Romania

The challenge of improving policy coordination of R&I and upgrading the economy

Summary: Performance in research and innovation

The indicators in the table below present a synthesis of research and innovation (R&I) performance in Romania. They relate knowledge investment and input to performance and 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 indicator on excellence in science and technology takes into consideration the quality of scientific production as well as technological development. The Innovation Output Indicator covers technological innovation, skills in knowledge-intensive activities, the competitiveness of knowledge-intensive goods and services, and the innovativeness of fast-growing enterprises, focusing on innovation output. The indicator on knowledge-intensity of the economy focuses on the economy’s sectoral composition and specialisation and shows the evolution of the weight of knowledge-intensive sectors and products.

<table>
<thead>
<tr>
<th>Key indicators of research and innovation performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D intensity</strong></td>
</tr>
<tr>
<td>2012: 0.49 %</td>
</tr>
<tr>
<td>2007-2012: -4.2 %</td>
</tr>
<tr>
<td>(EU: 2.07 %; US: 2.79 %)</td>
</tr>
<tr>
<td>(EU: 2.4 %; US: 1.2 %)</td>
</tr>
<tr>
<td><strong>Excellence in S&amp;T</strong></td>
</tr>
<tr>
<td>2012: 13.2</td>
</tr>
<tr>
<td>2007-2012: +2.3 %</td>
</tr>
<tr>
<td>(EU: 47.8; US: 58.1)</td>
</tr>
<tr>
<td>(EU: +2.9 %; US: -0.2)</td>
</tr>
<tr>
<td><strong>Innovation Output Indicator</strong></td>
</tr>
<tr>
<td>2012: 78.0</td>
</tr>
<tr>
<td>(EU: 101.6)</td>
</tr>
<tr>
<td><strong>Knowledge-intensity of the economy</strong></td>
</tr>
<tr>
<td>2012: 27.5</td>
</tr>
<tr>
<td>2007-2012: +3.5 %</td>
</tr>
<tr>
<td>(EU: 51.2; US: 59.9)</td>
</tr>
<tr>
<td>(EU: +1.0 %; US: +0.5 %)</td>
</tr>
<tr>
<td><strong>Areas of marked S&amp;T specialisations:</strong></td>
</tr>
<tr>
<td>Automobiles, ICT, new production technologies, energy, nanosciences and nanotechnologies, and security</td>
</tr>
<tr>
<td><strong>HT + MT contribution to the trade balance</strong></td>
</tr>
<tr>
<td>2012: 0.4 %</td>
</tr>
<tr>
<td>2007-2012: -14.2 %</td>
</tr>
<tr>
<td>(EU: 4.23 %; US: 1.02 %)</td>
</tr>
<tr>
<td>(EU: +4.8 %; US: -32.3 %)</td>
</tr>
</tbody>
</table>

The key challenge for Romania remains its low level of competitiveness, which has significant consequences for the research and innovation system. The high-tech and medium-tech sectors of the economy do not contribute sufficiently to the trade balance, demand for knowledge remains weak, and the innovation culture continues to be underdeveloped. Romania is ranked as a modest innovator and has one of the lowest values in the EU for both R&D intensity and business R&D investments. To complete the picture of poor innovation, the Global Competitiveness Report 2013-14 still classifies the country as efficiency-driven (together with Bulgaria) while the rest of the EU economies are either in transition to, or are already at the innovation-driven stage.

Over the last decade, policy-makers have made significant efforts to reform the R&I system in Romania. Yet, the absence of a consistent long-term vision at the political level and the lack of awareness of the added value of R&I for enhancing competitiveness and securing high-quality jobs has hampered the full implementation of most of the adopted measures. In addition, a lack of both continuity in policy decisions from one government to another and coordination among ministries has also proved particularly detrimental in a domain that requires the development of capacities over time. In order to leverage the importance of R&I in the country’s overall policy-mix, R&I policy measures need to be considered in the broader context of Romania’s economic development and better integrated into its overarching policy objectives.

However, among the last developments, a new National Strategy for Research and Innovation for the period 2014-2020 has been developed and, following a public debate, is ready to be submitted for government approval. The new strategy is aiming at a gradual rebalance of research to innovation through a strong component of smart specialisation3, and includes a well-developed

---

1 Composite indicator that includes PCT per population, ERC grants per public R&D, top universities and research institutes per GERD and highly cited publications per total publications.

2 Composite indicator that includes R&D, skills, sectoral specialization, international specialization and internationalization sub-indicators.

3 The strategy identifies the smart specialisation domains (bio-economy; ICT, space and security; energy, environment and climate change; eco-nano technologies and advanced materials) and outlines three fields of specific national interest (health; heritage and cultural identity; new and emerging technologies).
The public-private collaboration shows promising bottom-up initiatives for developing clusters in economic sectors (automotive, IT) and research fields (life sciences, nuclear physics). These clusters gather around researchers, businesses and policy-makers and are increasingly able to attract funding from European and national sources. It would be sensible for the government to design well-targeted top-down measures for supporting further development of these clusters since they are a concrete solution for improving public-private collaboration in the R&D field.


![Romania R&D intensity projections](image)

Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: DG Research and Innovation, Eurostat, Member State

Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2007–2012 in the case of the EU, and for 2007–2010 in the case of Romania.

(1) EU: The projection is based on the R&D intensity target of 3.0 % for 2020.

(1) RO: The projection is based on a tentative R&D intensity target of 2.0 % for 2020.

(1) RO: There is a break in series between 2011 and the previous years.

Over the last decade, R&D intensity in Romania increased from 0.37 % in 2000 to 0.58 % in 2008, only to drop back to 0.49 % in 2012. Romania currently has the second lowest R&D intensity in the EU, at less than one-quarter of its 2 % target for 2020. In absolute terms, public R&D funding reached a peak in 2008, following the adoption of the 2007-2013 Strategy for R&D and Innovation. The Strategy foresaw a gradual rise in the R&D public budget, but the planned increase in 2009 did not take place due to the economic crisis which has severely affected the government’s budget, including R&D appropriations. In absolute terms, government budget appropriations for R&D fell by 25.4 % in 2009, followed by an oscillating evolution over the period 2009–2013. The provisional value for 2013 is expected to be higher than the 2012 value (by 6.2 %). Higher education expenditure on R&D suffered a large reduction of 32.2 % in 2009, followed by a rise of 1.4 % in 2010, although it fell again by 4.2 % in 2012. The government has expressed its intention to increase the public budget in the years to come4, by 10.8 % (2013) and by 13.8 % (2014).

In 2012, Romania had one of the lowest business R&D intensities in the EU (0.19 % of GDP and ranked 26th out of 28), and an average annual growth rate of -6.8 % between 2007 and 2010. No Romanian firm is among the top-1000 EU R&D investing firms. The recent trends show that the 2 % R&D intensity target for 2020 is very ambitious and will be difficult to reach.

4 ERAC Survey, 2013
Innovation Union progress at country level: Romania

given both the recent low budgetary commitment and the very low level of business R&D activities. This target can only be achieved if the country prioritises R&I in the context of smart fiscal consolidation, whilst implementing – without delay – the key reforms outlined in the Action Plan for Research and Innovation, which were adopted by the government in July 2011.

To date, the total number of Romanian participants in the EU’s Seventh Framework Programme (FP7) is 1000 (out of 6848 applicants), and Romania has received EUR 148.2 million from successful applications. The participants’ success rate is 14.6%, below the EU average of 20.5%. Romania receives the 19th largest share in the EU of FP7 funding and has most collaborative links with Germany, Italy, the United Kingdom, France and Spain. Private and public R&D investment also receives support via co-funding from the Structural Funds. Currently, only 5.9% of the Structural Funds are allocated to RTDI, which is significantly below the EU average (15%). A large part of the Structural Funds for R&I has been focused on programmes for developing R&I infrastructure and human resources, which have been developed to complement the national R&D programmes. However, the massive reduction in the R&D budget in 2009 hampered this complementarity. Although the absorption rate for Structural Funds in the R&I sector has reached 50% (rate of approved payments), the national R&D budget has been severely cut.

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

The graph below illustrates the strengths and weaknesses of Romania’s R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2007 to the latest available year are given in brackets.

### Romania, 2012 (∗)

In brackets: average annual growth for Romania, 2007–2012 (∗)

- **New graduates (ISCED 5) in science and engineering per thousand population aged 25–34 (7.1%)**
- **New doctoral graduates (ISCED 6) per thousand population aged 25–34 (15.1%)**
- **Business R&D Intensity (BERD as % of GDP) (-6.8%)**
- **Business enterprise researchers (FTE) per thousand labour force (-8.9%)**
- **SMEs introducing marketing or organisational innovations as % of total SMEs (∗) (-0.5%)**
- **SMEs introducing product or process innovations as % of total SMEs (∗) (-16.1%)**
- **Public expenditure on R&D (GOVERD plus HERD) financed by business enterprise as % of GDP (9.6%)**
- **Public-private scientific co-publications per million population (15.5%)**
- **EC Framework Programme funding per thousand GERD (euro) (16.6%)**
- **PCT patent applications per billion GDP in current PPS€ (-0.5%)**
- **SMEs introducing marketing or organisational innovations as % of total SMEs (4) (-0.5%)**
- **SMEs introducing product or process innovations as % of total SMEs (4) (-16.1%)**
- **BERD financed from abroad as % of total BERD (8.6%)**
- **Foreign doctoral students (ISCED 6) as % of all doctoral students (∗) (4.5%)**
- **Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country (∗) (-5.3%)**
- **Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15–64 (3.7%)**
- **Public expenditure on R&D (GOVERD plus HERD) financed by business enterprise as % of GDP (9.6%)**
- **Public-private scientific co-publications per million population (15.5%)**
- **EC Framework Programme funding per thousand GERD (euro) (16.6%)**
- **PCT patent applications per billion GDP in current PPS€ (-0.5%)**
- **SMEs introducing marketing or organisational innovations as % of total SMEs (4) (-0.5%)**
- **SMEs introducing product or process innovations as % of total SMEs (4) (-16.1%)**
- **BERD financed from abroad as % of total BERD (8.6%)**
- **Foreign doctoral students (ISCED 6) as % of all doctoral students (∗) (4.5%)**
- **Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country (∗) (-5.3%)**
- **Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15–64 (3.7%)**
- **Public expenditure on R&D (GOVERD plus HERD) financed by business enterprise as % of GDP (9.6%)**
- **Public-private scientific co-publications per million population (15.5%)**
- **EC Framework Programme funding per thousand GERD (euro) (16.6%)**
- **PCT patent applications per billion GDP in current PPS€ (-0.5%)**

**Source:** DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies  
**Data:** DG Research and Innovation, Eurostat, OECD, Science-Metrix/Scopus (Elsevier), Innovation Union Scoreboard.  
**Notes:** (∗) The values refer to 2012 or to the latest available year.  
(‡) Growth rates which do not refer to 2007–2012 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2007–2012.  
(§) Fractional counting method.  
(‡) EU does not include EL.  

RTDI includes the following sectors: (01) RTD activities in research centres, (02) RTD infrastructures and centres of competence, (03) Technology transfer and improvement of cooperation of networks, (04) Assistance to RTD, particularly in SMEs (and RTD services in research centres), (06) Assistance to SMEs for the promotion of environmentally friendly products and processes, (07) Investment in firms directly linked to research and innovation, (09) Other methods to stimulate research and innovation and entrepreneurship in SMEs, and (74) Developing human potential in the field of research and innovation.
The Romanian R&I system is primarily public-based, with only 29% of research performed by the business sector (the EU average is 63%). The graph above shows that Romania scores well (above the EU average) as regards the number of new S&T and PhD graduates. The two indicators are linked with the performance potential of the research system as they refer to the supply of highly skilled human resources for research. However, the overall under-financing of R&I since the 1990s has created a brain-drain effect, making Romania an important exporter of researchers. The country is suffering a net outflow of researchers with an estimated 15,000 Romanian researchers working abroad (roughly three-quarters of the total number of researchers who are in the country). As a result, it risks being left with a pool of researchers of high average age and limited career prospects.

Another structural feature is the fragmentation of the public R&D system, which has a large number of research performers but a lack of critical mass of research results. Romania performs well as regards its international participation in the research area, scoring well in the indicators on EU FP funding and the BERD financed from abroad.

However, Romanian universities are underperforming in all major international rankings and their scientific production and staff composition are less internationalised compared to other Member States. While an increase in international scientific co-publications was noted over the period 2007-2011, the share of national scientific publications in the top 10% most-cited publications worldwide has declined slightly in recent years. Overall, the number of international co-publications with other European countries is the lowest in Europe, suggesting that Romania does not benefit sufficiently from the international knowledge flows favoured by the ERA architecture. One positive aspect is that Romanian scientific and technological cooperation is well distributed across Europe, with France, Germany, Italy, the United Kingdom, and Spain as main co-publication partners and Germany and Ireland as co-patenting partners.

It is obvious that the Romanian business sector’s interest in developing their own R&I activities is low, which is illustrated by the very low numbers of PCT patent applications and researchers employed by business enterprises, and a very low level of business R&D intensity, which is continuing to fall. The business sector is not promoting collaborative links with R&D institutes and universities in the public sector (as reflected by the very low number of public-private co-publications). Some improvements can be seen in public-private cooperation due to the development of cluster initiatives that have succeeded in gathering policy-makers, public research institutions, large companies and SMEs around them. This type of initiative could be the solution for improving the overall lack of collaboration and coordination between the public sector, the private sector and the government. Well-targeted, top-down support measures will be instrumental in supporting their further development.

**Romania’s scientific and technological strengths**

The spider graph below illustrates the areas, based on the Framework Programme thematic priorities, where Romania shows scientific and technological specialisations. Both the specialisation index (SI, based on the number of publications) and the revealed technological advantage (RTA, based on the number of patents) measure the country’s scientific (SI) and technological (RTA) capacity compared to that at the world level. For each specialisation field it provides information on the growth rate in the number of publications and patents.

---

6 The scientific-driven cluster European Light Infrastructure in Măgurele, the strategic-driven cluster the Danube-Danube Delta-Black Sea Institute, and the business-driven cluster Cluj Innovation City (bottom-up initiative).
In Romania, there is no overall correlation between specialisation in science and specialisation in technologies. The science base is not generally of sufficient quality to support knowledge transfer through technologies towards industry. At the same time, the country has yet to benefit from sufficient inflows of foreign direct investments for technological activities, which would help shape more coherent industrial specialisation. Within the whole spectrum of fields analysed there are three with co-specialisation in both S&T: ICT, new production technologies, and energy. This shows a certain degree of knowledge transfer from science to technologies in these three fields, making them important candidates for a smart specialisation strategy. In addition, there are other fields, such as automobiles and construction, which show good technological specialisation. On the other hand, fields of nanosciences and nanotechnologies, aeronautics and health show no co-specialisation in S&T, no growth on the technological side over the last decade, and no science of any substantial quality.

In the field of materials – the best rated in terms of scientific production – there are several mismatches between scientific and technological developments. Despite considerable specialisation in science, the research field has been very static over the last ten years and not at all matched by technologies. In other words, industry is failing to absorb the large amount of high-quality knowledge being created in the field of materials. This may well be due to the fact that Romania’s chemical industry has declined substantially over the last decade. Without an industrial revival in this field, it seems likely that research will continue to decline.

In the fields of ICT and new production technologies, co-specialisation in S&T has been backed up by visible growth rates in both publications and patents over the last decade, which is probably due to the existence of firms on the Romanian market absorbing the scientific results in related industries. Policy decisions should be oriented towards further increasing the quality of science publications,
which is well below the world average in both fields. Compared to the two fields mentioned previously, the energy sector is more static as regards technologies, with few patents over the last decade. On the other hand, research results in the energy field are among the best in Romania, registering just below the world average as regards the quality of publications.

Technologies in the automobiles sector are stronger compared to other fields and show both specialisation and high growth rates in patents over the last 10 years. However, this is not sufficiently matched by science results, with the quality of publications needing substantial improvement. This seems to be a situation of apparent comparative advantage, with industrial development in place, but with the science side needing further improvements.

The field of construction and construction technologies reveals obvious development potential. Although specialisation in technology is already evident, it is the research field that has seen the most growth over the last ten years. However, the overall quality of science needs to be improved considerably. The environment field also presents certain dynamism, with specialisation in technologies and high growth rates in science.

The graph below illustrates the positional analysis of Romania’s publications showing the country situation in terms of scientific specialisation and scientific impact over the period 2000-2010. The scientific production of the country is reflected by the size of bubbles, which corresponds to the share of scientific publications from a science field in the country’s total publications.

The fields of food, agriculture and fisheries, and biotechnologies point to interesting developments. A serious decline in the food and agriculture field after 1990 was coupled with a lack of specialisation in science and industry, despite the massive potential in terms of natural resources and primary production factors. As developments can often be rebooted bottom-up in the case of existing latent comparative advantages, over the last decade the quality of science in this field rose spectacularly, accompanied by high growth in the number of publications in the biotechnologies sector. However, the country has not yet reached the critical mass of publications required to specialise in these fields, and the related technologies are missing. In this context, there is room to further boost science in the fields of food and agriculture, and biotechnology. This is backed up by a large domestic economy.

Romania – Positional analysis of publications in Scopus (specialisation versus impact), 2000–2010

Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies
Data: Science-Metrix Canada, based on Scopus
(over 30% of the population is still employed in the agriculture and food industry) and the potential to upgrade these industries’ positions in international value chains. However, neither of these sectors is substantially backed up by technologies.

**Policies and reforms for research and innovation**

Over the last 10 years, the country has undertaken a wide range of measures in the R&I field. Development of the last two strategies for R&I, both for 2007-2013 and 2014-2020, have been based on a broad consultation exercise; Romanian scientific journals have been promoted on the international circuit; the share of competition-based funding has surpassed the share of institutional funding for research; measures have been taken to improve science-industry links by means of grants for projects with industrial partners; and innovation vouchers and tax incentives have been introduced. The certification process is ongoing for national R&D institutes and the legal framework regarding the funding of these institutes has been amended. However, such measures would have a greater impact if they were supported by a long-term vision. Indeed, the adopted/planned measures need to be better interrelated within an overarching reform in order to improve the overall efficiency of the R&I system.

A new National Strategy for Research and Innovation for the period 2014-2020 is currently being debated publicly before being submitted for government approval. The new Strategy is aiming at a gradual rebalance of research to innovation through a strong smart specialisation component and includes a well-developed monitoring system and multi-annual budgetary planning. Although the Strategy benefits from the R&I system’s strong ownership, having been developed through a large consultation exercise with experts and stakeholders, its implementation remains highly uncertain. It depends on the government’s commitment to finance the activities included in the Strategy’s implementation instrument, which is the National Plan for R&I. With a view to better positioning R&I policy in the country's economic development, it would be beneficial to improve coordination between the R&I Strategy and the 2014-2020 Competitiveness Strategy, as well as the SMEs Strategy and current industrial policy developments.

As regards the efficiency and effectiveness of the research system, an important process started in 2013 which aimed to better coordinate and concentrate research resources in order to address the fragmentation of the system and reach the critical mass needed for highly relevant and qualitative research results. The reorganisation of the Ministry of Education, Research, Youth and Sport brought the different research institutions formally subordinated to other ministries under the umbrella of the new Ministry of National Education. It could be expected that these measures would improve the efficiency of these institutions, with effectively a concentration of institutional resources, besides the formal gathering of institutions under the same ministry umbrella. However, the impact of these measures on the research system’s performance will be assessed in the future.

Also, an ambitious reform of universities has begun but has slowed down in the last year. The new system, which aims to pave the way towards more autonomy and differentiation between research universities and those more oriented towards teaching and local needs, has been contested by several universities. Thus, in 2014, the university funding system returned to the old system, which only looked at quality indicators and the number of full-time equivalent students.

Private-sector R&I investments remain underdeveloped and have seen a continuous decline since 2000. The existing measures to promote private R&I investments are not fully commensurable with the challenges faced by local innovative enterprises, multinationals and start-ups. Moreover, there is visible mismatch between the skills needed by the knowledge market and the qualifications provided by academia that must be addressed. It is worth considering whether or not the system could benefit from replacing the current ‘one-size-fits-all’ interventions by targeted ones for innovative enterprises with proven successful track records. Moreover, the current unclear and contradictory provisions of the national framework of intellectual property rights make large companies somewhat reluctant to invest in innovation. The finalisation of the Employees Patents Law and the implementation guidelines are essential steps towards increasing foreign direct investments for innovative activities in Romania. Nevertheless, it is worth mentioning a relatively recent, bottom-up trend in the country indicating a concentration of innovation resources.

---

7 According to the Government Ordinance of 22.12.2012, the Ministry of Education, Research, Youth and Sport has been reorganised by splitting it into the Ministry of National Education (MNE) and the Ministry of Youth and Sport. The National Authority for Scientific Research (NASR) has been dissolved and all of its attributes will be taken over by the new MNE.
around economic sectors, such as automotive or IT, or major research infrastructures in fields such as life sciences or nuclear physics, such as:

- **Cluj Innovation City**, a business-driven cluster focused around four sectors: IT, energy, environment, and healthcare;

- **European Light Infrastructure** in Măgurele, a promising scientific-driven cluster;

- **The Danube-Danube Delta-Black Sea Research Institute**, which builds on the Danube Delta’s unique natural laboratory and, in addition, is strategically driven, as part of the Danube Strategy.

In this context, it would be sensible for the government to design well-targeted measures to support these clusters, given that they are solving in a bottom-up way problems in the system for which the top-down approach has not proved very successful to date. There are already some figures showing that these clusters are increasingly capable of attracting funding from both European and national sources. In addition, the problem of governance appears to have been sorted out in the case of concrete projects. These clusters gather around researchers, businesses and policy-makers, which represent the actual knowledge triangle in a national R&I system.

### Innovation Output Indicator

The Innovation Output Indicator, launched by the European Commission in 2013, was developed at the request of the European Council to benchmark national innovation policies and to monitor the EU’s performance against its main trading partners. It measures the extent to which ideas stemming from innovative sectors are capable of reaching the market, providing better jobs and making Europe more competitive. The indicator focuses on four policy axes: growth via technology – (patents); jobs (knowledge-intensive employment); long-term global competitiveness (trade in mid/high-tech commodities); and future business opportunities (jobs in innovative fast-growing firms). The graph below enables a comprehensive comparison of Romania’s position regarding the indicator’s different components:

![Romania – Innovation Output Indicator](image_url)

**Source:** DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies  
**Data:** Eurostat, OECD, Innovation Union Scoreboard 2014, DG JRC  
**Notes:** All data refer to 2012 except PCT data, which refer to 2010.  
- **PCT** = Number of PCT patent applications per billion GDP, PPS.  
- **KIA** = Employment in knowledge-intensive activities in business industries as % of total employment.  
- **DYN** = Innovativeness of high-growth enterprises (employment-weighted average).  
- **COMP** = Combination of sub-components GOOD and SERV, using equal weights.  
- **GOOD** = High-tech and medium-high-tech products exports as % total exports. EU value refers to EU-28 average (extra-EU = 59.7 %).  
- **SERV** = Knowledge-intensive services exports as % of total service exports. EU value refers to EU-28 average (extra-EU = 56 %).
Romania is a low performer in the European innovation indicator. This is a result of low performance in several components of the innovation indicator, notably in patents. However, its performance has been improving since 2010.

The very low performance in patents is linked to the weak synergies between the research system and business activities and to the economic structure, notably the lack of large Romanian multinational manufacturing companies and the division of work within international companies, including motor vehicle producers, which have production facilities in Romania but tend to do research and patenting in the headquarter country.

Relatively strong employment in wholesale and retail trade, in low-tech manufacturing sectors such as food products, and in agriculture and construction, and the relatively small size of the financial sector contribute to a very low share of employment in knowledge-intensive activities.

Romania is a strong performer in computer services exports, but also has significant road transport services exports, not classified as knowledge-intensive. As a result, the country performs near the EU average in the export of knowledge-intensive services.

The country performs below the EU average as regards the innovativeness of fast-growing firms in innovative sectors. This is also the result of a high share of employment in wholesale and retail trade and low-tech manufacturing sectors among employment in fast-growing firms.

**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 of moving to the left-hand side reflects the decline in manufacturing in the overall economy. The sectors above the x-axis are those where research intensity has increased over time. The size of the bubble represents the sector share (in value added) in manufacturing (for all sectors presented in the graph). The red sectors are high-tech or medium-high-tech sectors.

**Romania – Share of value added versus BERD intensity: average annual growth, 2008–2010**

![Graph illustrating the upgrading of knowledge in different manufacturing industries.](image)

**Source:** DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

**Data:** Eurostat

**Notes:**
Romania’s limited innovation performance is reflected in its economic structure in which low- and medium-technology sectors are still prevalent. Demand for knowledge is weak and there is an underdeveloped innovation culture.

In terms of trade and industry specialisation, Romania is part of the group of lower-income countries in the EU, with lower GDP per person than the EU average and specialisation in less technologically advanced sectors. It is highly specialised in labour-intensive industries (food products, wearing apparel and accessories), in capital-driven industries (cement), and market-driven ones (footwear).

In terms of innovation, Romania is specialised in both low-innovation sectors (textiles, wearing apparel and leather) and medium-high innovation sectors (motor vehicles, computer, electronic and optical products).

In dynamic terms, a certain degree of structural change is shown in the graph above by the increasing added value in technology-driven and innovative sectors (motor vehicles, electrical equipment, computer, electronic and optical products and, to a lesser extent, machinery and equipment). On the other hand, fields with high-knowledge-intensity sectors, such as pharmaceutical products and chemical and chemical products, have declining shares of value added. However, although the quality of labour-intensive industries has improved, this is not yet the case for technology-driven ones.
## Key indicators for Romania

### ENABLERS

**Investment in knowledge**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New doctoral graduates (ISCED 6) per thousand population aged 25–34</td>
<td>1.17</td>
<td>0.97</td>
<td>0.91</td>
<td>1.06</td>
<td>1.55</td>
<td>1.65</td>
<td>1.98</td>
<td>1.85</td>
<td>15.1</td>
<td><strong>1.81</strong></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Performance in mathematics of 15-year-old students: mean score (PISA study)</td>
<td>415</td>
<td>416</td>
<td>427</td>
<td>445</td>
<td><strong>29.8</strong> (%)</td>
<td>495 (%)</td>
<td>25 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business enterprise expenditure on R&amp;D (BERD) as % of GDP</td>
<td>0.25</td>
<td>0.20</td>
<td>0.22</td>
<td>0.17</td>
<td>0.19</td>
<td>0.18</td>
<td>0.18 (%)</td>
<td>0.19</td>
<td>-6.8</td>
<td>1.31</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Public expenditure on R&amp;D (GOVERD + HERD) as % of GDP</td>
<td>0.11</td>
<td>0.20</td>
<td>0.23</td>
<td>0.30</td>
<td>0.40</td>
<td>0.28</td>
<td>0.28</td>
<td>0.32 (%)</td>
<td>0.30</td>
<td>-2.4</td>
<td>0.74</td>
<td>27</td>
</tr>
<tr>
<td>Venture capital as % of GDP</td>
<td>0.05</td>
<td>0.07</td>
<td>0.10</td>
<td>0.13</td>
<td>0.09</td>
<td>0.07</td>
<td>0.06</td>
<td>0.04</td>
<td>0.02</td>
<td>-33.0</td>
<td><strong>0.29</strong> (%)</td>
<td>18 (%)</td>
</tr>
</tbody>
</table>

**Sc&T excellence and cooperation**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>专利申请/每百万GDP在当前PPS (EUR)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>-0.5</td>
<td>3.9</td>
<td>28</td>
</tr>
<tr>
<td>专利申请/每百万GDP在当前PPS (EUR)</td>
<td>0.01</td>
<td>0.05</td>
<td>0.03</td>
<td>0.02</td>
<td>0.12</td>
<td>0.12</td>
<td>0.28</td>
<td>0.13</td>
<td>0.21</td>
<td>53.8</td>
<td><strong>0.59</strong></td>
<td>13</td>
</tr>
<tr>
<td>Community trademark (CTM) applications per million population</td>
<td>0.2</td>
<td>2</td>
<td>6</td>
<td>15</td>
<td>13</td>
<td>15</td>
<td>19</td>
<td>29</td>
<td>27</td>
<td><strong>13.1</strong></td>
<td>152</td>
<td>27</td>
</tr>
<tr>
<td>Community design (CD) applications per million population</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>18.8</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>Growth of total factor productivity (total economy)</td>
<td>2007 = 100</td>
<td>67</td>
<td>94</td>
<td>98</td>
<td>100</td>
<td>102</td>
<td>95</td>
<td>93</td>
<td>94</td>
<td>92</td>
<td><strong>-8</strong> (%)</td>
<td>97</td>
</tr>
</tbody>
</table>

**FIRM ACTIVITIES AND IMPACT**

### Innovation contributing to international competitiveness

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite indicator on research excellence</td>
<td>-</td>
<td>-</td>
<td>11.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11.2</td>
<td>2.3</td>
<td>47.8</td>
<td><strong>28</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country</td>
<td>-</td>
<td>3.7</td>
<td>3.7</td>
<td>3.9</td>
<td>3.5</td>
<td>3.5</td>
<td>-</td>
<td>5.3</td>
<td>11.0</td>
<td><strong>25</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International scientific co-publications per million population</td>
<td>86</td>
<td>91</td>
<td>114</td>
<td>130</td>
<td>145</td>
<td>155</td>
<td>161</td>
<td>177</td>
<td>9.2</td>
<td>343</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Public-private scientific co-publications per million population</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>-</td>
<td>15.5</td>
<td>53</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

### Factors for structural change and addressing societal challenges

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite indicator on structural change</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27.5</td>
<td>3.5</td>
<td>51.2</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.6</td>
<td>5.8</td>
<td>6.0</td>
<td>6.5</td>
<td>6.5</td>
<td>3.7</td>
<td>13.9</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>SMEs introducing product or process innovations as % of SMEs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>19.4</td>
<td>-</td>
<td>-</td>
<td>18.0</td>
<td>-</td>
<td>-</td>
<td>-16.1</td>
<td>33.8</td>
<td>28</td>
</tr>
<tr>
<td>Environment-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>-</td>
<td>-</td>
<td>-33.0</td>
<td>0.44</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Health-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)</td>
<td>0.01</td>
<td>0.03</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.002</td>
<td>-</td>
<td>-</td>
<td>-35.4</td>
<td>0.53</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

### EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment rate of the population aged 20-64 (%)</td>
<td>69.1</td>
<td>65.6</td>
<td>64.8</td>
<td>64.4</td>
<td>63.5</td>
<td>63.3</td>
<td>62.8</td>
<td>63.8</td>
<td>-0.2</td>
<td>68.4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>R&amp;D intensity (GERD as % of GDP)</td>
<td>0.37</td>
<td>0.41</td>
<td>0.45</td>
<td>0.52</td>
<td>0.58</td>
<td>0.47</td>
<td>0.46</td>
<td>0.50 (%)</td>
<td>0.49</td>
<td>-4.2</td>
<td>2.07</td>
<td>27</td>
</tr>
<tr>
<td>Greenhouse gas emissions: 1990 = 100</td>
<td>55</td>
<td>58</td>
<td>60</td>
<td>58</td>
<td>57</td>
<td>49</td>
<td>48</td>
<td>50</td>
<td>-8 (%)</td>
<td>83</td>
<td>3 (%)</td>
<td></td>
</tr>
<tr>
<td>Share of renewable energy in gross final energy consumption (%)</td>
<td>-</td>
<td>17.6</td>
<td>17.1</td>
<td>18.4</td>
<td>20.3</td>
<td>22.3</td>
<td>23.4</td>
<td>21.4</td>
<td>-</td>
<td>3.8</td>
<td>13.0</td>
<td>8</td>
</tr>
<tr>
<td>Share of population aged 30-34 who have successfully completed tertiary education (%)</td>
<td>8.9</td>
<td>11.4</td>
<td>12.4</td>
<td>13.9</td>
<td>16.0</td>
<td>16.8</td>
<td>18.1</td>
<td>20.4</td>
<td>21.8</td>
<td>9.4</td>
<td>35.7</td>
<td>27</td>
</tr>
<tr>
<td>Share of population aged 18-24 with at most lower secondary education and not in further education or training (%)</td>
<td>22.9</td>
<td>19.6</td>
<td>17.9</td>
<td>17.3</td>
<td>15.9</td>
<td>16.6</td>
<td>18.4</td>
<td>17.5</td>
<td>17.4</td>
<td>0.1</td>
<td>12.7</td>
<td>24 (%)</td>
</tr>
<tr>
<td>Share of population at risk of poverty or social exclusion (%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-1.9</td>
<td>24.8</td>
<td>27 (%)</td>
</tr>
</tbody>
</table>

Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

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 2007-2012.
- (2) EU average for the latest available year.
- (3) The value is the difference between 2012 and 2006.
- (4) PISA (Programme for International Student Assessment) score for EU does not include CY and MT. These Member States were not included in the EU ranking.
- (5) Break in series between 2011 and the previous years. Average annual growth refers to 2007-2010.
- (6) Venture capital: EU does not include EE, HR, CY, LV, LT, MT, SI and SK. These Member States were not included in the EU ranking.
- (7) EU is the weighted average of the values for the Member States.
- (8) The value is the difference between 2012 and 2007.
- (9) The value is the difference between 2011 and 2007. A negative value means lower emissions.
- (10) The values for this indicator were ranked from lowest to highest.
- (11) Values in italics are estimated or provisional.
How to obtain EU publications

**Free publications:**
- one copy: via EU Bookshop (http://bookshop.europa.eu);
- more than one copy or posters/maps:
  - from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  - from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
  - by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

**Priced publications:**

**Priced subscriptions:**
"If we get it right, Europe will become the leading destination for ground-breaking science and innovation."

Máire Geoghegan-Quinn
European Commissioner for Research, Innovation and Science

Research and Innovation policy