European Commission

Research and Innovation performance in Turkey

Country profile

2013

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate C – Research and Innovation
Unit C.6. – Economic analysis and indicators

European Commission
B-1049 Brussels

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Cataloguing data can be found at the end of this publication.

Luxembourg: Publications Office of the European Union, 2013

ISBN 978-92-79-29201-9
doi 10.2777/93660

Turkey

The challenge of structural change for a more competitive economy

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Turkey. They relate knowledge investment and input to performance or economic output throughout the innovation cycle. They show thematic strengths in key technologies and also the high-tech and medium-tech contribution to the trade balance. The table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

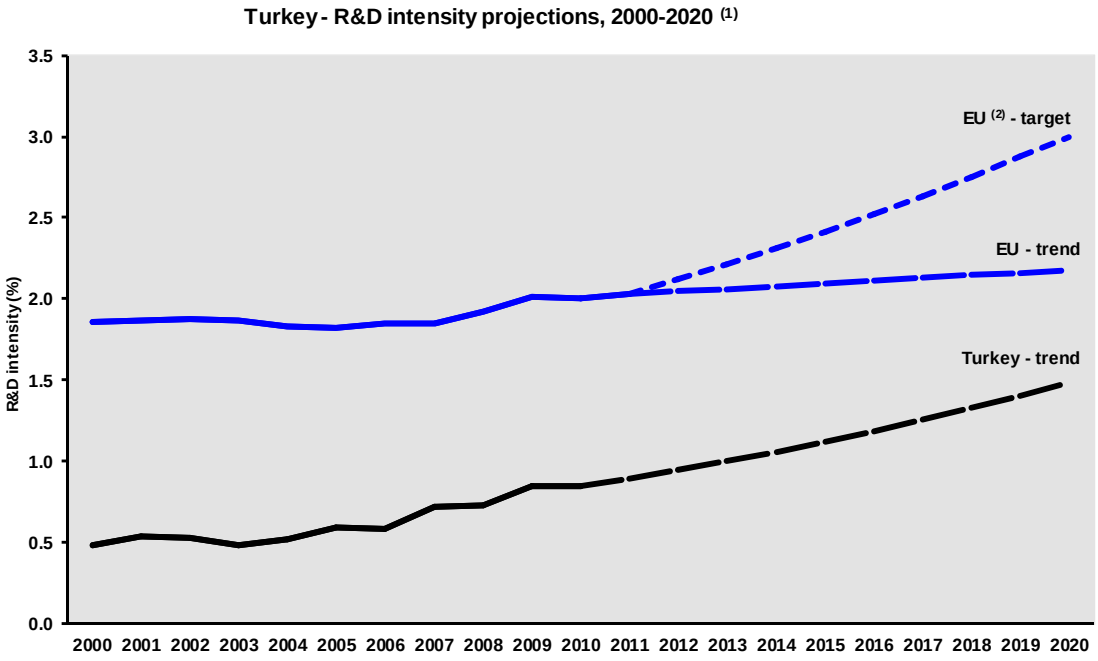
	Investment and Input	**Performance/economic output**
Research	*R&D intensity* 2011: 0.84% (EU: 2.03%; US: 2.75%) 2000-2011: +5.82% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010:13.79 (EU:47.86; US: 56.68) 2005-2010: +2.52% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: 0.315 (EU: 0.612)	*Knowledge-intensity of the economy* 2010:18.6 (EU:48.75; US: 56.25) 2000-2010: +0.92% (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* Energy, Water, Food, Space	*HT + MT contribution to the trade balance* 2011: -2.22% (EU[1]: 4.2%; US: 1.93%) 2000-2011[2]: n.a. (EU[1]: +4.99%; US:-10.75%)

[1]*The EU value is the weighted average of the trade balance of the Member States.*
[2]*For the period 2000-2010 there are no data available to provide the annual growth rate. The negative values for this period indicates a structural deficit for the industry for the country.*

Since the early 2000s, Turkey has devoted increasing importance to investment in science, technology and innovation as shown by the continuous increase in Government funding for R&D and innovation activities. The growing political commitment to science, technology and innovation has also been reflected in the Ninth Development Plan (2007–2013), which was issued in 2006. The Plan identifies improving science and technology performance as one of the building blocks for greater competitiveness.

The new science, technology and innovation strategy document, National Science, Technology and Innovation Strategy, covering the period 2011-2016 was approved by the Supreme Council of Science and Technology (BTYK) in December 2010. It aims to create more output from existing research capacity and to enhance needs-oriented research capacity and defines strategic focus areas for increased science, technology and innovation performance. Target-oriented approaches are identified in the areas where Turkey has R&D and innovation capacities, demand-oriented approaches where further R&D and innovation efforts are needed and bottom-up approaches (including basic, applied and frontier research) are also an option.

Investing in knowledge



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) TR: An R&D intensity target for 2020 is not available.

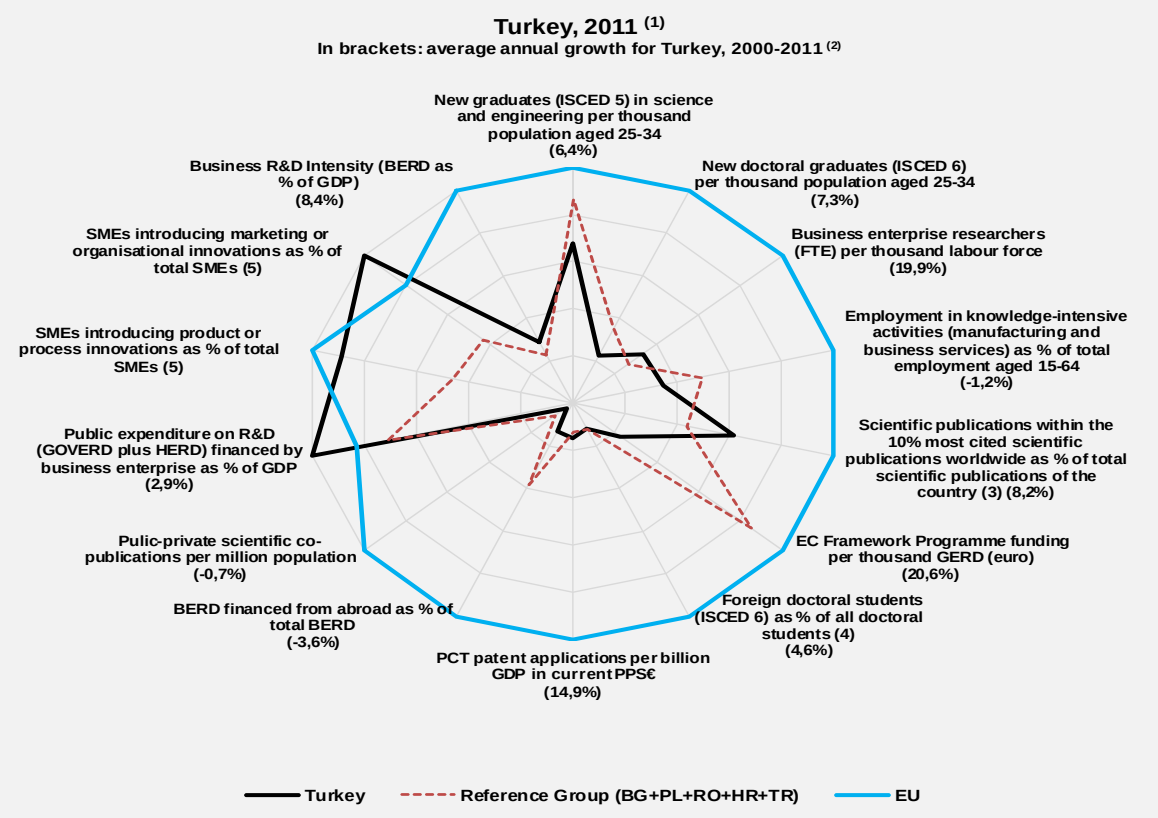
R&D intensity in Turkey has increased progressively from 0.48% in 2000 to 0.84% in 2010. Over this period R&D intensity has experienced an average annual growth rate of 5,8%. If this trend continues Turkey will have an R&D intensity of 1.48% in 2020, a very good achievement although still below the projected European Union average for 2020.

Turkey's R&D intensity decreased from 0.85% in 2009 to 0.84% in 2010 due to a corresponding decrease in public R&D intensity from 0.51% to 0.48%. Despite the decrease in Public R&D intensity and the economic crisis, R&D expenditure in all sectors has increased and business R&D intensity has grown from 0.34% in 2009 to 0.36% in 2010. Although Turkey's business R&D intensity is still well below the EU average of 1.26%, it is involved in a positive catching up process with an average annual growth rate of 8.4%.

Turkish research and innovation are also benefitting from support from the EU budget. The main instrument is the 7th Framework Program for Research and Development. The total number of participants in the 7th Framework Program in Turkey is 879 (out of 5982 applicants), receiving more than € 145,1 million. The success rate of participants of 14,7 % is below the EU average success rate of 21.95 %.

An effective research and innovation system building on the European Research Area

The graph below illustrates the strengths and weaknesses of Turkey's R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard
Notes: (1) The values refer to 2011 or to the latest available year.
(2) Growth rates which do not refer to 2000-2011 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2000-2011.
(3) Fractional counting method.
(4) EU does not include DE, IE, EL, LU, NL.
(5) TR is not included in the reference group.

The graph above shows that the Turkish research and innovation system is still weaker than the EU average in all areas except innovation in SMEs and public expenditure on R&D financed by business enterprise as a % of GDP. On the other hand, the average annual growth rates for most of the indicators indicate a progressive increase.

Most vulnerable areas include human resources, patents and public-private scientific co- publications. In particular Turkey is behind countries with similar knowledge capacity and economic structure in human resources with new graduates in science and engineering and new doctoral graduates showing especially low averages. Nevertheless, the research and innovation system in Turkey has relative strength in the quality of its scientific production, with an average annual growth of 8,2 % in the share of its scientific publications among the top 10 % most cited worldwide.

Policies and reforms for research and innovation

Eight sectors are identified as priority areas in UBTYS 2011-2016 in Turkey. These include automotive, machinery and manufacturing technologies, ICT, energy, water, food, space and defense. The sector-oriented standpoint adopted within UBTYS 2011-2016 has been promoted by two result driven and targeted call based funding programs which were recently set up by TUBITAK. Accordingly, temporary governance mechanisms have been established by TUBITAK in automotive, machinery and manufacturing technologies, and also in the ICT, energy, water and food areas which are designed to enable a bottom-up approach and an entrepreneurial discovery of the technology needs of each sector. These governance mechanisms are comprised of high level representatives from academia, the private sector, and the public sector. In the high level prioritization meetings of these actors, a consultative and a consensus building process takes place to designate R&D priorities in each sector. Calls through the aforementioned funding programs are opened in each sector in the technology needs/topics that have been previously identified and prioritized at the high-level prioritization meetings

The most recent STI priorities in Turkey include the decrees adopted in the 23rd and 24th meetings of BTYK which have set new targets for the national innovation and entrepreneurship system of Turkey. The main themes of these meetings were “Ecosystem of innovation and entrepreneurship in Turkey” and “Human resources for STI”. Regarding these themes, 17 new decrees were adopted which are being implemented in coordination with all relevant ministries and stakeholders.

The national innovation and entrepreneurship system targets have been renewed and targets have been set for the year 2023 with the objective of being one of the top 10 economies in the world by 2023. The 2023 targets for the National Innovation and Entrepreneurship System of Turkey are as follows:

- To increase R&D intensity to 3%
- To increase business R&D intensity to 2%
- To raise the number of full-time equivalent (FTE) researchers to 300,000
- To raise the number of FTE researchers in business to 180,000

The private sector is considered to be the driving force for many improvements and therefore supportive decrees were adopted both for increasing the private sector’s activities and fostering collaboration between the private sector and universities. For example, it has been decided to develop policies to provide R&D intensive start-ups with ready access to finance and complementary mentorship support at all stages of the life cycle of start-ups and to adoptembracing a tailor-made approach. It has also been decided to establish an adequate innovation and entrepreneurship ecosystem to increase the number of R&D intensive start-ups in Turkey. Furthermore, governmental organizations will be allowed to participate in venture capital funds in order to increase their effectiveness, especially in the seed funding and start-up capital phases. In this way it is hoped to reinvigorate venture capital funding in Turkey. These measures are expected to activate and enhance the commercialization process of research results.

Another example can be given by the decree aims at developing policy tools to trigger innovation and entrepreneurship in the universities by

- developing proper mechanisms to support technology transfer offices with an aim to trigger the commercialization of research conducted at universities
- developing proper mechanisms to support technology incubators with an aim to provide a gateway between universities and technoparks
- developing an index to measure the entrepreneurship and innovativeness performances of universities with an aim to increase the entrepreneurship and innovation oriented competition between universities
- redesigning academic promotion criteria to foster entrepreneurship and innovative activities by academicians

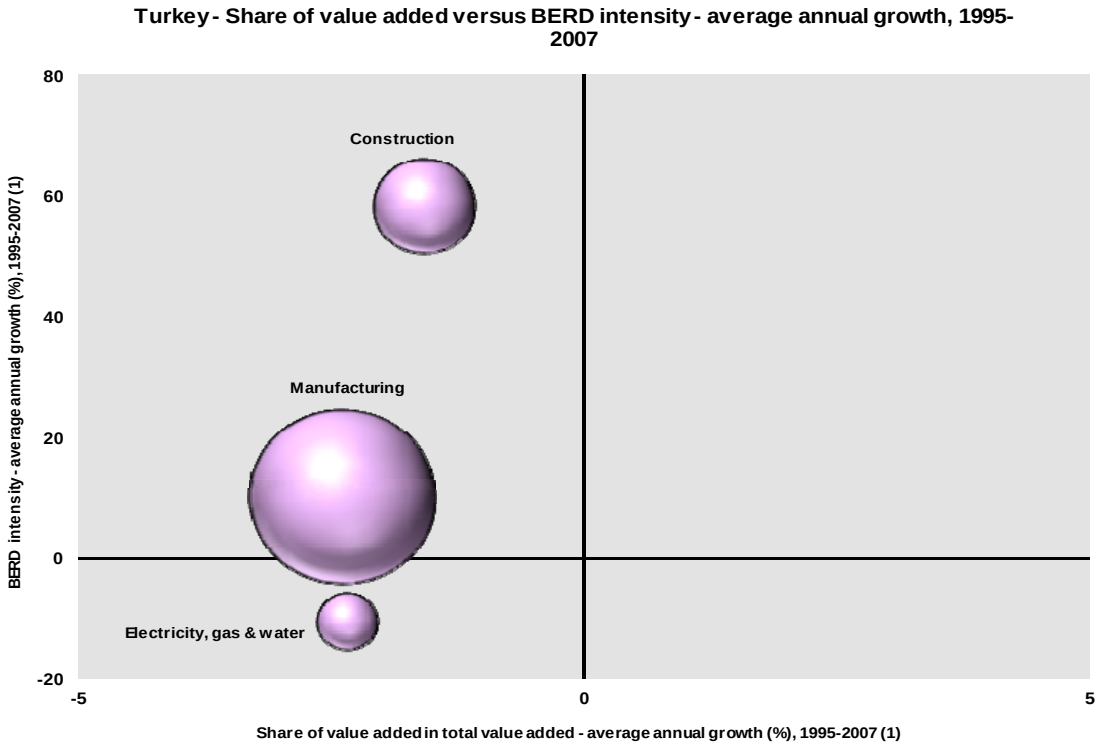
In line with this decree, in 2012, a university index has been developed to evaluate the entrepreneurship and innovativeness performance of universities based on such criteria as R&D projects, university-industry collaborations, international collaborations, articles, licences and spin-offs. The 50 most entrepreneurial universities in Turkey were listed for the first time, and this list will be renewed and published each year.

A similar approach will probably also be used in relation to university research institutions based on a protocol between the Ministry of Development and TUBITAK. Under this new protocol, a more efficient utilization and sustainability of existing and future Higher Education Research Centers will be ensured by a classification based on the measurement, monitoring and evaluation of their performances.
Furthermore, a temporary inter-ministerial coordination board including the participation of related governmental bodies has been set up to review all R&D, innovation and entrepreneurship support mechanisms in Turkey with a view to ensuring a target oriented approach.

Fostering and diffusing S&T awareness in society are among the areas which are under the auspices of the Prime Minister. It has been decided to work in close cooperation with local authorities to establish science centers, featuring interactive exhibits that encourage children and young people to experiment and explore, in each metropolis by the year 2016 and in each city by the year 2023.
The decrees adopted at the 24th meeting of BTYK which are focused on furthering the development of human resources for STI can be considered as complementary initiatives to the National Science and Technology Human Resources and Action Plan (2011-2016). These decrees strengthen the linkage between the Action Plan and education policies, as their main purpose is to improve the quality of the education system in Turkey by conducting educational assessment studies, developing digital course contents for primary-secondary education and also higher education, revising teaching programmes to enable students to acquire core competencies more efficiently, restructuring scholarship programs for graduate students to study abroad, and organizing science fairs for primary and secondary school students.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.



Source: DG Research and Innovation - Economic Analysis unit
Data: Eurostat
Note: (1) 'Construction': 1997-2007.

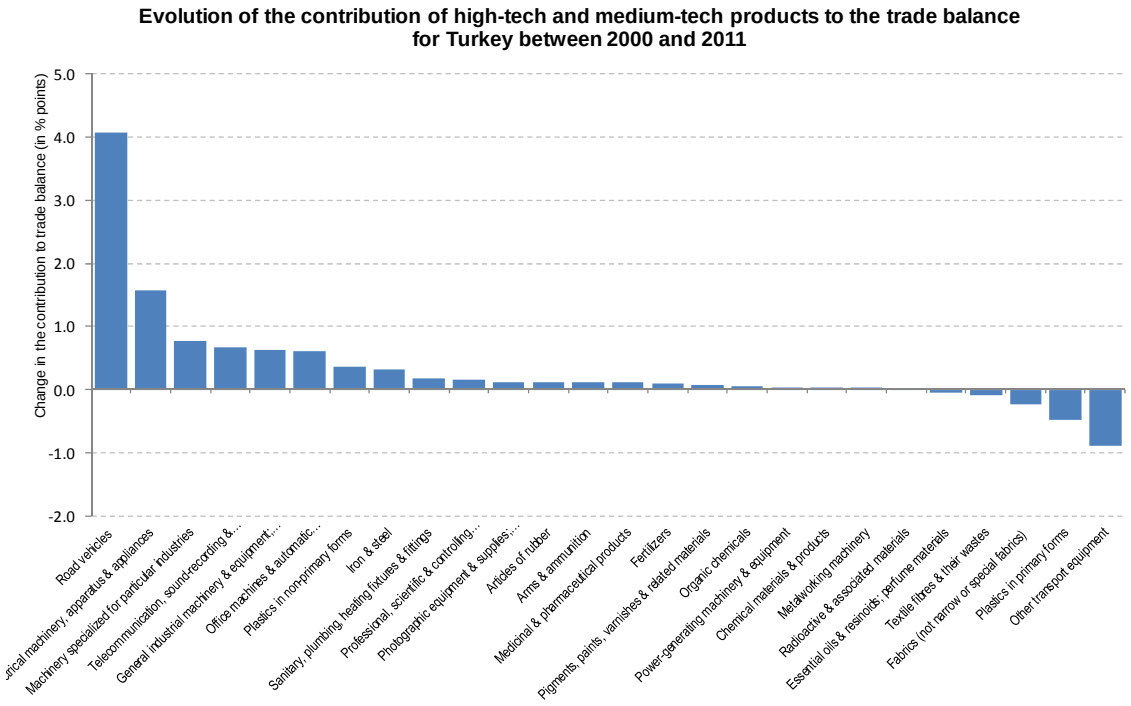
The graph above illustrates that in Turkey,as in many other countries, the share of value added of manufacturing industries is tending to decrease due to the increase of services in the overall economy (as illustrated by a leftward shift in the graph above).

The three major industry sectors have seen their shares in the Turkish economy decrease over the period 1995-2007. However manufacturing and construction are moving towards more research intensive activities as shown by increases in business R&D intensity (business expenditure on R&D as % of value added) for these sectors. Turkey has four companies in the 2011 EU Industrial R&D Scoreboard - companies with a considerable level of R&D expenditure in the fields of general industrials, automobiles and parts, and leisure goods.

Turkey has strengths in medium–high technology manufacturing industries and knowledge services and is fast becoming Eurasia´s production base for medium–high and high-technology products. The aim of UBTYS 2011-2016 is to strengthen national R&D and innovation capacities in order to upgrade the industrial structure towards high–technology industries.

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.



Source: DG Research and Innovation - Economic Analysis unit
Data: COMTRADE
Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

The overall contribution of high-tech and medium-tech products to Turkey's trade balance was negative for each year over the last decade. Nevertheless, as the graph above illustrates several high-tech and medium-tech industries have improved their contributions to the Turkish trade balance, in particular road vehicles, electrical machinery, apparatus and appliances and machinery specialized for particular industries.

On other hand, industries with the biggest decreases in their contributions to the trade balance are power-generating machinery and equipment, plastics in primary forms and medical and pharmaceutical products, indicating a possible relative decline in world competitiveness.

Total factor productivity is growing strongly in Turkey, and so is the employment rate. Clear progress is also visible in R&D intensity and in the share of population aged 30-34 having successfully completed tertiary education. However, the overall values are still at a low level. Greenhouse gas emissions have increased over the last decade, despite some improvements in patenting in environment-related technologies. Patenting in health-related technologies has also grown, but from a very modest level.

Key indicators for Turkey[1]

TURKEY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth (1) (%)	EU average (2)
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	0.19	0.17	0.21	0.23	0.21	0.22	0.20	:	0.31	0.34	0.38	:	:	7.3	*1.69*
Business enterprise expenditure on R&D (BERD) as % of GDP	0.16	0.18	0.15	0.11	0.13	0.20	0.21	0.30	0.32	0.34	0.36	:	:	8.4	*1.26*
Public expenditure on R&D (GOVERD + HERD) as % of GDP	0.32	0.36	0.38	0.37	0.39	0.39	0.37	0.42	0.40	0.51	0.48	:	:	4.3	*0.74*
Venture Capital as % of GDP	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	12.2	:	:	:	:	13.8	:	:	2.5	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	3.6	3.4	3.8	3.8	4.7	5.0	5.5	6.6	6.7	:	:	:	:	8.2	10.9
International scientific co-publications per million population	18	17	22	33	40	42	45	52 (3)	56	62	66	71	:	7.9	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	2	2	2	2	2	:	-0.7	53
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	:	:	:	14.9	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	:	:	:	0.00	0.00	0.00	0.00	:	:	:	0.58
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	:	:	15.8	:	:	:	:	:	:	:	14.4
Knowledge-intensive services exports as % total service exports	:	:	:	:	8.2	14.1	13.9	16.6	18.7	18.8	21.3	:	:	17.3	45.1
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-10.66	-7.79	-6.74	-6.09	-5.84	-4.79	-2.94	-1.95	-0.82	-3.88	-2.83	-2.22	:	-	4,20 (4)
Growth of total factor productivity (total economy) - 2000 = 100	100	93	98	102	112	117	120	:	:	:	:	:	:	20 (5)	103
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	17.0	:	:	:	:	12.9	:	:	:	:	18.6	:	:	0.9	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	:	4.8	4.8	4.7	:	-1.2	13.6
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	:	:	29.5	:	:	:	:	:	:	:	38.4
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.004	0.002	0.01	0.004	0.01	0.01	0.01	0.01	0.01	:	:	:	:	17.5	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	:	:	:	:	10.9	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 20-64 (%)	:	:	:	:	:	:	48.2	48.2	48.4	47.8	50.0	52.2	:	1.6	68.6
R&D Intensity (GERD as % of GDP)	0.48	0.54	0.53	0.48	0.52	0.59	0.58	0.72	0.73	0.85	0.84	:	:	5.8	*2.03*
Greenhouse gas emissions - 1990 = 100	159	149	153	162	167	176	187	203	196	198	:	:	:	39 (6)	85
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of population aged 30-34 who have successfully completed tertiary education (%)	:	:	:	:	:	:	11.9	12.3	13.0	14.7	15.5	16.3	:	6.5	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	:	:	72.4	:	:	:	:	:	:	:	*24.2*

Source: DG Research and Innovation - Economic Analysis Unit

Data: Eurostat, DG JRC - ISPRA, DG ECFIN, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard

Notes: (1) Average annual growth refers to growth between the earliest available year and the latest available year for which compatible data are available over the period 2000-2012.

(2) EU average for the latest available year.

(3) Break in series between 2007 and the previous years. Average annual growth refers to 2007-2011.

(4) EU is the weighted average of the values for the Member States.

(5) The value is the difference between 2006 and 2000.

(6) The value is the difference between 2009 and 2000. A negative value means lower emissions.

(7) Values in italics are estimated or provisional.

[1] According to data provide by Turkish Government, values for some indicators are as follows:

- BERD as % of GDP increased from 0.16 in 2000 to 0.36 in 2010 with an average annual growth rate of 10.7
- GERD as % of GDP increased from 0.48 in 2000 to 0.84 in 2010 with an average annual growth rate of 6.2
- In 2010 the average of SMEs introducing products or process innovations was 32.6%

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Luxembourg: Publications Office of the European Union

2013 — 8 pp. — 21 x 29,7 cm

ISBN 978-92-79-29201-9
doi 10.2777/93660

KI-32-13-180-EN-N

Research and Innovation policy

ISBN 978-92-79-29201-9

doi:10.2777/93660