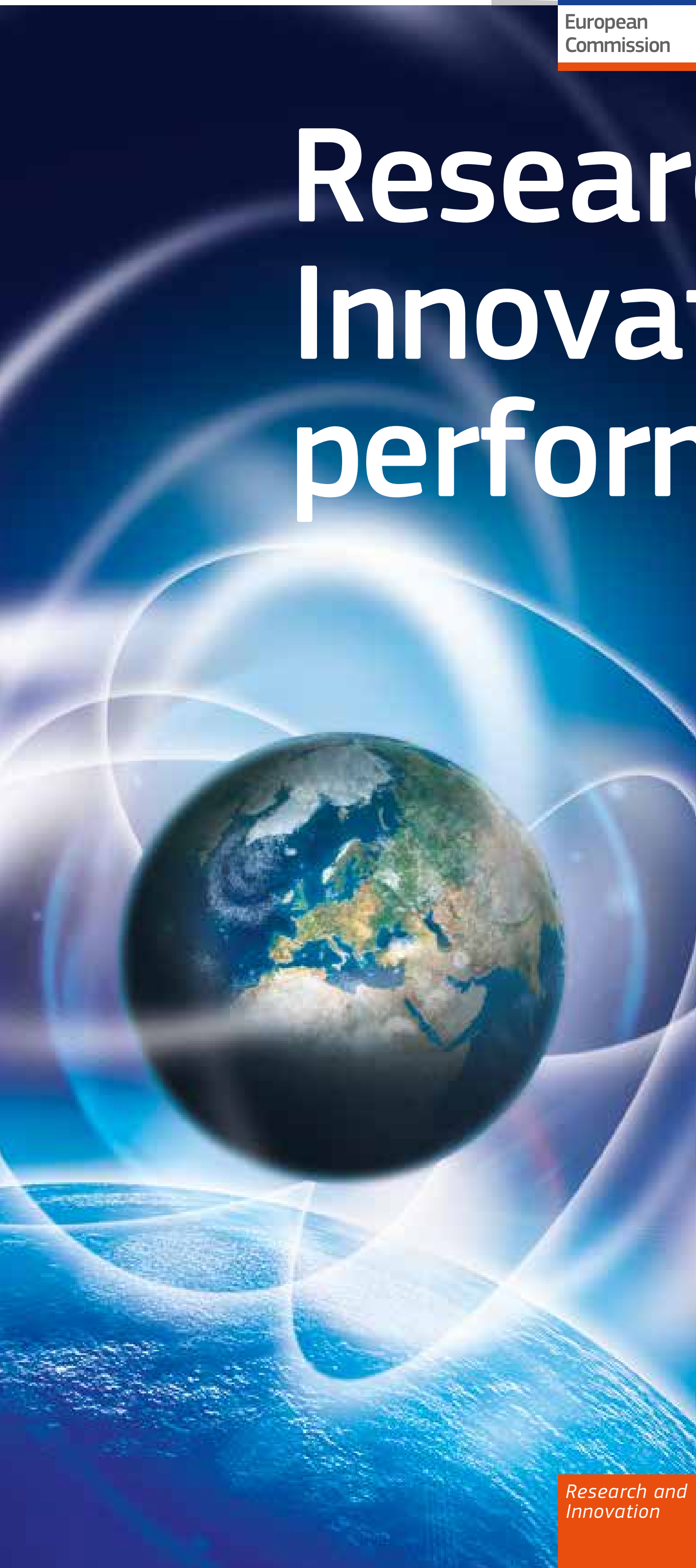
European Commission

Research and Innovation performance in

Ireland

Country Profile

2014



Research and Innovation

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Ireland

Prioritising increased public investment in research while better exploiting results

Summary: Performance in research and innovation

The indicators in the table below present a synthesis of research and innovation (R&I) performance in Ireland. 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.

Key indicators of research and innovation performance	
R&D intensity 2012: **1.72 %** (EU: 2.07 %; US: 2.79 %) 2007-2012: **+6.1 %** (EU: 2.4 %; US: 1.2 %)	***Excellence in S&T***[1] 2012: **60.9** (EU: 47.8; US: 58.1) 2007-2012: **+14.6 %** (EU: +2.9 %; US: -0.2)
Innovation Output Indicator 2012: **116.5** (EU: 101.6)	***Knowledge-intensity of the economy***[2] 2012: **68.2** (EU: 51.2; US: 59.9) 2007-2012: **+3.5 %** (EU: +1.0 %; US: +0.5 %)
Areas of marked S&T specialisations: Food and agriculture, medical technologies, nanotechnologies, biotechnology, ICT, and new production technologies	***HT + MT contribution to the trade balance*** 2012: **2.0 %** (EU: 4.23 %; US: 1.02 %) 2007-2012: **+11.6 %** (EU: +4.8 %; US: -32.3 %)

Ireland has expanded and consolidated its research and innovation system over the last decade. Investments in R&I have grown substantially, and public investment in R&I grew considerably until the financial crisis. Since 2007, however, business enterprise investment in R&D has increased at a much higher rate than public investment in R&D.

The considerable increase in public and private R&D expenditure since 2000 has resulted in a clear shift to a knowledge-based economy, including a trend towards services. The Irish economy has a high proportion of knowledge-intensive products and services, which has not changed substantially over the last decade. Although the recession hit Ireland particularly hard, since then the economy has partly recovered because of the strength of exports by companies in the high-tech sectors. These firms are mainly affiliates of multinational enterprises (MNEs).

In contrast, in a number of sectors those domestic firms which do not have a propensity to export have struggled. Accordingly, the main challenges are to return to the previous policy of increasing public R&D expenditure and to complement the policy to promote the procurement of innovation with budgetary allocations to procurement authorities[3].

Prior to the crisis, policy was based on a Strategy for Science, Technology and Innovation which articulates the ambition to be a leading knowledge economy. More recently, the focus has been on accelerating growth and job creation. The government has also adopted the report of a research prioritisation group which sets out the basis for the country's national R&I Smart Specialisation Strategy which recommended targeted competitive research investment in 14 priority areas as well as a new IP protocol on putting public research to work for Ireland.

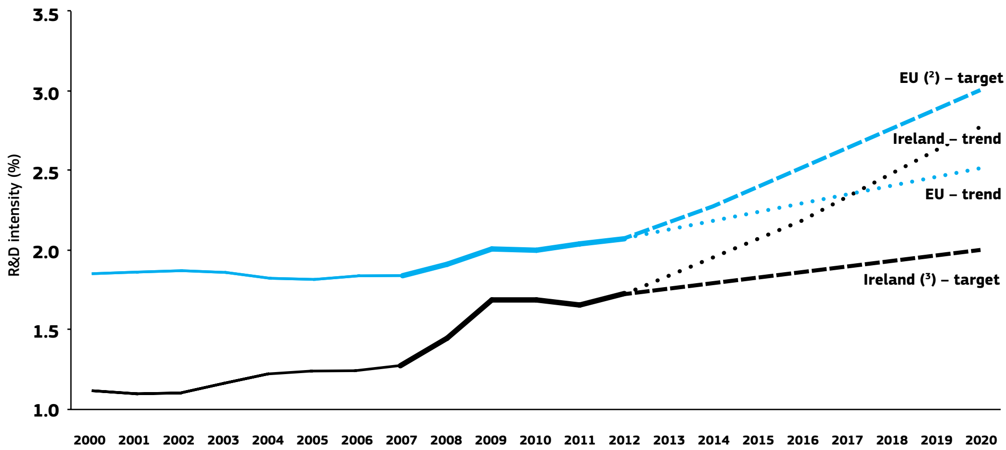
1 Composite indicator that includes PCT per population, ERC grants per public R&D, top universities and research institutes per GERD and highly cited publications per total publications.

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

3 Concrete measures were presented in the Commission Communication Europe 2020 Ireland, June 2012.

Investing in knowledge

Ireland – R&D intensity projections: 2000–2020 (1)



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.
(2) EU: The projection is based on the R&D intensity target of 3.0 % for 2020.
(3) IE: The projection is based on a tentative R&D intensity target of 2.0 % for 2020.

Ireland has a national R&D intensity target for 2020 of 2.5 % of GNP (estimated to be equivalent to 2.0 % of GDP). In 2012, Ireland had an R&D intensity of 1.72 %, with a public sector R&D intensity of 0.53 % and a business R&D intensity of 1.20 %.

Over the period 2007-2012, R&D intensity in Ireland grew at an average annual rate of 6.1 %, which is the eighth highest growth rate in the EU. Whereas this increase is greater than that for the period 2002-2007, it occurred in the context of an economic contraction during which the government budget for R&D decreased steadily. Thus, one of the main challenges for Ireland would be to return to a trend of increasing public investment in R&D which, if it was better related to business needs, would raise the R&D intensity of Irish firms. If this line were followed, a shift in the Irish economy towards a knowledge-based economy, already very visible, could be pursued and a more ambitious target could be envisaged on the occasion of the mid-term review of the Europe 2020 targets (2014/2015). This would be more in line with the country's clear potential, illustrated by the trend in R&D intensity above.

In absolute terms, public R&D funding reached a peak in 2008. R&D investment by firms appears not to have been seriously affected by the economic crisis. The increase of 42 % in BERD intensity over the period 2007-2012 was double that of public R&D intensity at 21 %. Ireland has a relatively low level of direct government support for BERD, although indirect support amounts to 75 % of public support of private R&D. In real terms, business R&D investment continued to rise and reached a peak in 2012. At 20.4 %, the share of GERD financed from abroad is more than double the EU average and reflects the policy of attracting foreign direct investment (FDI) with a large R&D component. In order to reach its national target by 2020, R&D intensity in Ireland would have to grow at an average annual rate of 1.9 % over the period 2012-2020. This growth would depend on sustained incentives to attract and boost business R&D investment.

Structural Funds are an important source of funding for R&I activities. Of the EUR 751 million of Structural Funds allocated to Ireland over the 2007-2013 programming period, around €155 million (21% of the total) relate to RTDI[4]. Under the Seventh Framework Programme (FP7), beneficiaries from Ireland have received EUR 528 million. Overall, Irish applicants had a close-to-average success rate.

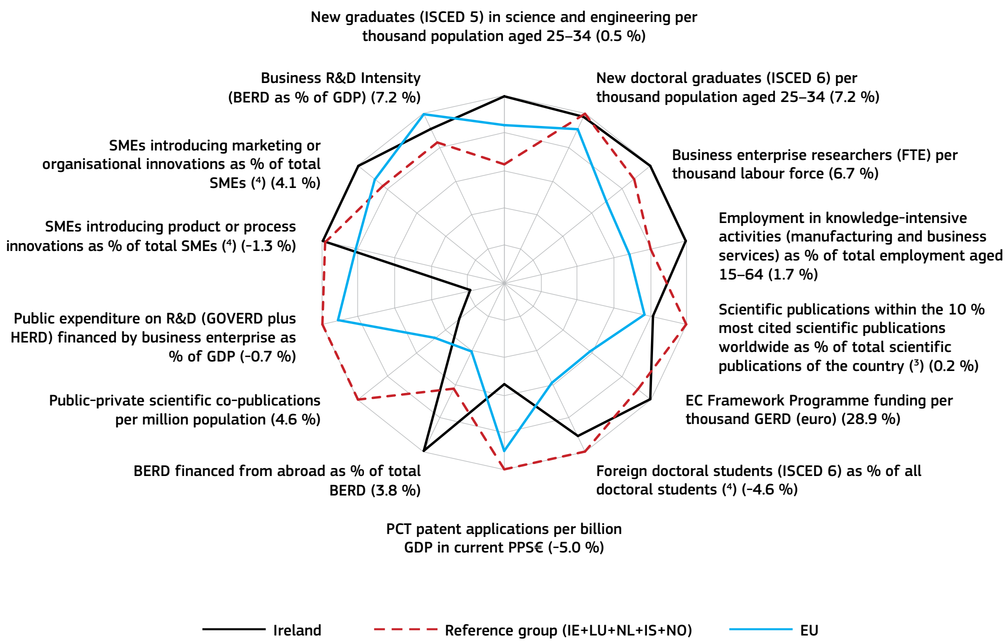
4 RTDI includes the following sectors: (01) RTD activities in research centres, (02) RTD infrastructures and centres of competence, (03) Technology transfer and improvement of cooperation of networks, (04) Assistance to RTD, particularly in SMEs (and RTD services in research centres), (06) Assistance 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.

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

The graph below illustrates the strengths and weaknesses in the Irish R&I system. Reading clockwise, the graph 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.

Ireland, 2012 (1)

In brackets: average annual growth for Ireland, 2007–2012 (2)



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: (1) The values refer to 2012 or to the latest available year.
(2) 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.
(3) Fractional counting method.
(4) EU does not include EL.

The graph shows in broad terms that Ireland's increasing investment in R&D has triggered stronger scientific production with increases in business R&D intensity, the number of new doctoral graduates, employment in knowledge-based activities, and scientific publications in the most highly cited journals. The number of researchers employed in business has also grown. The relative weaknesses of the Irish R&I system are the relatively low level of public-private co-publications, the low level of public expenditure on R&D financed by business enterprise, as well as a relatively low level of patent applications (PCT) per billion GDP. Recent policy is leading to the establishment of large research centres by Science Foundation Ireland (SFI) focusing on research and innovation aligned to the 14 research priority areas, and requiring the strong involvement and cash funding of industry. Establishment of the Industrial Development Authority/Enterprise Ireland Technology Centres is also being influenced by the 14 research priority areas.

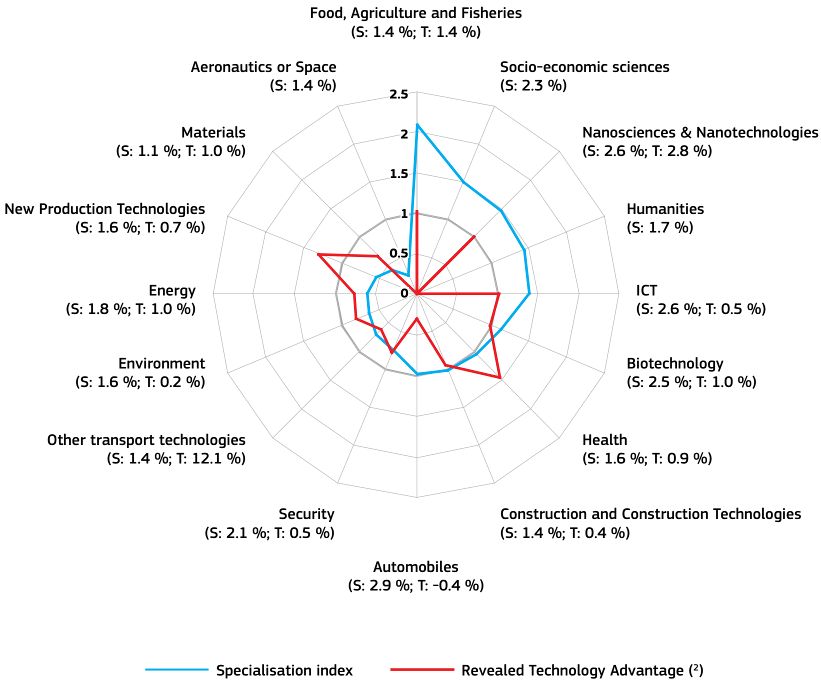
In 2011, Ireland had a small net outflow of tertiary students to the United States. In 2011, 1145 students at undergraduate, masters or doctoral level left Ireland to study in the United States, while there was a corresponding inflow of 1013 students from the United States to Ireland. The country has engaged in the European Strategy Forum on Research Infrastructures (ESFRI) process from the beginning and supports 20 of the 44 areas identified in the original roadmap as well as participating in seven FP7-funded research infrastructure preparatory phase projects.

On knowledge transfer, Ireland's efficiency is relatively high with regard to the amount invested in generating each patent application, licence agreement and spin-off.

Ireland's scientific and technological strengths

The graph below illustrates the areas, based on the Framework Programme thematic priorities, where Ireland 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.

Ireland – S&T National Specialisation (1) in thematic priorities, 2000–2010
in brackets: growth rate in number of publications (3) (S) and in number of patents (4) (T)

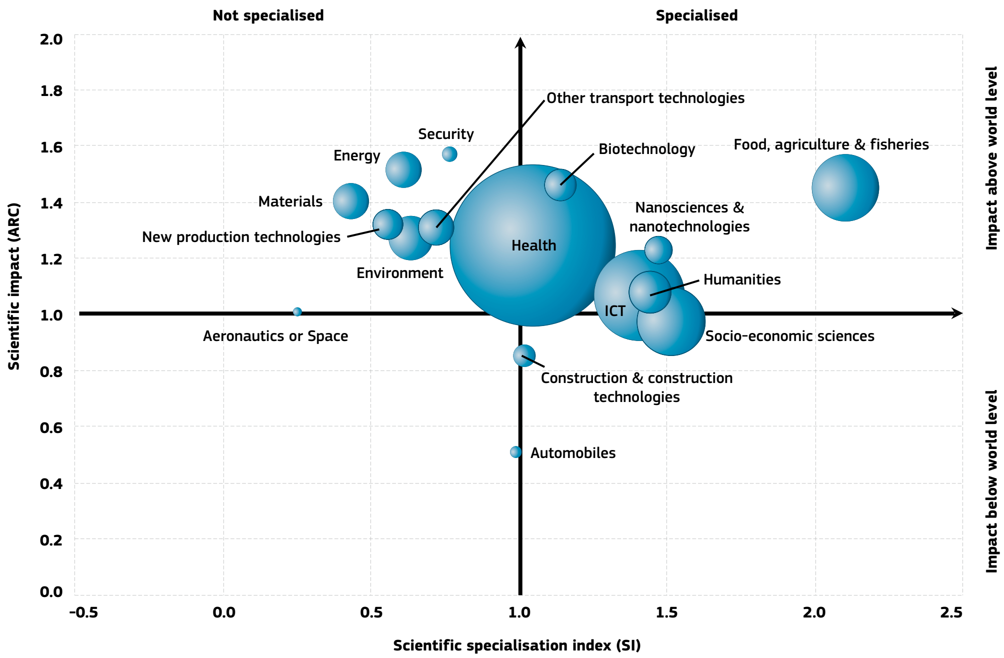


Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies
Data: Science-Metrix Canada; Bocconi University, Italy
Notes: (1) Values over 1 show specialisation; values under 1 show a lack of specialisation.
(2) The Revealed Technology Advantage (RTA) is calculated based on the data corresponding to the WIPO-PCT number of patent applications by country of inventors. For the thematic priorities with fewer than 5 patent applications over 2000–2010, the RTA is not taken into account. Patent applications in 'Aeronautics or Space' refer only to 'Aeronautics' data.
(3) The growth rate index of the publications (S) refers to the periods 2000–2004 and 2005–2009.
(4) The growth rate in number of patents (T) refers to the periods 2000–2002 and 2003–2006.

Comparison of the scientific and technological specialisation in selected thematic priorities shows a strong technological specialisation in the sectors of health, and new production technologies, whereas significant scientific specialisation exists in the sectors of food, agriculture and fisheries, nanosciences and nanotechnologies, ICT, socio-economic sciences, and humanities. There is obvious potential for stronger scientific and technological co-specialisations in the fields of health, biotechnology, construction, ICT, nanotechnologies, and food and agriculture.

The graph below illustrates the positional analysis of Irish publications showing the country's 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.

Ireland – 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
Note: Scientific specialisation includes 2000–2010 data; the impact is calculated for publications of 2000–2006, citation window 2007–2009.

The graph above shows a positional analysis of scientific publications in Ireland. The country has a high specialisation in food, agriculture and fisheries with an impact well above the global average. Other specialised fields with impacts above the world level are biotechnology, nanosciences and nanotechnologies, ICT, and health. It is interesting to note that a number of non-specialised fields have high impacts at world level, including energy, materials, new production technologies, other transport technologies, and environment.

Policies and reforms for research and innovation

The Irish research system is centralised and whilst research policies are set nationally they address regional aspects and needs and take into account the effects of clustering which have led to regional specialisation. The significance of the Structural Funds for Ireland has been reduced, with funding for RTDI over the period 2007-2013 amounting to EUR 155 million which represents around 20 % of the annual government budget for R&D. Ireland comprises two NUTS II regions. The Border, Midland and Western region's key challenge is to develop its Institutes of Technology and to enhance the research, innovation and ICT infrastructure to promote enterprise development. The Southern and Eastern region has made a commitment to developing incubator spaces in close proximity to the institutes of Technology.

Policy before the economic crisis was based on a Strategy for Science, Technology and Innovation 2006-2013 which articulates the ambition to be a leading knowledge economy. Following the onset of the economic crisis, this policy is being implemented in the context of the Framework for Sustainable Economic Renewal which, through an Action Plan for Jobs, involves actions to deliver reform and create economic growth and includes measures related to science, technology and innovation. The government's programme for national recovery places increased emphasis on delivering and accelerating value from the state's investment in research, the approach being to direct the majority of competitive funding towards 14 research priority areas. These are identified in the National Research Prioritisation exercise which forms the basis for Ireland's national R&I Smart Specialisation Strategy. In addition, a portion of funding will be retained for research into policy and research for knowledge.

In 2004, fiscal measures involving R&D tax credits were introduced and provided a 25 % tax credit for qualifying incremental expenditure covering all categories of research from basic to applied research and experimental development. According to OECD surveys on tax incentives, indirect support of business R&D in Ireland is almost three times higher than direct support. The fiscal incentives for carrying out R&D were complemented by an expansion of tax credits in 2010 to enhance investment in intellectual property (including software) by excluding royalties income from withholding tax.

In 2012, the government adopted a proposal for the prioritisation of competitive research funding for activities related to areas of industrial strength. In addition, policy emphasis is being placed on increasing the innovation potential of indigenous firms and improving links between industry and higher education institutions, particularly in the establishment of SFI research centres and the Enterprise Ireland and IDA Ireland Technology Centres. Following the publication of the higher education strategy, the Department of Education and Skills and the Higher Education Authority are putting in place compact agreements with the higher education institutes which will set out performance indicators for the HEIs, including indicators relevant to R&I.

The existing national policies on IPR were reviewed by a task force and were found to be in line with international practice, including that emerging at EU level from the Commission Recommendation C(2008)1329 and the Responsible Partnering initiative from the key stakeholders. This has recently been updated with a new IP protocol (adopted in 2012) to clarify the rules on knowledge transfer in the context of collaboration between industry and HEIs. A key recommendation in the protocol is being implemented by setting up a central Technology Transfer Office due to be officially opened at the end of May 2014. This new office, branded 'Knowledge Transfer Ireland' (KTI), aims to make it easier for companies to access and use ideas developed through publicly funded research to develop new products and services and ultimately create jobs and exports. KTI will ensure that the IP protocol is responding to the needs of business and stakeholders, and its remit will include promoting, enabling and monitoring HEI/business engagement across the wide range of intellectual assets that occurring in the creation of and access to intellectual property, in all its forms.

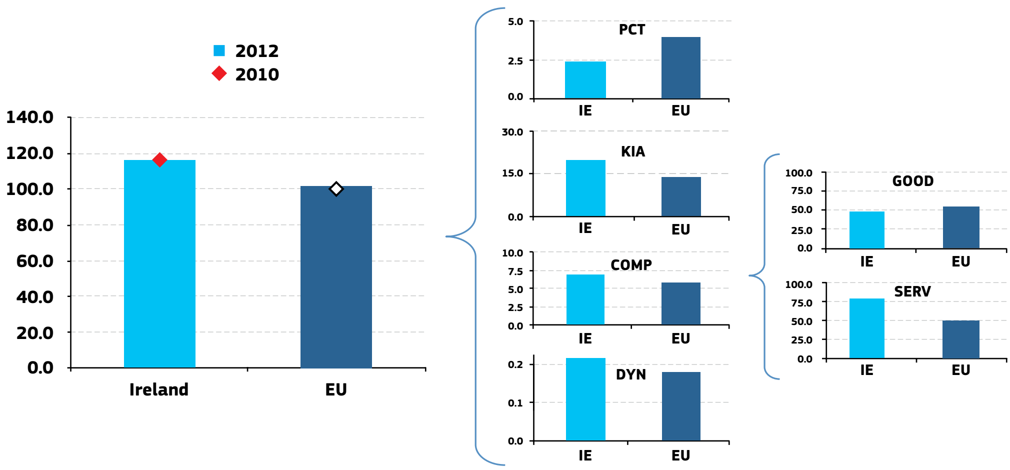
In 2009, an innovation task force was established. Key areas recommended for action include a better matching between supply and demand for innovation, a financial framework fostering innovation, high-quality and extended human capital, and international projection. It also takes in promotion of public procurement for innovative products and services. However, due to the need for strong fiscal consolidation, the implementation of some of these recommendations has been limited.

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 medium/high-tech commodities); and future business opportunities (jobs in innovative fast-growing firms).

The graph below enables a comprehensive comparison of Ireland's position regarding the indicator's different components.

Ireland – Innovation Output Indicator



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 %).

Ireland is one of the best performers in the EU in terms of the innovation output indicator. Only Germany and Sweden are ranked higher in the EU. Employment in knowledge-intensive activities in business industries and in high-growth innovative enterprises, as well as the share of knowledge-intensive services exports in total services exports is clearly above the EU average. Ireland is below the EU average in the indicators for PCT patent application per billion GDP and the share of medium-high and high-tech products in total goods exports. However, this should be seen in the context of the weight of ICT in the Irish economy and the fact that computer program patentability is limited.

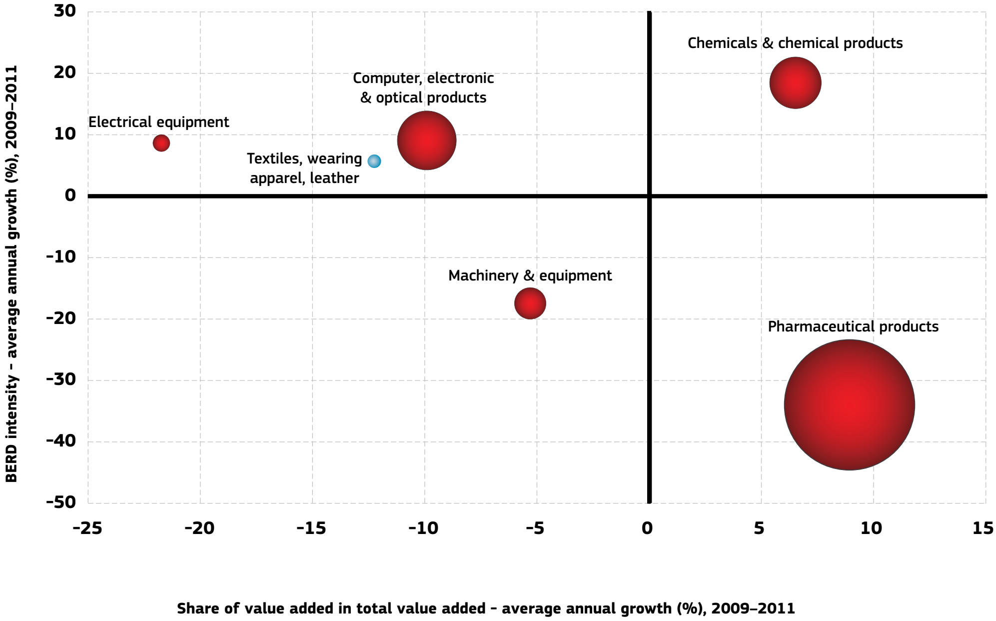
Ireland is ranked second in the EU (after Luxembourg) in terms of share of total employment in knowledge-intensive activities (20.1 %) and first in the share of knowledge-intensive services in total exports (78.6 %).

Foreign multinational firms perform a large part of the activity in the knowledge-intensive sectors while foreign direct investments have continued to support the more technology-intensive sectors. In 2012, at 24.8 %, Ireland had by far the highest technology balance of payments receipts as % of GDP among those OECD countries for which data are available. The corresponding average annual growth rate for Ireland over the period 2007-2012 was 14.8 %.This can be largely attributed to the high level of foreign direct investment in Ireland and the resulting intra-group transfers of technology. In general, Ireland has favourable framework conditions for innovation, in particular in terms of time taken to start a business, barriers to entrepreneurship, and corporate taxation. In contrast, it is below average in terms of percentage of self-employed people, women entrepreneurs and entrepreneurs under 45 years of age. Barriers to entrepreneurship (including regulatory, administrative burdens and barriers to competition) are lower than in many other EU Member States. However, following the financial crisis, ease of access to capital in Ireland have fallen to a very low level, and in 2012, the country was ranked in 16th place in the EU in terms of venture capital investment as a % of GDP.

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 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.

Ireland – Share of value added versus BERD intensity: average annual growth, 2009–2011



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies
Data: Eurostat
Note: ([1]) High-tech and medium-high-tech sectors (NACE Rev. 2 – two-digit level) are shown in red.

As recognised in Irish economic and industrial policy, the medium-term avenue for a more sustainable economy is to upgrade and move up on the value chain and internationalise its outreach. Compared to other countries, Ireland has scope to further increase both the R&D intensity in existing high-tech and medium-high-tech sectors and to boost knowledge intensity in the more traditional sectors of the economy.

The graph above illustrates recent structural change in the Irish economy. It shows that the economic expansion over the period 2009-2011 was mainly related to chemicals and pharmaceutical products, whereas the contribution of computer, electronic and optical products, and electrical equipment has fallen. The contribution from pharmaceutical products will also shrink as many of the medicines produced in Ireland have come off patent and thus their prices have fallen.

Key indicators for Ireland

IRELAND	2000	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth 2007–2012 (1) (%)	EU average (2)	Rank within EU
ENABLERS												
Investment in knowledge												
New doctoral graduates (ISCED 6) per thousand population aged 25–34	0.89	1.20	1.38	1.38	1.41	1.56	1.59	1.90	1.95	7.2	*1.81*	11
Performance in mathematics of 15-year-old students: mean score (PISA study)	:	:	501	:	:	487	:	:	501	0.0 (3)	495 (4)	8 (4)
Business enterprise expenditure on R&D (BERD) as % of GDP	0.80	0.82	0.83	0.85	0.94	1.15	*1.16*	1.14	*1.20*	*7.2*	1.31	11
Public expenditure on R&D (GOVERD + HERD) as % of GDP	0.32	0.43	0.42	0.44	0.51	0.53	0.53	*0.51*	*0.53*	*3.8*	*0.74*	18
Venture capital as % of GDP	0.21	0.07	0.06	0.17	0.04	0.04	0.03	0.04	0.05	-20.2	0,29 (5)	16 (5)
S&T excellence and cooperation												
Composite indicator on research excellence	:	:	:	30.9	:	:	:	:	60.9	14.6	47.8	7
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	:	10.9	10.9	11.5	11.6	11.5	:	:	:	0.2	11.0	8
International scientific co-publications per million population	:	702	749	820	915	1003	1089	1133	1138	6.8	343	8
Public–private scientific co-publications per million population	:	:	:	29	26	22	29	34	:	4.6	53	12
FIRM ACTIVITIES AND IMPACT												
Innovation contributing to international competitiveness												
PCT patent applications per billion GDP in current PPS (EUR)	2.3	2.4	2.4	2.7	2.9	2.8	2.3	:	:	-5.0	3.9	11
License and patent revenues from abroad as % of GDP	0.52	0.38	0.42	0.46	0.56	0.75	1.39	2.22	2.37	39.1	0.31	2
Community trademark (CTM) applications per million population	179	129	173	177	181	183	185	179	181	0.5	152	10
Community design (CD) applications per million population	:	15	14	13	14	14	18	15	16	4.3	29	20
Sales of new-to-market and new-to-firm innovations as % of turnover	:	:	12.6	:	11.0	:	9.3	:	:	-8.0	14.4	20
Knowledge-intensive services exports as % total service exports	:	:	:	:	:	71.3	72.7	71.4	:	0.0	45.3	2
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-5.37	-1.20	-0.92	-1.33	1.28	2.43	2.38	2.53	1.99	-	4.23 (6)	14
Growth of total factor productivity (total economy): 2007 = 100	96	100	100	100	96	94	95	98	98	-2 (7)	97	7
Factors for structural change and addressing societal challenges												
Composite indicator on structural change	:	:	:	57.5	:	:	:	:	68.2	3.5	51.2	1
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15–64	:	:	:	:	18.2	19.1 (8)	19.5	19.7	20.2	1.7	13.9	2
SMEs introducing product or process innovations as % of SMEs	:	:	43.8	:	42.3	:	41.2	:	:	-1.3	33.8	7
Environment-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)	0.10	0.05	0.08	0.09	0.23	0.17	:	:	:	35.8	0.44	12
Health-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)	0.53	0.55	0.39	0.62	0.60	0.75	:	:	:	10.0	0.53	6
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES												
Employment rate of the population aged 20–64 (%)	70.4	72.6	73.4	73.8	72.3	66.9 (8)	64.6	63.8	63.7	-1.6	68.4	21
R&D intensity (GERD as % of GDP)	1.11	1.25	1.25	1.28	1.45	*1.69*	*1.69*	*1.66*	*1.72*	*6.1*	*2.07*	12
Greenhouse gas emissions: 1990 = 100	124	128	128	127	125	114	113	106	:	-21 (9)	83	21 (10)
Share of renewable energy in gross final energy consumption (%)	:	2.8	3.1	3.6	4.0	5.2	5.6	6.7	:	16.8	13.0	22
Share of population aged 30–34 who have successfully completed tertiary education (%)	27.5	39.2	41.3	43.3	46.1	48.9	50.1	49.7	51.1	3.4	35.7	1
Share of population aged 18–24 with at most lower secondary education and not in further education or training (%)	:	12.5	12.1	11.6	11.3	11.7	11.5	10.8	9.7	-3.5	12.7	13 (10)
Share of population at risk of poverty or social exclusion (%)	:	25.0	23.3	23.1	23.7	25.7	27.3	29.4	:	6.2	24.8	20 (10)

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 Internatonal Student Assessment) score for EU does not include CY and MT. These Member States were not included in the EU ranking.
(5) 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.
(6) EU is the weighted average of the values for the Member States.
(7) The value is the difference between 2012 and 2007.
(8) Break in series between 2009 and the previous years. Average annual growth refers to 2009–2012.
(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.

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