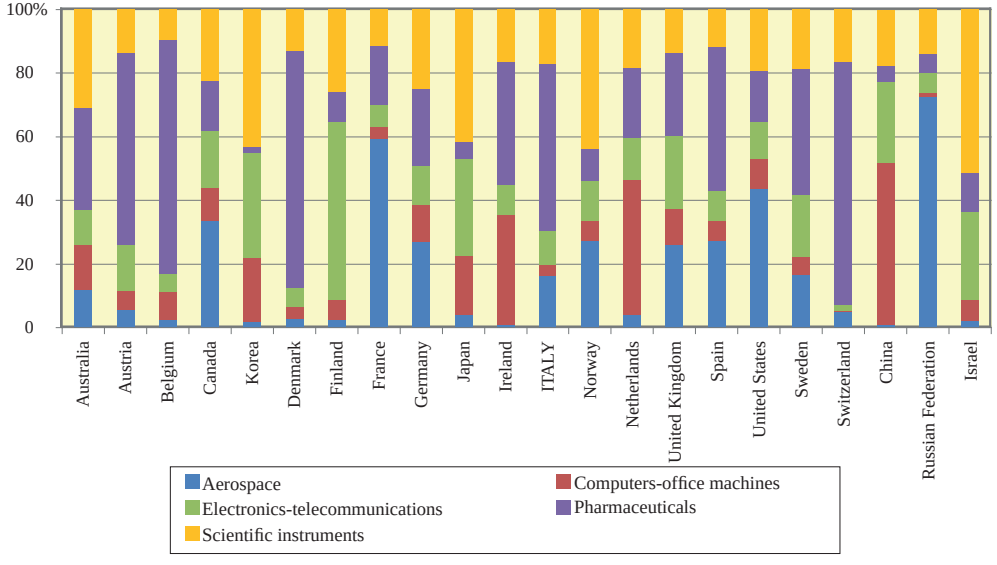
Source: OECD, *Main Science and Technology Indicators*, 2009-2.

Figure 10.3 - Export shares of high-tech manufacturing products over total manufacturing exports in some OECD and non-OECD countries, 2001 and 2006



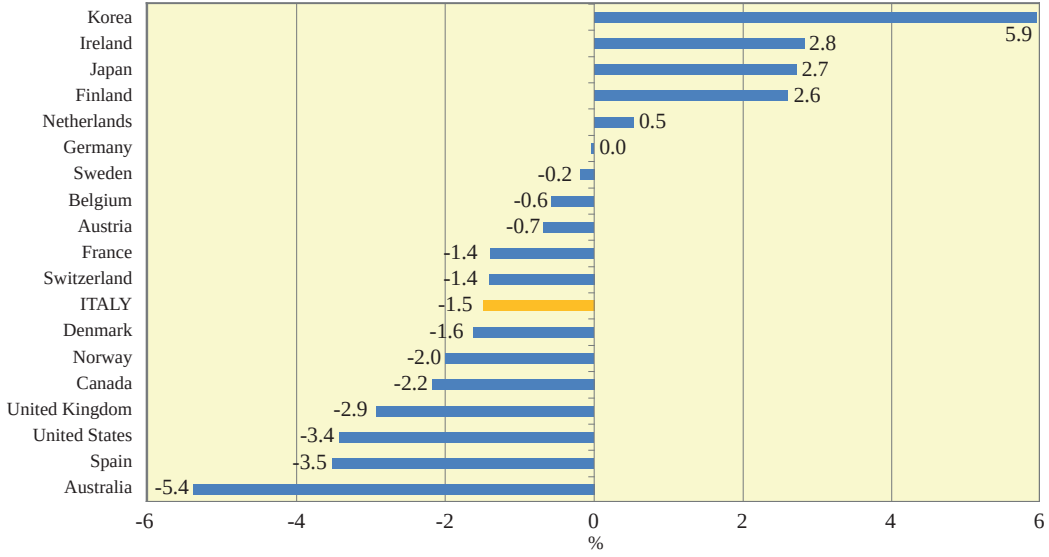
Source: EUROSTAT.

Figure 10.4 - Exports in various high-tech sectors of some OECD and non-OECD countries, 2006



Source: EUROSTAT, *Science, technology and innovation in Europe*, 2009.

Figure 10.5 - Balance of the trade of ICT goods in some OECD countries: ICT goods share over total trades, 2007



Note: The ICT goods' trade balance indicator is calculated as ICT exports minus ICT imports divided by total trade (exports plus imports).
Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

11. Innovation

In 2008 ISTAT published the results of its survey on innovation activities carried out by Italian enterprises, based on defining criteria and surveying methods shared by all the countries in the European Union. This investigation was performed within the fourth European survey on innovation (Community Innovation Survey – CIS) and it focused on Italian firms with at least 10 employees operating in the industrial and service sector in the 2004-2006 period.

Hence, ISTAT is the source for Italy, while the data used for international comparisons are provided by the *CIS* investigation and the sources are Eurostat and the OECD.

The main indicators of innovation in Italian enterprises are those referring to firms that, in the three-year period under investigation, brought an innovation to the market in the industrial sector, as well as in the construction and service sectors. They highlight the distribution by type of innovation: process, product, or both (table 11.1). The expenditure for innovation refers to the economic sector in which industrial and service firms operate (tables 11.2 e 11.3) and to the industrial sector and class of workers (figure 11.1). Moreover, the expenditure of innovative manufacturing enterprises is broken down into four broad groups of firms (following Pavitt's taxonomy which identifies *clusters* of industries based mainly on their sources of information): - high research intensity firms (based on science), - economy of scale firms, - specialised suppliers, - firms with innovative activities dictated by machinery suppliers (figure 11.2). Figures 11.3 and 11.4 present the numbers of innovative firms divided into the four main groups mentioned above and the types of innovations introduced.

As for international comparisons, table 11.4 displays the percentage weight of innovative enterprises in relation to the class of workers. Figure 11.5 shows the number of innovative enterprises in various European countries, while figure 11.6 presents the type of innovation introduced. Figures 11.7 and 11.8 describe the intensity of collaborations in innovation activities and the role played by firm size (large enterprises and SMEs) in bringing completely new products to the market.

Table 11.1 - Main innovation indicators in Italian companies, 2004-2006

	Number
Industrial companies	89,291
of which: Innovating companies	33,292
Construction companies	30,844
of which: Innovating companies	5,419
Services companies	90,085
of which: Innovating companies	19,901
Industrial, construction and service companies interviewed	17,000
	Percentages
Companies that introduced innovation	
of which: Industrial companies	56.8
Construction companies	9.2
Service companies	33.9
Industrial companies that introduced	
product innovation	17.5
process innovation	41.9
both product and process innovation	40.6
Construction companies that introduced	
product innovation	4.8
process innovation	60.2
both product and process innovation	35.0
Service companies that introduced	
product innovation	11.5
process innovation	62.4
both product and process innovation	26.1

Source: ISTAT, *L'innovazione nelle imprese italiane. Anni 2004-2006*, Rome, November 2008.

Table 11.2 - Innovation expenditure of innovative manufacturing firms by economic activity in Italy, 2006

Economic activities	*Expenditure (million euros)*	*Expenditure by employee of innovative firms (thousand euros)*
Mining and quarrying	99.6	5.0
Food and tobacco	853.8	6.2
Textiles industry	474.2	5.6
Garment	157.6	3.9
Shoes and leather	290.1	6.0
Wood	215.4	6.0
Pulp, paper	353.7	9.8
Print and publishing	601.8	12.3
Oil and coke	155.0	19.4
Chemical industry	2,100.5	14.5
Pharmaceuticals, medicinal chemicals and botanical products	864.3	14.7
Rubber and plastics	869.6	8.1
Non metallic mineral products	552.5	5.6
Basic metals	602.9	7.3
Metal products	1,451.7	6.3
Machinery and equipment n.e.c.	2,771.0	8.0
Office machinery and computers	179.7	20.3
Electrical machinery and computers	697.3	7.4
Telecommunications	1,324.2	24.6
Precision instruments	895.9	12.5
Motor vehicles, trailers and semi-trailers	1,449.5	11.9
Other transportation equipment	1,134.1	15.1
Manufacture of aircraft and spacecraft	732.3	23.7
Other manufacturing industries	437.9	4.9
Recycling	39.8	8.6
Electricity, gas and water supply	637.9	9.5
Water transport	23.8	2.4

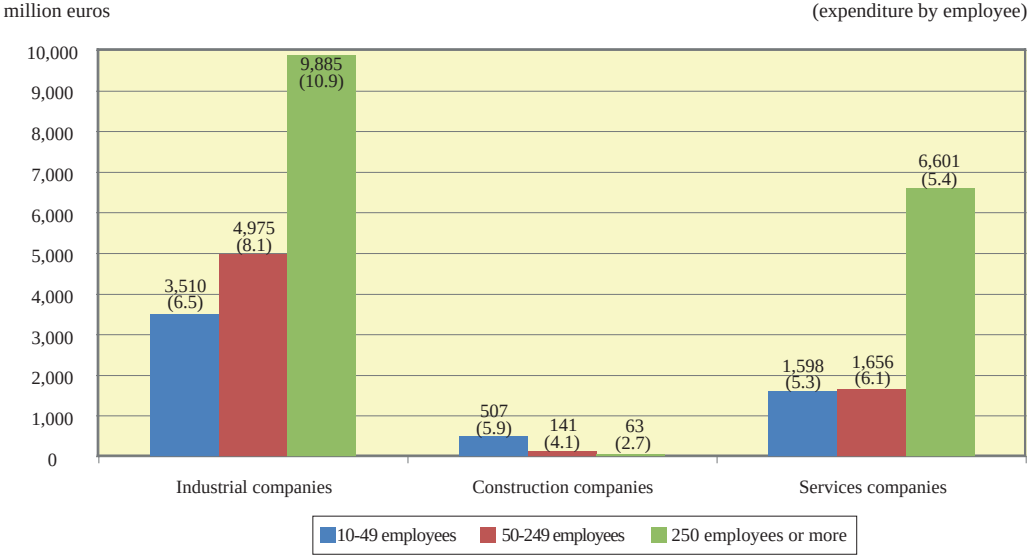
Source: ISTAT, *L'innovazione nelle imprese italiane*. *Anni 2004-2006*, Rome, November 2008.

Table 11.3 - Innovation expenditure of innovative service firms by economic activity in Italy, 2006

Economic activities	*Expenditure (million euros)*	*Expenditure by employee of innovative firms (thousand euros)*
Automobile trade	245.1	4.9
Wholesale trade	1,674.0	8.8
Retail trade	538.1	3.1
Hotels and restaurants	404.0	4.1
Transport by land	512.0	2.7
Transport by sea	43.6	3.8
Transport by air	68.2	4.0
Support activities to transport	238.6	2.2
Post and telecommunications	989.8	3.9
Financial brokerage	1,751.9	6.7
Insurance	238.4	9.1
Support to financial brokerage	57.9	6.2
Real estate	25.1	5.6
Renting of machinery and equipment	36.1	6.3
Computers-linked activities	1,719.9	14.1
R&D	580.9	55.4
Other business activities	731.4	2.7
Engineering activities	185.0	8.0
Tests and technical analyses	48.2	6.4

Source: ISTAT, *L'innovazione nelle imprese italiane*. *Anni 2004-2006*, Rome, November 2008.

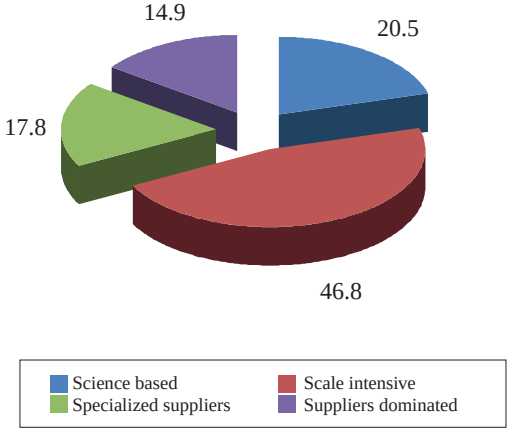
Figure 11.1 - Innovation expenditure of innovative firms by sector and number of employees in Italy, 2006



Source: ISTAT, *L'innovazione nelle imprese italiane*. *Anni 2004-2006*, Rome, November 2008.

Figure 11.2 - Innovation expenditure of innovative manufacturing firms by groups of firms in Italy, 2006

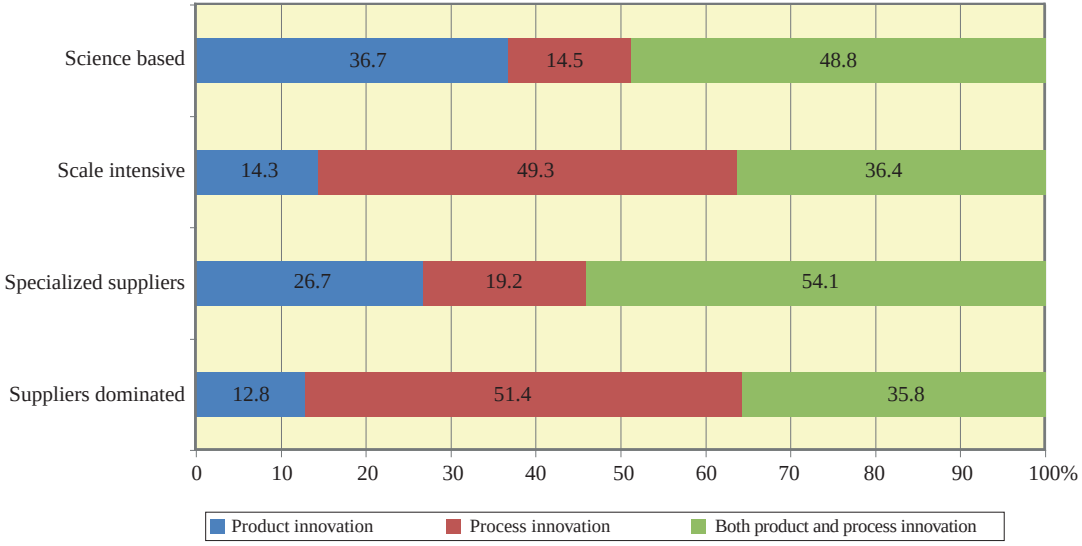
(percentage distribution)



	million euros
Science based	3,996.5
Scale intensive	9,116.4
Specialized suppliers	3,468.3
Suppliers dominated	2,909.2

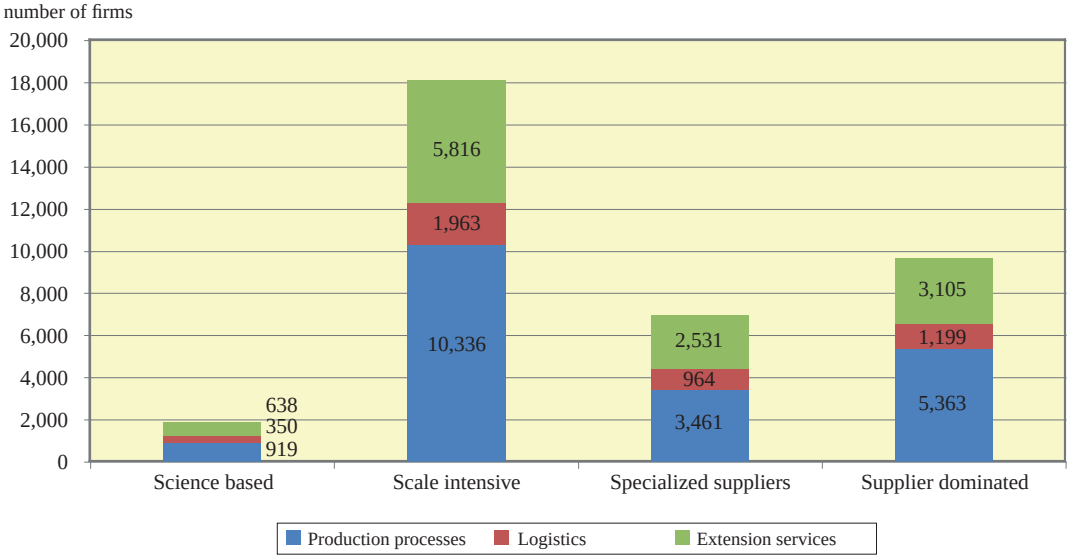
Source: ISTAT, *L'innovazione nelle imprese italiane*. *Anni 2004-2006*, Rome, November 2008.

Figure 11.3 - Innovative manufacturing firms by groups of firms and type of innovation in Italy, 2004-2006



Source: ISTAT, *L'innovazione nelle imprese italiane. Anni 2004-2006*, Rome, November 2008.

Figure 11.4 - Process innovative firms by groups of firms and sector of innovation introduced in the firm in Italy, 2004-2006



Source: ISTAT, *L'innovazione nelle imprese italiane*. *Anni 2004-2006*, Rome, November 2008.

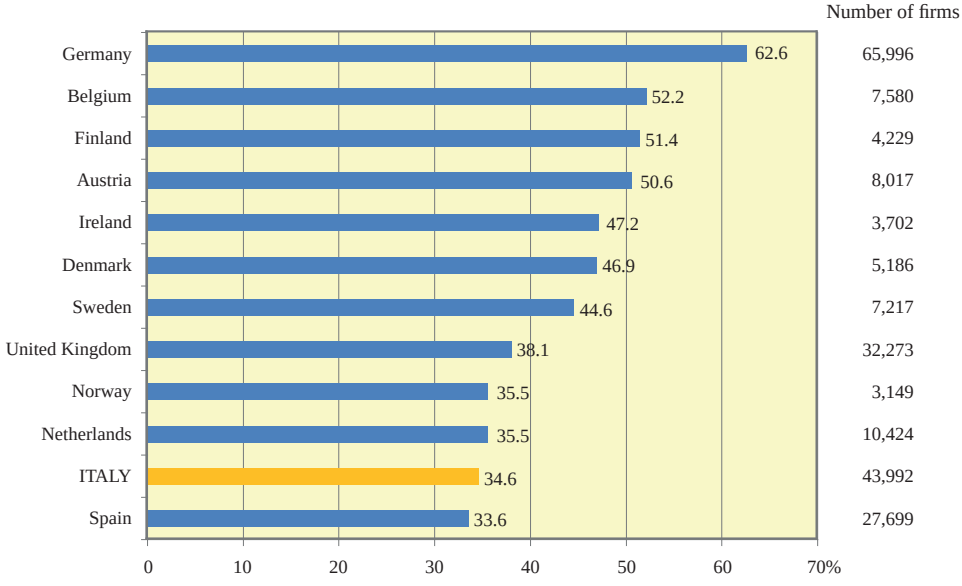
Table 11.4 - Innovative enterprises by size-class, on all enterprises in some European countries, 2006

(percentages)

	Total	*10-49*	*50-249*	*250 or more*
EU-27	38,87	34,4	52,27	70,07
Austria	50,64	44	71,05	82,81
Belgium	52,19	48,57	62,27	81,52
Denmark	46,89	42,33	59,68	81,24
Finland	51,44	46,85	61,19	82,98
Germany	62,64	57,27	71,85	87,35
Ireland	47,22	42,72	62,51	74,92
ITALY	34,61	31,31	54,19	69,23
Netherlands	35,51	31,25	49,19	65,46
Norway	35,53	31,91	48,14	57,27
Spain	33,6	30,04	48,59	71,96
Sweden	44,57	40,49	56,87	74,22
United Kingdom	38,06	35,98	44,97	52,34

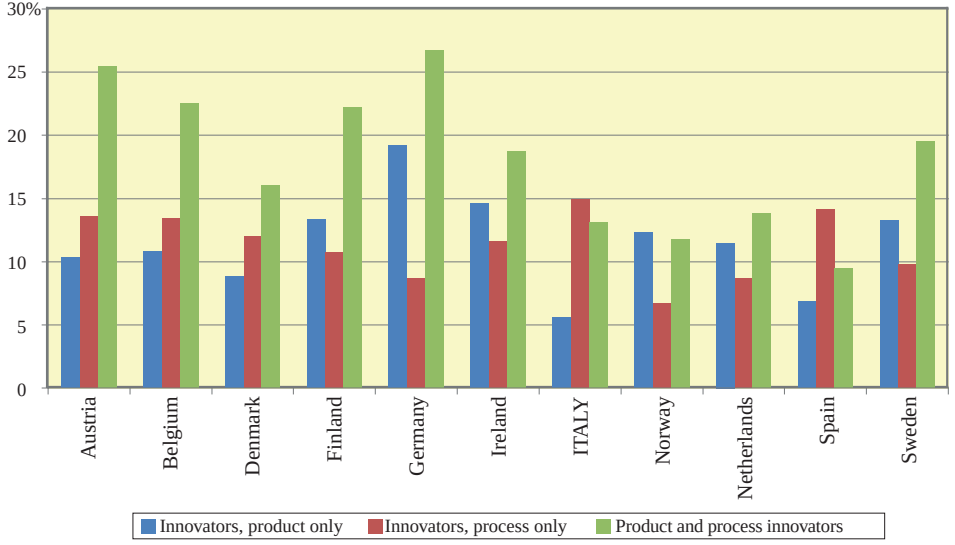
Note: Missing data for France.
Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

Figure 11.5 - Innovative enterprises on total enterprises in some European countries, 2006



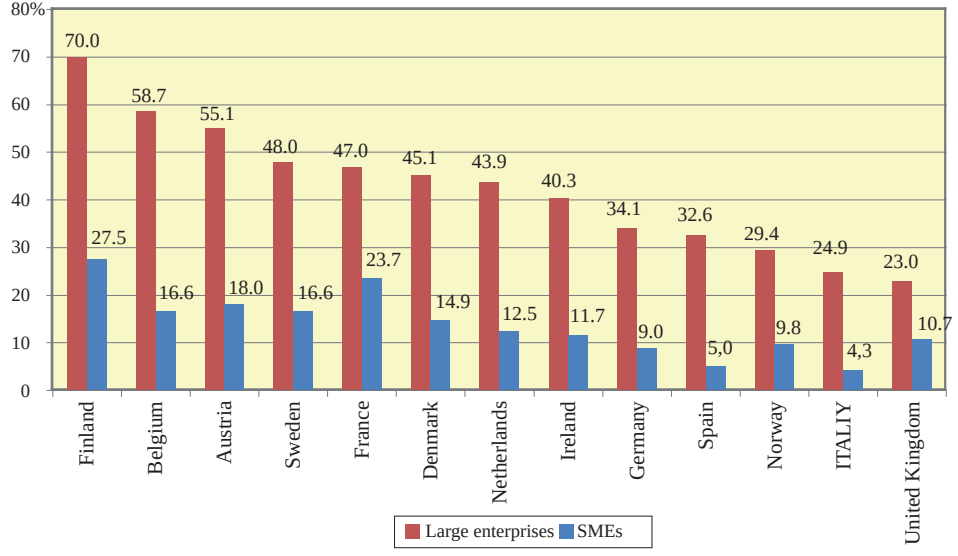
Note: Missing data for France.
Source: EUROSTAT, *Science, technology and innovation in Europe*, 2010.

Figure 11.6 - Innovative enterprises by type of innovators on the total number of enterprises in some European countries, 2006



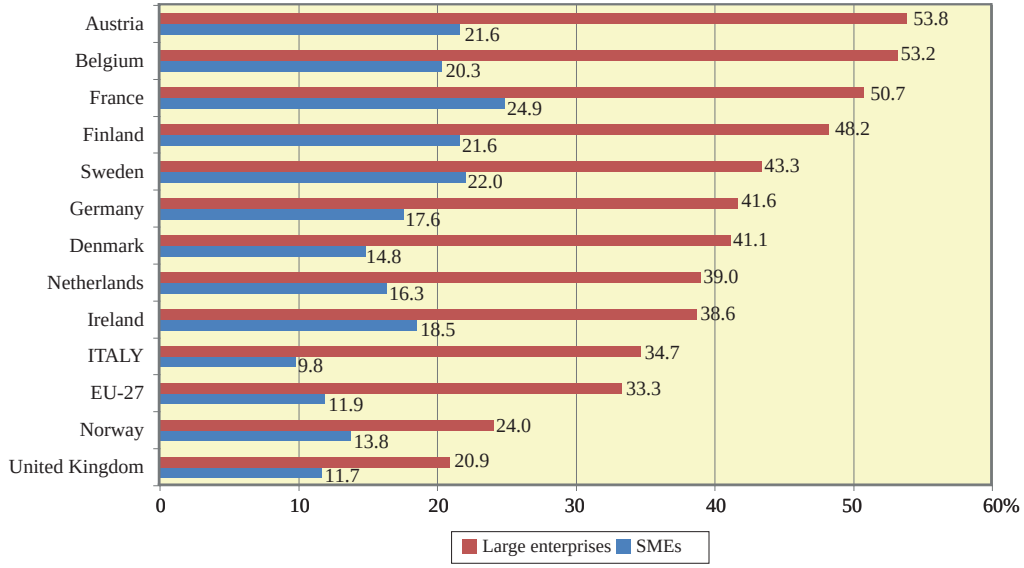
Note: Missing data for France and United Kingdom.
Source: EUROSTAT, *Science, technology and innovation in Europe*, 2009.

Figure 11.7 - Large enterprises and SMEs that collaborate in innovative activities on the total of their size class in some European countries, 2004-2006



Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

Figure 11.8 - Large enterprises and SMEs with new-to-market product innovations on the total of their size class in some OECD countries, 2004-2006



Source: OECD, *Science, Technology and Industry Scoreboard*, 2009.

This publication provides statistical information on science and technology in Italy, based on data available in mid-2010.

It presents a set of magnitudes concerning financial and human resources for Research & Development, publications, patents, Technology Balance of Payments, export and import of high-technology products and innovation in the Italian economic system.

It also provides R&D data about other countries, thus allowing for international comparisons.

Furthermore, it offers detailed information on research programmes of the European Union and on *Venture capital*.

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