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# Research and Innovation performance in EU Member States and Associated countries – Innovation Union progress at country level

***Accompanying the document***

**COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS**

**State of the Innovation Union 2012 - Accelerating change**

{COM(2013) 149 final}

## Latvia

*A better partnership R&I-Business as a step forward towards competitiveness*

***Summary: Performance in research, innovation and competitiveness***

The indicators in the table below present a synthesis of research, innovation and competitiveness in Latvia. 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.

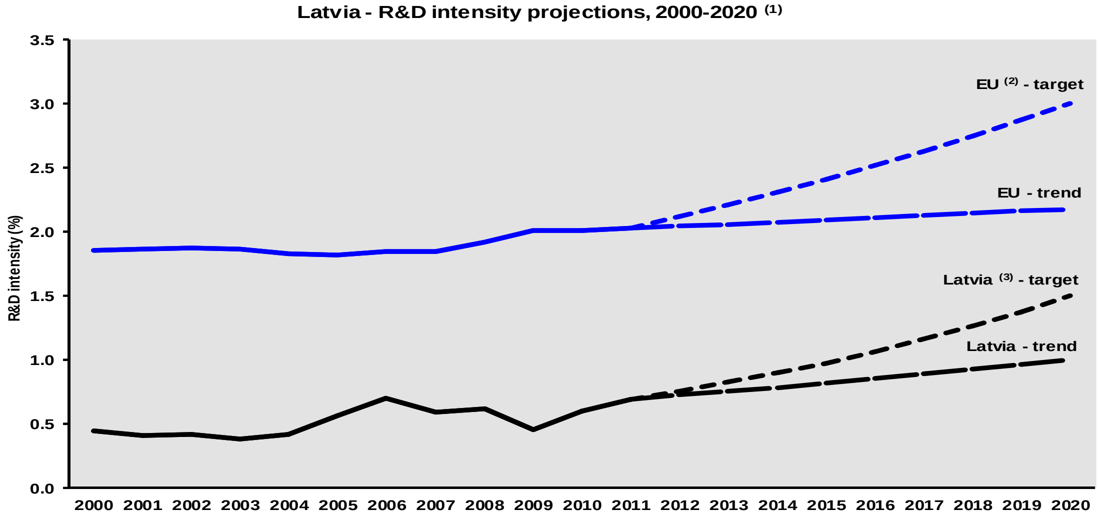
| | Investment and Input | Performance/economic output |
|---|---|---|
| **Research** | *R&D intensity*<br>2011: 0.70% (EU: 2.03%; US: 2.75%)<br>2000-2011: +4.15% (EU: +0.8%; US: +0.2%) | *Excellence in S&T*<br>2010:11.49 (EU:47.86; US: 56.68)<br>2005-2010: -0.15% (EU: +3.09%;US: +0.53) |
| **Innovation and Structural change** | *Index of economic impact of innovation*<br>2010-2011: 0.248 (EU: 0.612) | *Knowledge-intensity of the economy*<br>2010:34.38 (EU:48.75; US: 56.25)<br>2000-2010: +3.96% (EU: +0.93%; US: +0.5%) |
| **Competitiveness** | *Hot-spots in key technologies*<br>Materials, Health, Nano-sciences, Environment, Energy | *HT + MT contribution to the trade balance*<br>2011: -5.42% (EU: 4.2%; US: 1.93%)<br>2000-2011: n.a. (EU: +4.99%; US:-10.75%) |

Conscious of its current limitations in terms of research and innovation (R&I) and of the necessity to raise the level of its industry, Latvia adopted in 2005 a law on research activity aiming to boost its performance. Since 2008, however, Latvia has undertaken a rigorous fiscal consolidation, which has left behind some of the objectives and targets embodied in the law. A number of measures have been taken however, with the support of structural funds, in order to improve governance of the R&I system, to modernise the scientific infrastructure and attract foreign academics, and to improve the capacity of industry to innovate, in particular by developing the links between research and industry.

These measures still need to produce their full effect. Latvia's poor innovation performance still impairs its competitiveness. Latvia has one of the lowest business R&D intensities in the EU (0.19% in 2011). The national innovation system is overshadowed by low scientific performance, as measured by the share of scientific publications in the top 10% most cited which is only 4%, significantly below the EU average. There is little R&D investment by domestic companies or large foreign affiliates to support specialisation in knowledge-intensive and innovation-driven sectors.

As indicated by one of the Country Specific Recommendations Latvia should continue its reforms in higher education, by implementing a new financing model that rewards quality, strengthens links with market needs and research institutions, and avoids fragmentation of budget resources. Taking into account the thematic priorities and budgetary constraints, Latvia should improve the quality of its science base and rationalise its research and higher education institutions. The result obtained would be fewer but larger entities more able to build up critical mass in specialised areas of education and research, and a more focused use of resources. Moreover, in order to address the current challenges, Latvia would also get benefits from drawing up an R&I strategy for smart specialisation, that would facilitate a more efficient use of EU structural funds and improve the synergies between different EU and national policies, as well as increasing public and private investment in R&D.

*Investing in knowledge*




*Source:* DG Research and Innovation - Economic Analysis Unit
*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 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) LV: This projection is based on a tentative R&D intensity target of 1.50% for 2020.

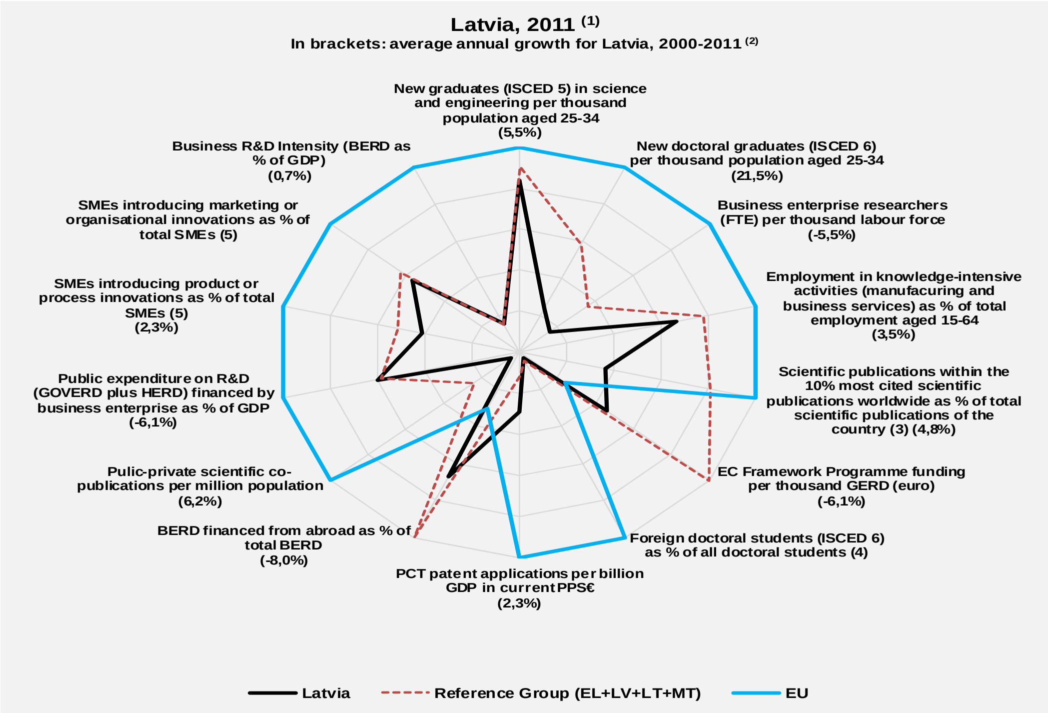
By the mid-2000s Latvia was faced with the realisation that it had to upgrade its Science and Technology infrastructure in order to become internationally competitive, to accumulate new knowledge and technology and to find high value added niches. In terms of research, Latvia had increased its government budget for R&D fivefold in absolute terms between 2000 and 2008. The financial crisis of 2008 had a major impact on the government budget for R&D, resulting in a 49% decrease between 2008 and 2009. Due to the country's rapid economic recovery, the public R&D budget has partially recovered in 2010 (with 27.3% increase compared to 2009). Moreover, in 2011 the public R&D funds have reached a level close to 2008, increasing by 48% compared to 2010 (HERD increased by 57.8%). Regarding innovation policy, Latvia does not have plans in the field of innovation procurement, is mostly supply led rather than demand-side led, and there are no tax incentives to support business R&D and innovation activities.

In strategic terms, Latvia has set a national R&D intensity target of 1.5%. In 2011, Latvia had an R&D intensity of 0.70%, with public R&D intensity amounting to 0.50% and business R&D intensity amounting to 0.19%. Latvia needs to increase the R&D intensity in both the public and the business sectors as a prerequisite to maintaining a performing R&I infrastructure and to boosting innovation in firms. Over the period 2000-2011, Latvia's R&D intensity has grown at an average annual growth rate of 4.2%. This growth rate is significantly higher than the EU average but still needs to be further increased if the country's 2020 R&D intensity target is to be achieved (in fact an average annual growth rate of 8.9% is required over the period 2011-2020 if the target of 1.5% is to be reached). The average annual growth rates of public sector R&D intensity and business sector R&D intensity over the period 2000-2011 are 5.97% and 0.69%, respectively. Latvia's participant success rate in the EC Seventh Framework Programme was 21.9%. The successful participants received a total EC financial contribution of € 26.4 million.

Structural Funds play a major role in the financing of R&I in Latvia (10% of the total ERDF–Cohesion Funds allocations for the 2007-2013 period). In 2010, R&I financing from the Structural Funds far exceeded national public funding for R&D and currently represents a third of total R&D expenditure in Latvia. The low level of business expenditure on R&D is seen as a critical challenge for Latvia. Business expenditure on R&D increased by 27% between 2009 and 2011. This increase is due in large part to the activities funded under Structural Funds programmes designed to improve the innovative capacity of industry. The growing share of Structural Funds in R&D funding is affecting the previous balance between institutional and competitive funding which is now inclining more towards project-based, competitive funding. A major issue for Latvia is the funding of R&D post 2013, in the period before the new round of Structural Funds becomes operational.

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

The graph below provides a synthetic picture of strengths and weaknesses of Latvia's R&I system. Reading clockwise, the graph provides information on human resources, scientific production, technology valorisation and innovation. The average annual growth rates from 2000 to the latest available year are given in brackets under each indicator.




*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) EL is not ncluded in the reference group.

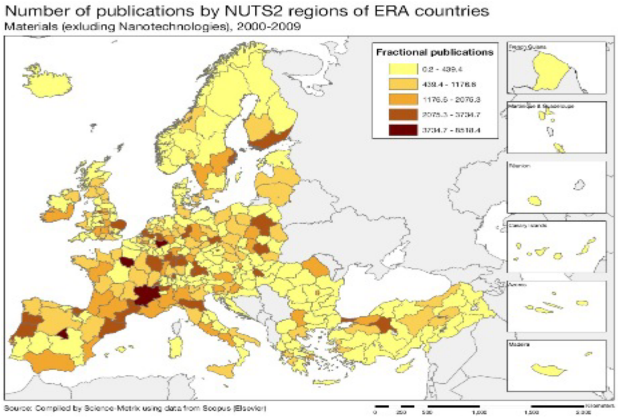
One important aspect of the Latvian R&I system is the lack of highly qualified scientists and engineers, a lack which is correlated to the low numbers of new doctorates awarded and graduates in science and engineering. Moreover, it can be seen from the above graph that the share of researchers in business enterprise is extremely low and employment in knowledge-intensive activities is still below the EU average. In fact, Latvia suffers an important outflow of graduates and researchers to the United States and other countries, many scientists preferring to pursue their careers abroad. In addition to this the country is not attracting any significant numbers of non-nationals in the field of R&I.

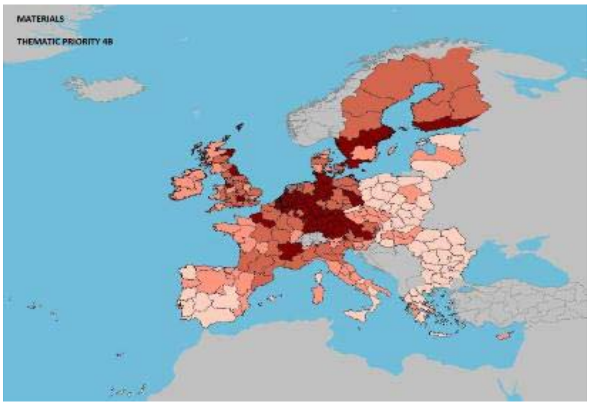
The national innovation system is therefore severely affected by low scientific performance (the share of scientific publications in the top 10% most cited is 4%) and low licence and patent revenues. Moreover, the country needs to enhance the quality of the higher education system and to address the need to better attune Latvian research to the needs of local industry while reinforcing the capacity of the latter for developing research and innovation activities. As shown on the graph above, public-private scientific cooperation is very low and research and innovation investment by foreign affiliates in support of specialisation in knowledge-intensive and innovation-driven sectors has been diminishing. The modest results produced by the technology transfer contact points operating in several universities, in part due to the incomplete legal framework for protecting intellectual property rights, is also a factor that contributes to the low level of commercialisation of research results.

### *Latvia's scientific and technological strengths*

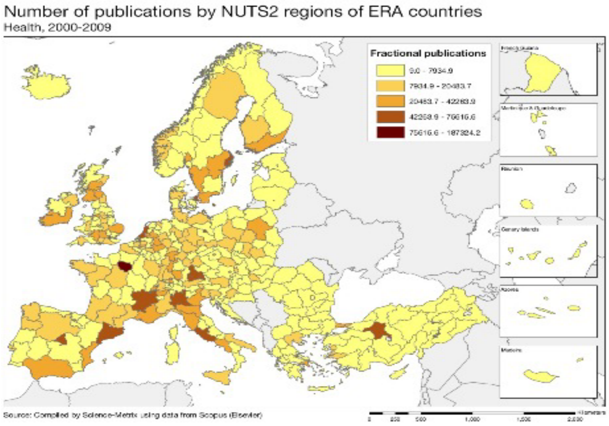
The maps below illustrate five key science and technology areas where Latvia has real strengths in a European context. The maps are based on the number of scientific publications and patents produced by authors and inventors based in the regions.

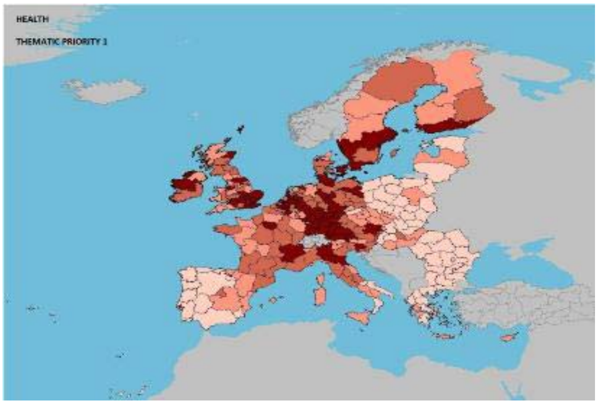
Scientific production | **Materials** | Technological production



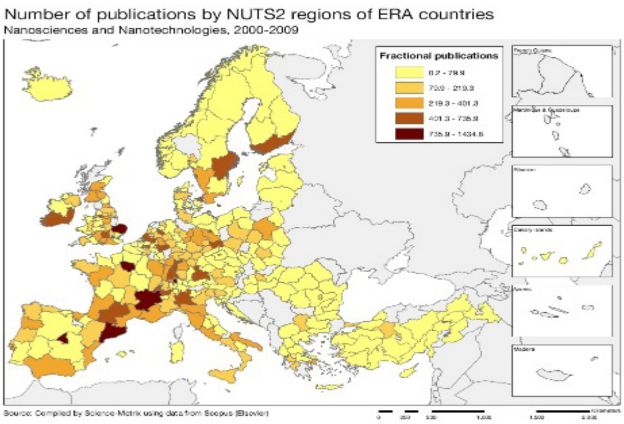



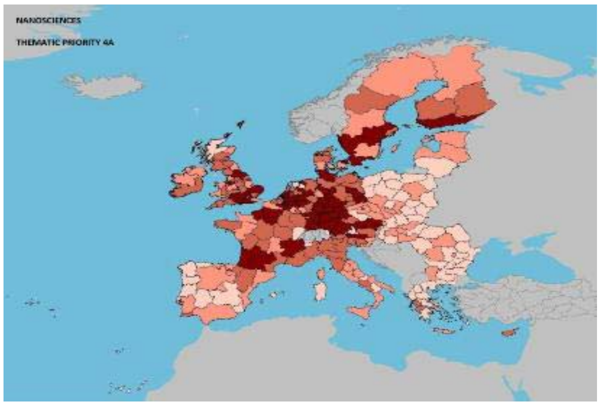

Scientific production | **Health** | Technological production



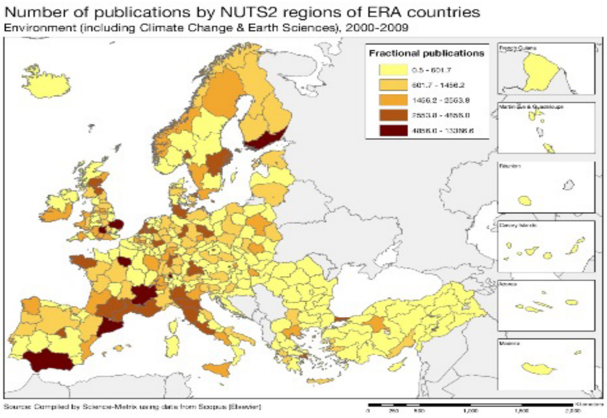

Scientific production | **Nano-sciences & Nano-technologies** | Technological production

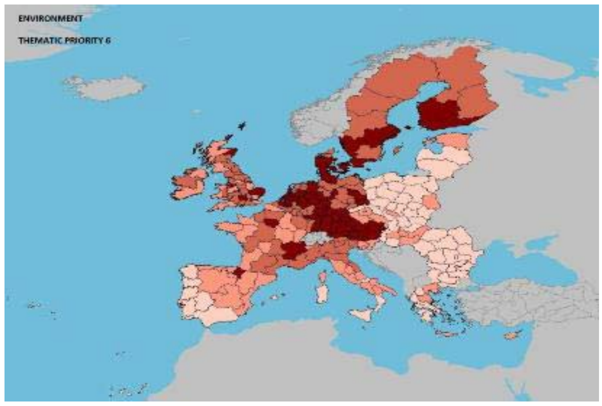


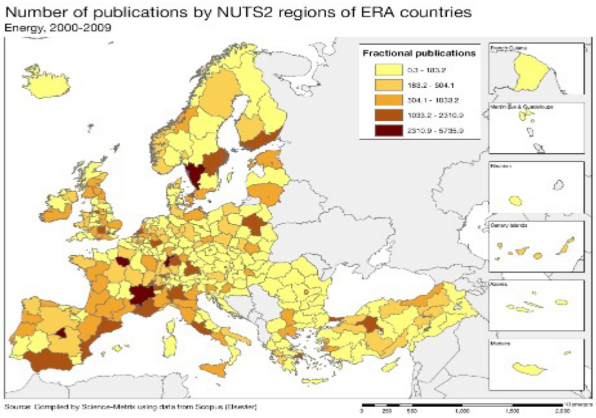

Source: DG Research and Innovation – Economic Analysis unit
Data: Science Metrix using Scopus (Elsevier), 2010; European Patent Office, patent applications, 2001-2010

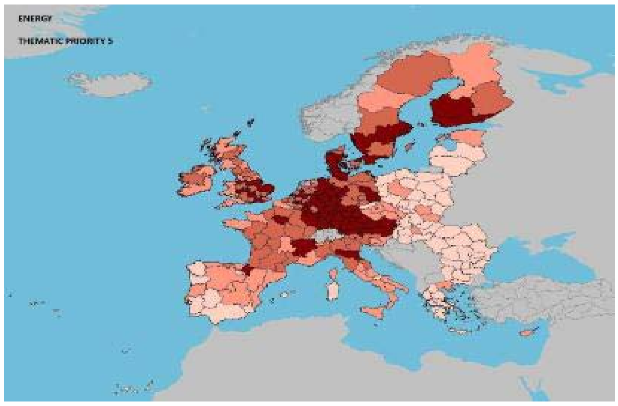
| Scientific production | **Environment** | Technological production |
|---|---|---|




| Scientific production | **Energy** | Technological production |
|---|---|---|




Latvia does not show any areas of particular excellence in terms of scientific or academic production. In terms of scientific capacity, no field appears to have reached any critical mass with the exception of materials. Latvia shows some activity in industry related technologies (surface technologies and coating, materials, engines, pumps and turbines, nano-sciences) and shows some strength in sectors such as IT methods for management, audio-visual, health, pharmacy, fine chemistry, and food chemistry. Latvia's scientific specialisation index, not shown on the maps above, shows that the country is relatively specialised in biotechnology, information and communication technologies, energy, other transport technologies (other than automobiles and aeronautics) and materials, materials being the main scientific field for Latvia.

***Policies and reforms for research and innovation***

The national research and innovation system faces a number of challenges:

- There is limited capacity to design, implement and coordinate research and innovation policy: Latvia has a complicated decision-making process for such a small country and the effectiveness of policy measures has been undermined by a lack of systematic evaluations.
- There is a lack of highly qualified scientists and engineers; the number of new doctorates awarded remains low and many scientists pursue their careers abroad.
- The scientific and research infrastructure is underdeveloped and the limited research and innovation resources available are spread too thinly to be efficient.
- The level of commercialisation of research is low: the technology transfer contact points operating in several universities produce modest results, in part due to the incomplete legal framework for protecting intellectual property rights.
- Cooperation between businesses and academics continues to be poor: companies are barely using the research potential of universities or state research institutes and their participation in the on-going competence centres programme is rather low.

In order to address these weaknesses, Latvia has taken the following steps:

- Governance is being improved by the setting up of a cross-departmental coordination centre under the Prime Minister.
- Measures have been taken to attract foreign academics, to increase the number of researchers and to attune the education system more to business needs by involving employers' organisations in the governance of universities and the assessment of vocational study programmes;
- Efforts are being made to modernise the scientific infrastructure — nine national research centres were established in 2011;
- Steps are being taken to promote commercialisation of science, encourage industrial innovation and support the development of innovative enterprises (business development involving new products and technologies, competence and technology transfer centres, innovation vouchers, etc.).

There have been quite a number of policy developments to support innovation. The most significant include:

- Development of innovation financing tools such as risk capital and seed/starting venture capital funds as well as the development of mezzanine loans for risky projects;
- Development of 10 business incubators to support new entrepreneurs across the country;
- Lowering administrative fees, simplifying administrative procedures and reducing the time for registering a business for entrepreneurs;
- Development of a long-term cooperation platform for enterprises and scientists - a framework for efficient cooperation between scientists and entrepreneurs in order to improve the research infrastructure, to support joint research and to foster technology transfer.

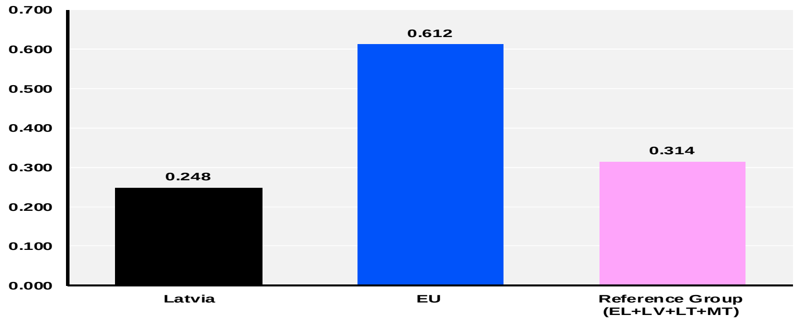
Further efforts could be made to improve the quality of the science base and to rationalise research and higher education institutions in line with the thematic priorities and budgetary constraints. This would result in fewer but larger entities more able to build up critical mass in specialised areas of education and research, coupled with the progressive introduction of competitive funding based on independent evaluation. In order to address the current challenges and to qualify for EU funding in the post 2013 period, Latvia would benefit from drawing up a research and innovation strategy for smart specialisation, so that EU Structural Funds can be used more efficiently and synergies between different EU and national policies, as well as public and private investment, can be increased.

Currently, Latvia is developing a National Industrial Policy (NIP) to be presented in 2013. The NIP will include inter alia specific measures for cross-cutting innovation policy implementation. Moreover, in order to increase the quality of Latvian research, the government has signed, at the end of 2012, an agreement with the Nordic Council of Ministers for an evaluation of its scientific institutions.

### *Economic impact of innovation*

The index below is a summary index of the economic impact of innovation composed of five of the Innovation Union Scoreboard's indicators[1].

**Latvia - Index of economic impact of innovation (1)**




*Source:* DG Research and Innovation - Economic Analysis Unit (2013)
*Data:* Innovation Union Scoreboard 2013, Eurostat
*Note:* (1) Based on underlying data for 2009, 2010 and 2011.

According to this index, the economic impact of innovation in Latvia is below its reference group, much below the EU average. Among the five indicators of the index, Latvia's performance is particularly low in patent inventions, contribution of high- and medium-tech products to the trade balance (see section 'Competitiveness in global demand and markets' below) and sales of new-to-market and new-to-firm innovations. In contrast, the share of knowledge-intensive exports in total services exports is relatively good. One key factor to increase the economic impact of innovation is of course the structural change that allows innovation-driven growth. High-growth innovative firms in particular play a catalytic role in this respect.

In this regard, the government is in the process of implementing a series of specific measures to improve the business environment. These include reducing the administrative burden on business, ensuring the appropriate e-services for business, providing on-line business registration, reducing the procedures and the time taken to obtain a construction permit, improving legislation for investor protection and providing greater transparency. In addition, a framework for more efficient cooperation between scientists and entrepreneurs is being developed to encourage innovation.

Access to financing within Latvia also needs to be improved. Most of the support programs available for SMEs and start-ups are financed mainly from EU Structural Funds and are rather fragmented and lack coherence. Programmes offering loans and guarantees to manufacturing industry as well as the microcredit programme for SMEs have had moderate success. Moreover, only a small part of the available venture capital funds has been invested so far.

In recent years, the use of Structural Funds to finance innovation support measures such as business R&D, the development of technology centres and technology transfer points has increased. In particular, the Competence Centre programme (also funded by the Structural Funds) aims to better develop links between Research and Industry in order to implement common, knowledge-intensive industrial research and product development projects. Core participants at Competence Centres are industry representatives who are responsible for defining R&D agendas and implementing research results. (At this time, there are at least 11 scientific institutions and 72 companies (mostly SMEs) involved in six Competence Centres.)

Overall, Latvia could benefit from a further strengthening of the growth potential of its economy through a range of structural reforms that would also help to improve its competitiveness and to move it towards a knowledge-based economy. Particular attention could be paid to the following: promoting a coherent industrial policy, improving public procurement and the performance of public administration, continuing to reduce the public burden and improve the absorption of EU funds.

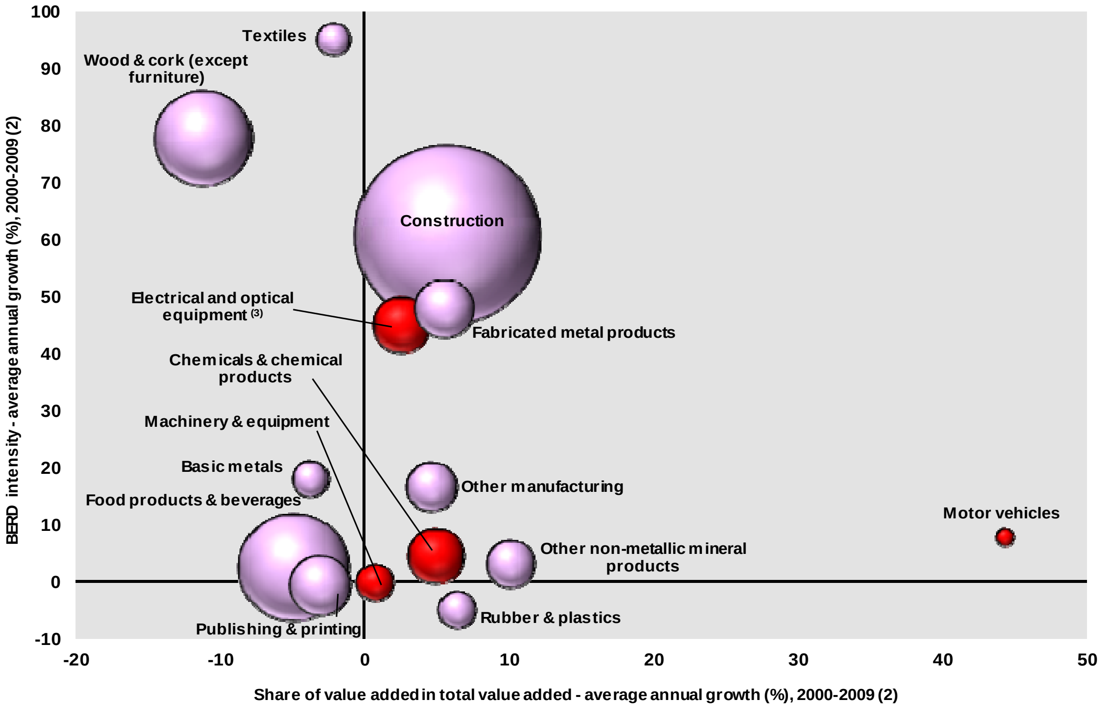
The business environment could also be further improved by encouraging companies to innovate and to better exploit the resources offered by universities, by improving access to finance, by creating a more competitive environment, by increasing the supply of highly-skilled labour and by improving (re)training schemes.

1 See Methodological note for the composition of this index.

*Upgrading knowledge and technologies in the manufacturing sector*

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 represented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

**Latvia - Share of value added versus BERD intensity - average annual growth, 2000-2009**




*Source:* DG Research and Innovation - Economic Analysis unit
*Data:* Eurostat
*Notes:* (1) High-Tech and Medium-High-Tech sectors are shown in red. 'Other transport equipment' includes High-Tech, Medium-High-Tech and Medium-Low-Tech.
(2) 'Textiles': 2000-2005; 'Basic metals', 'Machinery and equipment', 'Other non-metallic mineral products': 2000-2006; 'Construction', 'Other manufacturing': 2001-2006; , 'Fabricated metal products', 'Rubber and plastics': 2003-2005; 'Motor vehicles', 'Wood and cork (except furniture)': 2004-2006.
(3) 'Electrical and optical equipment' includes: 'Office, accounting and computing machinery', 'Electrical machinery and apparatus', 'Radio, TV and communication equipment' and 'Medical, precision and optical instruments'.

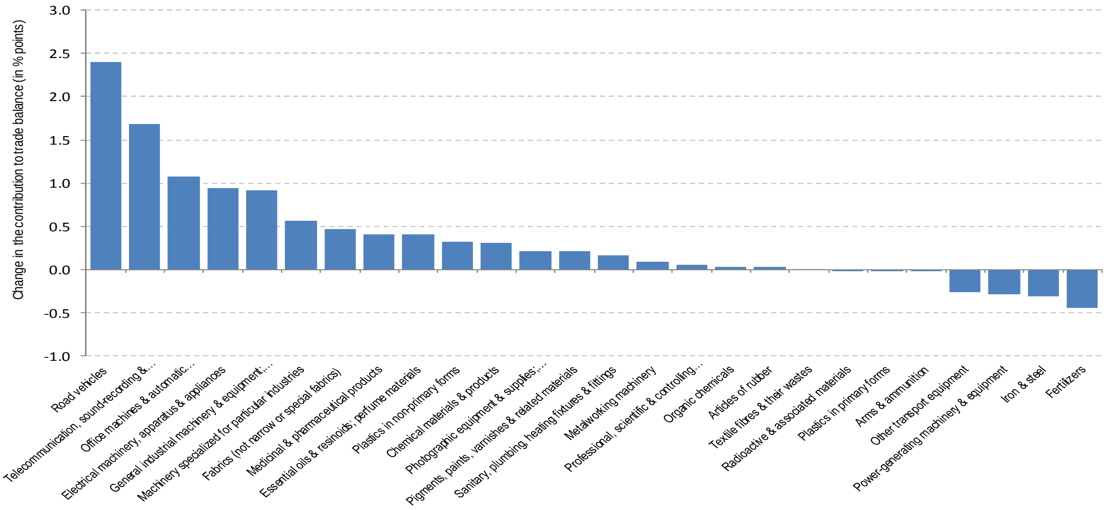
Latvia has been moving from more traditional industrial activities towards more knowledge-intensive industry. The contribution of manufacturing to Latvia's total gross value added (14.12% in 2011) is lower than the EU average (15.5% in 2011). Latvia is specialised in sectors with low and medium-low research intensities such as metal processing and machinery, wood and wood products, and food processing. Latvia's economic structure is highly biased towards small enterprises in traditional sectors such as sawmilling and wood planning as well as fish processing.

According to the results of the 2011 EU Industrial R&D Investment Scoreboard, there are no Latvian companies in the top 1000 EU companies listed by the publication, pointing to the fact that there are no large R&D intensive firms in a Latvian economy that is mainly characterized by SMEs and microenterprises.

### *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.

**Evolution of the contribution of high-tech and medium-tech products to the trade balance for Latvia between 2000 and 2011**




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.

Over the last 10 years, Latvian trade has been dominated by imports. This has led to a negative trend in the country's trade balance at global level and for high-tech (HT) and medium-tech (MT) products. Following a descending evolution of the trade balance over the period 2000-2008, a slight increase occurs in 2009 but the following years show another decline. The improvement in the trade balance for 2009 was the result of a significant decrease in imports while exports remained constant.

With regard to the contribution of HT & MT products to Latvia's trade balance, the graph above shows that the majority of products have positive evolutions. These evolutions are more evident in the case of road vehicles, telecommunication, sound-recording and reproducing equipment and office machines and automatic data-processing machines. Even if the absolute values are still negative, these products show a decrease in the level of imports while the level of exports was maintained or increased. On the other hand, products with descending evolutions of their contributions to the trade balance, such as other transport equipment, power-generating machinery and equipment, iron and steel and fertilizers, show both an increase in imports and a decrease in exports.

Overall, Latvia has made some progress towards the Europe 2020 targets, but there is still room for improvement in a significant number of areas. Total factor productivity which decreased substantially in 2009 due to the economic crisis increased significantly between 2010 and 2012. The effects of the economic crisis can also be seen in a much lower employment rate and in an increase in the share of population at risk of poverty or social exclusion after 2008. The share of population at risk of poverty or social exclusion in Latvia increased from 33.8% in 2008 to 40.1% in 2011, a value that is significantly higher than the EU average of 24.2%. In 2010 Latvia was the one of the Member States with the lowest levels of greenhouse gas emissions. At the same time, Latvia had one of the highest shares of renewable energy in total energy consumption in the EU.

# Key indicators for Latvia

| LATVIA | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average annual growth [1] (%) | EU average [2] | Rank within EU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENABLERS** | | | | | | | | | | | | | | | | |
| **Investment in knowledge** | | | | | | | | | | | | | | | | |
| New doctoral graduates (ISCED 6) per thousand population aged 25-34 | 0.12 | 0.11 | 0.16 | 0.20 | 0.26 | 0.36 | 0.33 | 0.46 | 0.43 | 0.53 | 0.40 | 1.05 | : | 21.5 | *1.69* | 25 [3] |
| Business enterprise expenditure on R&D (BERD) as % of GDP | 0.18 | 0.15 | 0.17 | 0.13 | 0.19 | 0.23 | 0.35 | 0.19 | 0.15 | 0.17 | 0.22 | *0.19* | : | *0.7* | *1.26* | 24 |
| Public expenditure on R&D (GOVERD + HERD) as % of GDP | 0.27 | 0.26 | 0.25 | 0.25 | 0.23 | 0.33 | 0.35 | 0.40 | 0.46 | 0.29 | 0.38 | *0.50* | : | 6.0 | *0.74* | 19 |
| Venture Capital as % of GDP | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| **S&T excellence and cooperation** | | | | | | | | | | | | | | | | |
| Composite indicator of research excellence | : | : | : | : | : | 11.6 | : | : | : | : | 11.5 | : | : | -0.2 | 47.9 | 27 |
| Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country | 2.7 | 2.1 | 2.0 | 3.0 | 2.0 | 5.3 | 3.6 | 2.2 | 4.0 | : | : | : | : | 4.8 | 10.9 | 23 |
| International scientific co-publications per million population | 73 | 63 | 79 | 88 | 102 | 123 | 111 | 119 | 138 | 133 | 131 | 178 | : | 8.5 | 300 | 26 |
| Public-private scientific co-publications per million population | : | : | : | : | : | : | : | 2 | 2 | 2 | 3 | 2 | : | 6.2 | 53 | 27 |
| **FIRM ACTIVITIES AND IMPACT** | | | | | | | | | | | | | | | | |
| **Innovation contributing to international competitiveness** | | | | | | | | | | | | | | | | |
| PCT patent applications per billion GDP in current PPS€ | 0.9 | 0.6 | 0.6 | 0.7 | 0.7 | 1.0 | 0.9 | 0.7 | 0.8 | 1.1 | : | : | : | 2.3 | 3.9 | 17 |
| License and patent revenues from abroad as % of GDP | : | : | : | : | 0.05 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.05 | 0.04 | : | -6.0 | 0.58 | 21 |
| Sales of new to market and new to firm innovations as % of turnover | : | : | : | : | 5.1 | : | 3.3 | : | 5.9 | : | 3.1 | : | : | -7.8 | 14.4 | 27 |
| Knowledge-intensive services exports as % total service exports | : | : | : | : | 35.7 | 35.3 | 35.3 | 34.6 | 34.9 | 35.8 | 35.3 | : | : | -0.2 | 45.1 | 12 |
| Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products | -14.39 | -14.44 | -14.84 | -14.33 | -12.34 | -10.47 | -9.59 | -8.87 | -6.08 | -2.83 | -4.98 | -5.42 | : | - | 4,20 [4] | 26 |
| Growth of total factor productivity (total economy) - 2000 = 100 | 100 | 105 | 109 | 114 | 118 | 122 | 124 | 124 | 113 | 99 | 101 | 110 | 111 | 11 [5] | 103 | 8 |
| **Factors for structural change and addressing societal challenges** | | | | | | | | | | | | | | | | |
| Composite indicator of structural change | 23.3 | : | : | : | : | 30.1 | : | : | : | : | 34.4 | : | : | 4.0 | 48.7 | 22 |
| Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64 | : | : | : | : | : | : | : | : | 8.2 | 9.1 | 9.6 | 9.1 | : | 3.5 | 13.6 | 24 |
| SMEs introducing product or process innovations as % of SMEs | : | : | : | : | : | : | 14.4 | : | 17.2 | : | 15.8 | : | : | 2.3 | 38.4 | 25 |
| Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.03 | 0.11 | 0.00 | 0.00 | 0.04 | 0.00 | 0.07 | 0.02 | 0.00 | : | : | : | : | -5.1 | 0.39 | 23 [6] |
| Health-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.34 | 0.12 | 0.22 | 0.20 | 0.21 | 0.41 | 0.16 | 0.18 | 0.11 | : | : | : | : | -13.3 | 0.52 | 18 |
| **EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES** | | | | | | | | | | | | | | | | |
| Employment rate of the population aged 20-64 (%) | 63.5 | 65.1 | 67.0 | 68.9 | 69.3 | 70.3 | 73.5 | 75.2 | 75.8 | 67.1 | 65.0 | 67.2 | : | 0.5 | 68.6 | 16 |
| R&D Intensity (GERD as % of GDP) | 0.45 | 0.41 | 0.42 | 0.38 | 0.42 | 0.56 | 0.70 | 0.60 | 0.62 | 0.46 | 0.60 | *0.70* | : | *4.2* | *2.03* | 22 |
| Greenhouse gas emissions - 1990 = 100 | 39 | 41 | 41 | 41 | 42 | 42 | 44 | 46 | 44 | 41 | 45 | : | : | 6 [7] | 85 | 2 [8] |
| Share of renewable energy in gross final energy consumption (%) | : | : | : | : | 32.8 | 32.3 | 31.1 | 29.6 | 29.8 | 34.3 | 32.6 | : | : | -0.1 | 12.5 | 2 |
| Share of population aged 30-34 who have successfully completed tertiary education (%) | 18.6 | 16.8 | 17,3 [9] | 18.3 | 18.5 | 18.5 | 19.2 | 25.6 | 27.0 | 30.1 | 32.3 | 35.7 | : | 8.4 | 34.6 | 16 |
| Share of population at risk of poverty or social exclusion (%) | : | : | : | : | : | 45.8 | 41.4 | 36.0 | 33.8 | 37.4 | 38.1 | 40.1 | : | 5.9 | *24.2* | 25 [8] |

*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) Rank in 2010.
(4) EU is the weighted average of the values for the Member States.
(5) The value is the difference between 2012 and 2000.
(6) Rank in 2007.
(7) The value is the difference between 2010 and 2000. A negative value means lower emissions.
(8) The values for this indicator were ranked from lowest to highest.
(9) Break in series between 2002 and the previous years. Average annual growth refers to 2002-2011.

**Country-specific recommendation in R&I adopted by the Council in July 2012:**
*"Continue reforms in higher education, inter alia, by implementing a new financing model that rewards quality, strengthens links with market needs and research institutions, and avoids fragmentation of budget resources. Design and implement an effective research and innovation policy encouraging companies to innovate, including via tax incentives, upgrading infrastructure and rationalising research institutions."*

# Lithuania

*Developing a stronger and thematically focused science base*

***Summary: Performance in research, innovation and competitiveness***

The indicators in the table below present a synthesis of research, innovation and competitiveness in Lithuania. 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*<br>2011: 0.92% (EU: 2.03%; US: 2.75%)<br>2000-2011: +4.13% (EU: +0.8%; US: +0.2%) | *Excellence in S&T*<br>2010: 13.92 (EU:47.86; US: 56.68)<br>2005-2010: +2.62% (EU: +3.09%;US: +0.53) |
| **Innovation and Structural change** | *Index of economic impact of innovation*<br>2010-2011: 0.223 (EU: 0.612) | *Knowledge-intensity of the economy*<br>2010: 35.28 (EU:48.75; US: 56.25)<br>2000-2010: +5.04% (EU: +0.93%; US: +0.5%) |
| **Competitiveness** | *Hot-spots in key technologies*<br>Other transport technologies (other than automobiles and aeronautics), Construction technologies, Energy | *HT + MT contribution to the trade balance*<br>2011: -1.27% (EU: 4.2%; US: 1.93%)<br>2000-2011: n.a. (EU: +4.99%; US:-10.75%) |

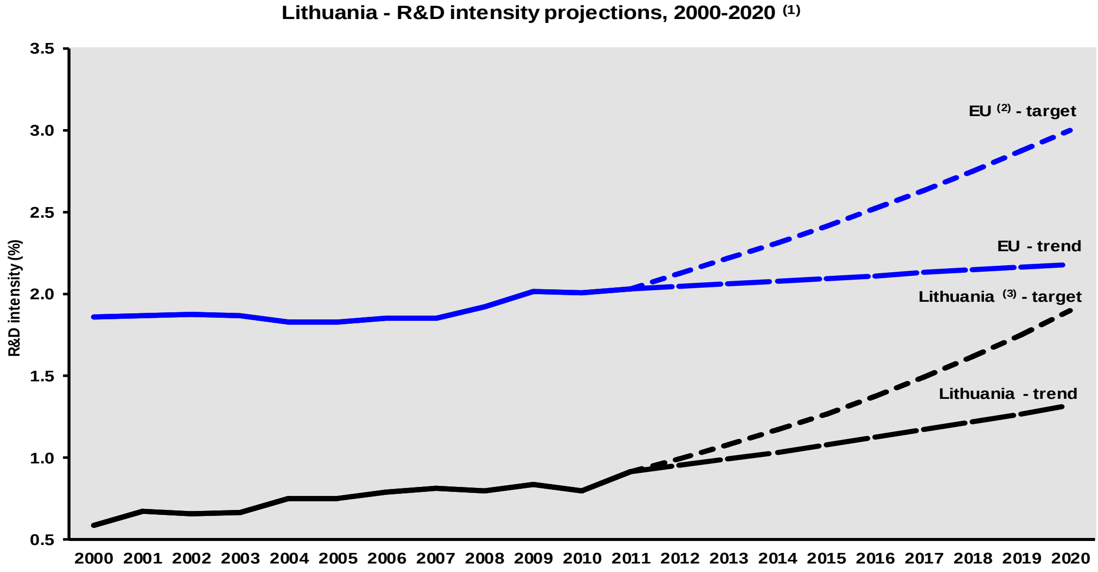
The main strengths of Lithuania's research and innovation (R&I) system are the size of its public research sector and the good supply of new graduates.

In contrast, R&D activities are very limited in the business sector: almost 3/4 of all R&D expenditure in Lithuania is performed by the public sector. Lithuania has one of the lowest business R&D intensity in the EU. Business investment in R&D will only improve if the quality, relevance and openness to the private sector of the science base and of higher education in Lithuania increase. The Lithuanian science base is insufficiently competitive and is not well connected to European networks. Due to unattractive research careers, the science base is also threatened by an insufficient supply of human resources. Links between education, research and the private sector are very weak.

In order to improve the situation, Lithuania has been conducting over the last years an ambitious reform of its science base: autonomy and new governance of universities, reorganisation of the network of public research institutions, increase in the share of project-based funding and of performance-based institutional funding, increase in researchers' salaries and dedicated schemes to attract local and international talents, creation and development of five clusters (called "Valleys") integrating higher education institutions, research institutions and businesses in identified scientific and technology areas. However, this important reform is not accompanied by the same degree of government commitment in budgetary terms. Consequently, as part of the Europe 2020 process, it was recommended that Lithuania should minimise cuts in growth-enhancing expenditure (the category of expenditure to which R&D expenditure belongs).

The reinforced innovation policy is expected to strengthen the links between higher education institutions, research institutions and businesses. S&T parks are created to act as a link between businesses and public laboratories by providing a number of innovation services and infrastructures, in particular in relation to knowledge transfer and intellectual property rights. Altogether, the reform of the science base is expected to make the Lithuanian research and innovation system more efficient and better performing in the years to come.

***Investing in R&D***




*Source:* DG Research and Innovation - Economic Analysis Unit
*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 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) LT: This projection is based on a tentative R&D intensity target of 1.90% for 2020.

Lithuania's R&D intensity substantially increased in 2011 to reach 0.92% of GDP, after five years of relative stagnation at around 0.8%. However, this is still less than half of Lithuania's R&D intensity target of 1.9% for 2020. Most of this increase in 2011 took place in the public sector and is due to progress in implementing R&D-related projects financed with EU Structural Funds. The business sector finances only about 28% of total R&D expenditure, one of the lowest shares of business funding in the EU. The economic crisis severely hit the national R&D budget which has been cut by half nominally between 2007 (€ 95.7 million) and 2010 (€ 47 million). It slightly increased in 2011 and was planned to increase in 2012-2013. Overall, the share of the R&D budget in total government expenditure has dramatically declined from 1.09% in 2004 to 0.43% in 2010.

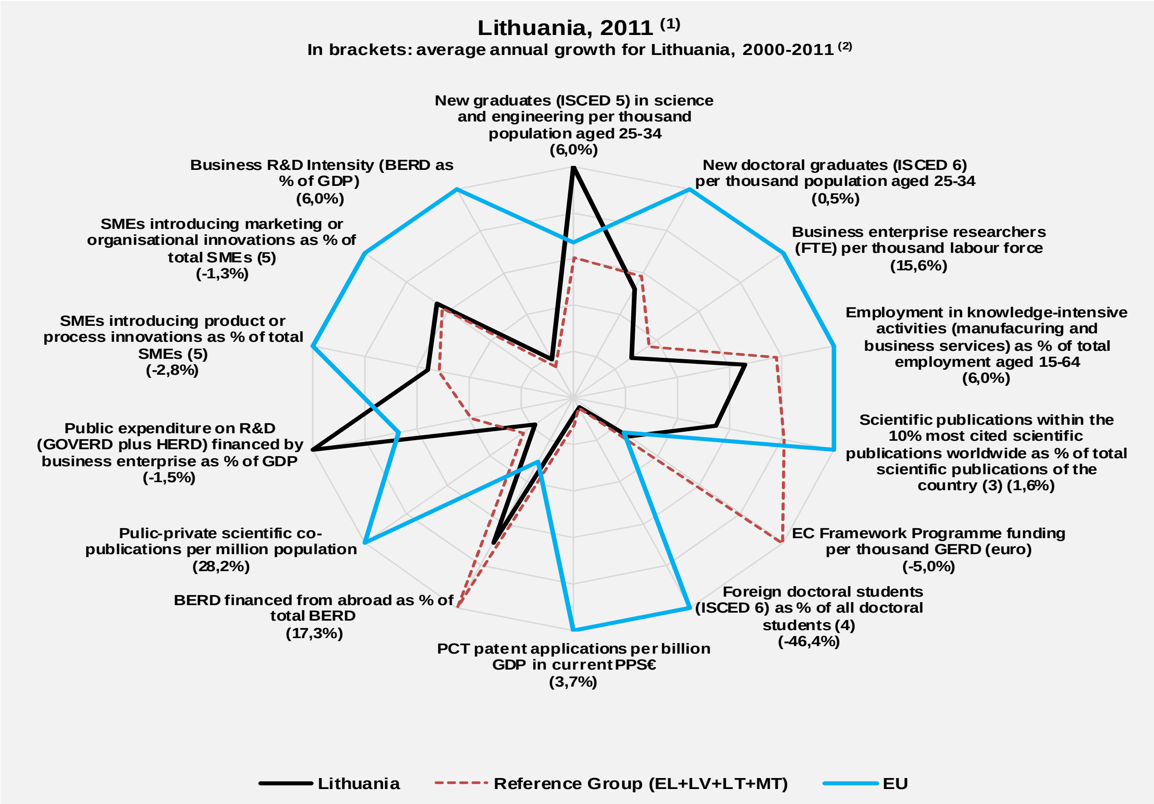
Continuity in public funding of R&D has been ensured by Structural Funds, with € 1511 million (22.3%) of ERDF funds earmarked for research, innovation, ICT and entrepreneurship for the period 2007-2013, and with a good absorption rate. In 2011-2012, Lithuania simplified the use of Structural Funds in favour of RTDI. Lithuania also benefited by about € 33.8 million from the EU FP7 for 280 Lithuanian participants from 2007 to early 2012. There was a good success rate for Lithuanian applicants (19.4% vs. 21.5% for the EU). Additional government support for investment in R&D and in new technologies is provided through R&D tax incentives - in place since 2008.

After some progress in the early 2000s, business R&D intensity has hardly changed between 2006 (0.22%) and 2011 (0.24%). Business financing of R&D was seriously affected by the economic crisis, decreasing by 11% in nominal terms between 2007 and 2009. It increased again by 3% in 2010 and by another 11% in 2011, i.e. just above the 2007 level. Business R&D has been most affected in the services sector with a decrease of 30% in nominal terms between 2008 and 2009. On the other hand it increased in the manufacturing sector by 13% between the same two years[2]. Professional, scientific and technical activities, human health and social work activities, and financial and insurance activities are the most affected services sectors. Among manufacturing sectors, R&D expenditure in wood, paper and printing increased by a factor of 4.8 and also increased in food products, beverages and tobacco, pharmaceuticals, and in computer, electronic and optical products, but decreased by more than 40% in fabricated metal products.

[2] Data from Eurostat, Business R&D expenditure (BERD) by economic activity based on the 'main activity' of the firm.

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

The graph below illustrates the strengths and weaknesses of Lithuania'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) EL is not ncluded in the reference group.

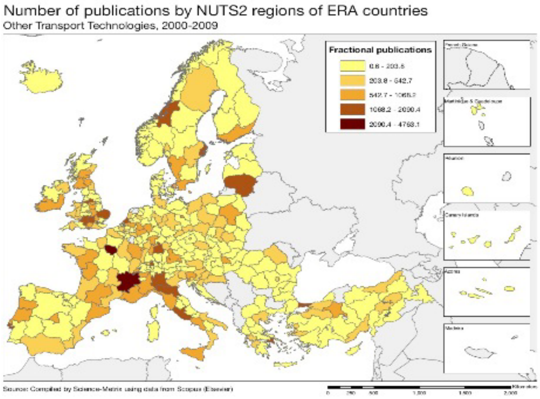
The graph shows that Lithuania's performance faces challenges in all four dimensions (human resources, scientific production, technology development, and innovation), for most of the main R&I indicators. Particular strengths are the number of new graduates in science and engineering (S&E) per population aged 25-34, the FP7 funding received compared to total R&D expenditure in Lithuania (at EU average), and the financing of business R&D expenditure from abroad (mainly EU Structural funds). The level of patenting activities and the level of public-private collaboration provide room for improvement, although business financing of university research has appeared recently to be relatively strong.

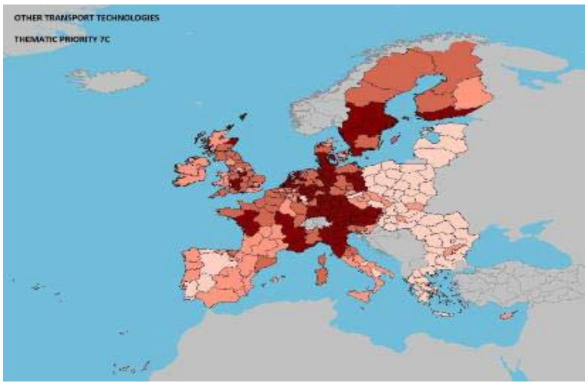
This leads to two observations: (i) Lithuania's R&D relies to a larger extent than the EU average on EU funds, be it Structural Funds or FP7 funds; (ii) a large share of the young population receives tertiary education in S&E in Lithuania, which is also reflected in the good share of total knowledge-intensive activities in total employment in Lithuania (close to the EU average). However, when it comes to doctoral level, the number of new doctoral graduates per thousand population aged 25-34 is considerably below the EU average, an indication that doctoral studies and the research system in Lithuania are less attractive for students.

***Lithuania's scientific and technological strengths at European level***

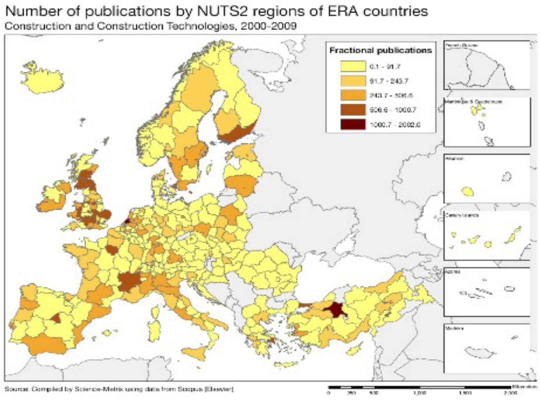
The maps below illustrate three key science and technology areas where Lithuania has real strengths in a European context. The maps are based on the number of scientific publications and patents produced by authors and inventors based in the regions.

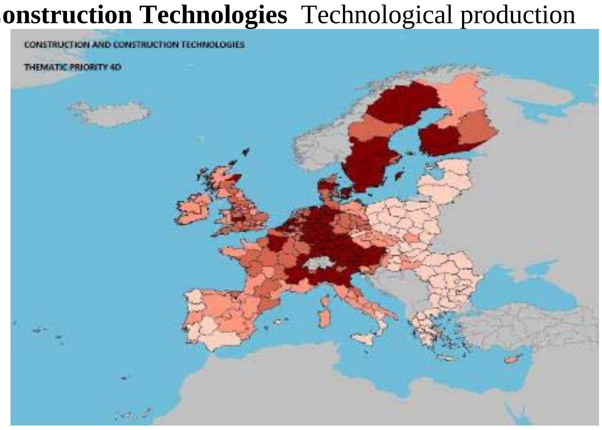
Scientific production **Other Transport Technologies** Technological production



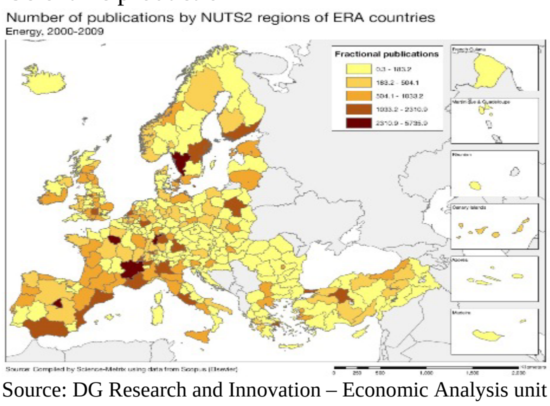


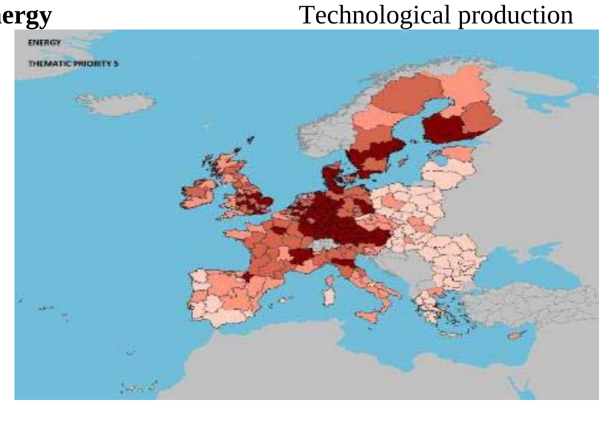

Scientific production **Construction and Construction Technologies** Technological production






Scientific production **Energy** Technological production






Source: DG Research and Innovation – Economic Analysis unit
Data: Science Metrix using Scopus (Elsevier), 2010; European Patent Office, patent applications, 2001-2010

In terms of volume of scientific publications, Lithuania performs best in other transport (i.e. transport other than automobiles and aeronautics) technologies. In this thematic area, Lithuania's volume of scientific publications is among the highest of all NUTS 2 regions in Europe (the country of Lithuania is classified as a NUTS 2 region). In construction technologies and in energy, Lithuania's volume of scientific publications is approximately in the median of NUTS 2 regions. In all other thematic areas, Lithuania is among the regions of Europe with low levels of scientific publishing. Patenting activity[3] in Lithuania is extremely low and does not show any statistically significant technological

[3] At the European Patent Office.

specialisation. In all thematic areas, the volume of patents invented in Lithuania places Lithuania among the NUTS 2 regions with the lowest volumes of patents in Europe.

***Policies and reforms for a more efficient science and technology system***

Reforms of the science base in Lithuania started to be implemented only recently after several years of discussions. The on-going reforms are far-reaching and on the whole drive the research system towards what is accepted as international good practices. Autonomy and a new mode of governance are given to universities. The network of public research institutions has been re-organised and rationalised. The share of project-based funding has considerably increased and institutional funding is increasingly allocated in relation to the performance of the research institutions. Researchers' salaries have increased and dedicated schemes to attract local and international talents are now implemented. Most importantly, the creation and development of five clusters (called "Valleys") integrating higher-education institutions, research institutions and businesses in identified scientific and technology areas is meant to increase linkages between higher education, science and businesses and improve knowledge transfer and the valorisation of research results in the country.

Lithuania's R&I strategy is described in the 2010-2020 National Innovation Strategy adopted in 2010. It contains an analysis of strengths, weaknesses, opportunities and threats to the national R&I system and proposes a vision and a series of objectives for the system. From the thematic point of view, however, the Strategy cannot be considered a specialisation strategy. Specialisation features more clearly in the 5 Joint Research Programmes in 5 "R&D and economic sectors" which cover all R&D activities[4], the 5 thematic Valleys, the 12 National Integrated Programmes in 12 knowledge-intensive economic sectors, and the 6 National Science Programmes in 6 scientific fields. The Structural Funds are used extensively in particular for the construction of the Valleys. Through these thematic efforts, Lithuania aims both to build on its RDI strengths and to develop its research and innovation capacity in some key high-tech areas.

Government policy towards trans-national collaboration, internationalisation of science and opening the national research system to researchers from other countries is still under-developed. The lack of policy attention to opening up the national research system stems from the need to first address the national problems related to unattractive career paths for researchers and limited research capacity. Also, some ERA-related policies and objectives, such as increasing the mobility of researchers, are seen as a threat to the weaker research and innovation systems of countries like Lithuania.

Joint design and coordination of programmes remains low on the political agenda but nevertheless exists. The Baltic Sea Region Starts programme is aimed at fostering R&D and business-related trans-national collaborations of clusters through networks of SMEs. In the context of this programme, StarDust runs 5 trans-national pilot projects on clean water, well-being and health, sustainable transport, digital business and services, and design of living spaces. A financial mechanism agreed with Norway, supports Lithuania's Green Innovation Programme which is focused on SMEs.

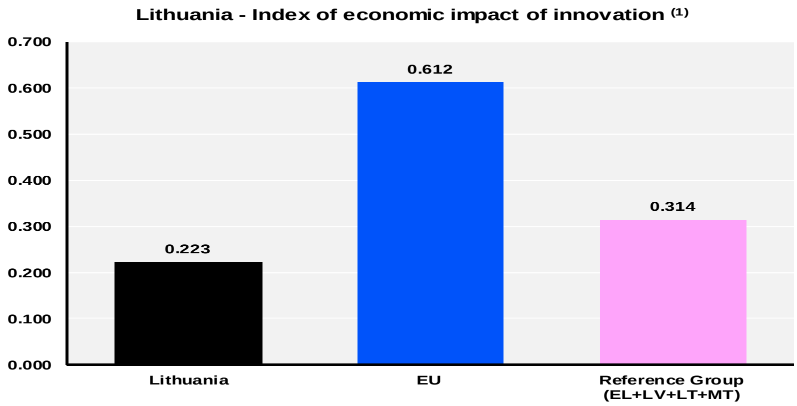
The country's involvement in existing international infrastructures is modest. Regarding the promotion of the research system's attractiveness for non-national researchers, some measures have been taken. In 2010 the Lithuanian Research Council started implementing the Global Grant Scheme, which is for the first time available to non-national world class researchers. Within the Researchers' Careers Programme, several schemes are implemented to encourage the return of Lithuanian researchers from abroad and to attract foreign researchers.

Public procurement of innovative products and services is being developed. A new programme to partly finance the recruitment of scientists in firms has been launched. Measures have been taken to both facilitate and lower the costs of starting up new businesses. These measures include, in particular, business vouchers and a new legal entity called "small partnership". Measures have also been taken to improve the business environment and reduce the administrative burden of firms.

[4] Material, physical and chemical technologies; engineering and ICT; biomedicine and biotechnologies; natural resources and agriculture; creative and cultural industries

***Economic impact of innovation***

The index below is a summary index of the economic impact of innovation composed of five of the Innovation Union Scoreboard's indicators[5].




*Source:* DG Research and Innovation - Economic Analysis Unit (2013)
*Data:* Innovation Union Scoreboard 2013, Eurostat
*Note:* (1) Based on underlying data for 2009, 2010 and 2011.

According to this index, the economic impact of innovation in Lithuania is below its reference group, much below the EU average. Among the five indicators of this index, Lithuania's performance is particularly low in patent inventions, knowledge-intensive services exports and sales of new-to-market and new-to-firm innovations. One key factor to increase the economic impact of innovation is of course the structural change that allows innovation-driven growth. High-growth innovative firms in particular play a catalytic role in this respect.

Over the last years, Lithuania has put in place a number of measures to improve the situation. Support for research and innovation activities in SMEs relies on the R&D tax credit, an intensive use of Structural Funds through a large and diversified set of schemes and instruments, support for the formation of clusters, public support of enterprises for IP protection costs, innovation vouchers to buy R&D from public research performers, and the development of the Valleys that are expected to provide a stimulating environment and networks for new innovative firms. Six agencies are active in the public support of innovation and businesses[6]. The abundance of support schemes, instruments and agencies might need to be rationalized and simplified.

Developing clusters that integrate higher education institutions, research institutions and firms is at the centre of innovation policy in Lithuania, involving in particular the 5 Valleys mentioned above in broadS&T areas. The objectives of the Valleys are to strengthen the public infrastructures for R&D and higher-education, to concentrate human resources geographically and to strengthen public-private cooperation. S&T parks are created in the Valleys to act as a link between businesses and public laboratories by providing a number of innovation services and infrastructures, in particular in relation to knowledge transfer and intellectual property rights. In addition, a new pilot scheme to launch joint public-private projects is being implemented by MITA.

Currently, a barrier to the creation of innovative firms is the difficulty that individuals have in financing the prototyping and business plan design phase in order to be able to solicit finance from private investors for the creation of new innovative businesses. Also, in order to improve the capacity of the country to exploit research results commercially, there is an urgent need to develop an entrepreneurship and innovation culture and skills in the higher education and public research sectors, as well as to provide the right incentives and training for researchers in the public sector to engage in knowledge transfer and commercialisation activities.

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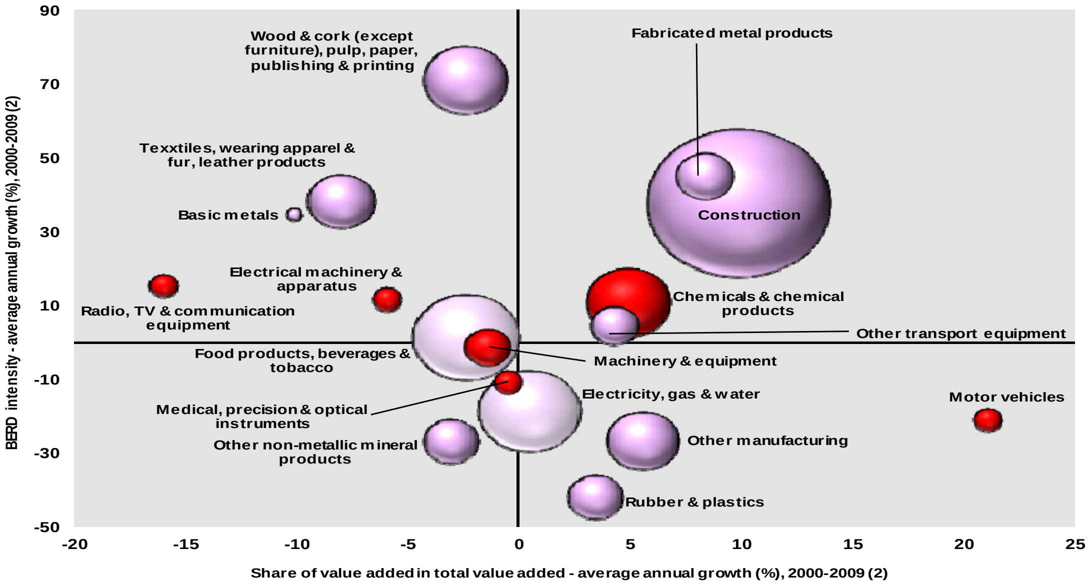
5 See Methodological note for the composition of this index.

6 The Agency for Science, Innovation and Technology (MITA), the Lithuanian Business Support Agency (administration of EU Structural Funds), Lithuanian Innovation Centre, INVEGA (loans, guarantees), Invest Lithuania (investments consultancy), Enterprise Lithuania.

*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.

**Lithuania - Share of value added versus BERD intensity - average annual growth, 2000-2009**




*Source:* DG Research and Innovation - Economic Analysis unit
*Data:* OECD
*Notes:* (1) High-Tech and Medium-High-Tech sectors are shown in red. 'Other transport equipment' includes High-Tech, Medium-High-Tech and Medium-Low-Tech.
(2) 'Textiles, wearing apparel and fur, leather products': 1997-2008; 'Food products, beverages and tobacco': 1997-2009; 'Medical, precision and optical instruments', 'Other transport equipment': 2000-2008; 'Basic metals': 2002-2007; 'Electrical machinery and apparatus', 'Radio, TV and communication equipment': 2002-2008; 'Wood and cork (except furniture), pulp, paper, printing and publishing': 2002-2009; 'Fabricated metal products', Other manufacturing': 2003-2008; 'Motor vehicles': 2004-2008; 'Construction': 2005-2008.

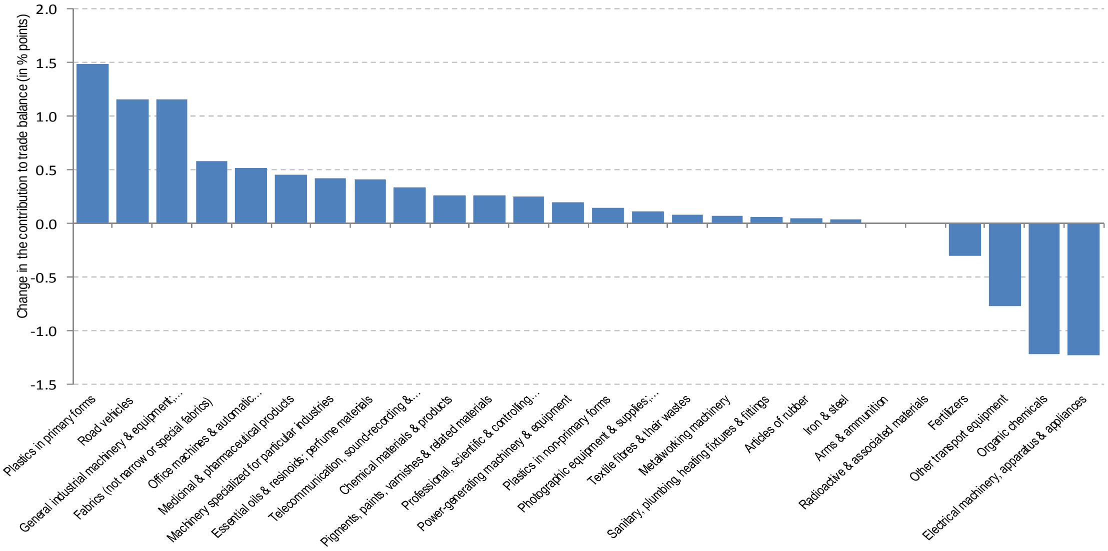
The graph above shows that Lithuania's manufacturing industry is dominated by low-tech and medium-low-tech sectors, which are intrinsically less research intensive than high-tech and medium-high-tech sectors (coloured in red above). The only sizeable medium-high-tech sector is chemicals (including pharmaceuticals). All other high-tech and medium-high-tech sectors in Lithuania are small and for some of them large part of the activity is import and re-export. This sector structure necessarily limits the overall level of business R&D intensity in the country. It should be noted that data on the effect of the crisis in 2009/10 are not yet available, notably the construction sector has declined significantly since.

Structural change towards a more research-intensive economy is mainly driven by high-tech and medium-high-tech manufacturing sectors. In Lithuania, no clear trend emerges for these sectors: the weight in the economy of two of these sectors has increased (motor vehicles and chemicals (including pharmaceuticals), but for three others the weight has decreased. Research intensity has increased in three of these sectors, while it has decreased for the two others. In total, the effect of the evolution of high-tech and medium-high-tech manufacturing sectors on overall business R&D intensity in Lithuania has been limited. The chemical sector (including pharmaceuticals) is clearly the most important medium-high-tech/high-tech sector in Lithuania, in terms both of current size and of evolution (positive evolution in research intensity and in economic weight).

***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.

**Evolution of the contribution of high-tech and medium-tech products to the trade balance for Lithuania between 2000 and 2011**




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.

HT and MT products have been making a negative contribution to the trade balance in Lithuania. This indicates a relative de-specialisation of the country in these products in international trade. However, the negativity of this contribution has continuously diminished since 2004 (except in 2011), a sign that the situation of Lithuania regarding trade in HT and MT products has improved compared to other products.

The above graph shows the HT and MT products which have most improved their contribution to the Lithuanian trade balance between 2000 and 2011: plastics in primary forms, road vehicles, and general industrial machinery and equipment. In contrast, the contribution to the trade balance of fertilizers, organic chemicals, and electrical machinery has strongly deteriorated. The previous graph showed the increasing share of the rubber and plastics and motor vehicles sectors in total value added in Lithuania and the decreasing share of the electrical machinery sector. Taken together, these results indicate the growing importance of the rubber and plastics and motor vehicles sectors in the Lithuanian economy, and conversely, a relative decline of the electrical machinery sector.

Total factor productivity (TFP) grew very rapidly in Lithuania between 2000 and 2007, dropped with the crisis in 2009 but recovered in 2010-2012 (table below). Despite the considerable 2009 fall, Lithuania is still ranked third in the EU in terms of TFP growth between 2000 and 2012. Regarding Europe 2020 targets, Lithuania's position is best in greenhouse gas emissions (although Lithuania's performance has deteriorated compared to 2000) and tertiary education rate of the population aged 30-34. Following a marked and rapid improvement between 2005 and 2008, the share of population at risk of poverty increased again during the economic crisis to 9 points above the EU average.

# Key indicators for Lithuania

| LITHUANIA | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average annual growth [1] (%) | EU average [2] | Rank within EU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENABLERS** | | | | | | | | | | | | | | | | |
| **Investment in knowledge** | | | | | | | | | | | | | | | | |
| New doctoral graduates (ISCED 6) per thousand population aged 25-34 | 0.87 | 0.53 | 0.79 | 0.52 | 0.63 | 0.69 | 0.71 | 0.81 | 0.81 | 0.87 | 0.88 | 0.92 | : | 0.5 | *1.69* | 20 |
| Business enterprise expenditure on R&D (BERD) as % of GDP | 0.13 | 0.19 | 0.11 | 0.14 | 0.16 | 0.15 | 0.22 | 0.23 | 0.19 | 0.20 | 0.23 | *0.24* | : | 6.0 | *1.26* | 22 |
| Public expenditure on R&D (GOVERD + HERD) as % of GDP | 0.46 | 0.47 | 0.55 | 0.53 | 0.59 | 0.60 | 0.57 | 0.58 | 0.61 | 0.63 | 0.56 | *0.68* | : | 3.6 | *0.74* | 11 |
| Venture Capital as % of GDP | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| **S&T excellence and cooperation** | | | | | | | | | | | | | | | | |
| Composite indicator of research excellence | : | : | : | : | : | 12.2 | : | : | : | : | 13.9 | : | : | 2.6 | 47.9 | 26 |
| Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country | 5.3 | 3.6 | 3.2 | 3.3 | 4.9 | 3.5 | 5.5 | 5.7 | 6.0 | : | : | : | : | 1.6 | 10.9 | 20 |
| International scientific co-publications per million population | 77 | 64 | 80 | 109 | 141 | 164 | 174 | 192 | 213 | 224 | 219 | 265 | : | 11.9 | 300 | 23 |
| Public-private scientific co-publications per million population | : | : | : | : | : | : | : | 4 | 5 | 7 | 8 | 10 | : | 28.2 | 53 | 22 |
| **FIRM ACTIVITIES AND IMPACT** | | | | | | | | | | | | | | | | |
| **Innovation contributing to international competitiveness** | | | | | | | | | | | | | | | | |
| PCT patent applications per billion GDP in current PPS€ | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.4 | 0.3 | 0.4 | 0.6 | 0.3 | : | : | : | 3.7 | 3.9 | 25 |
| License and patent revenues from abroad as % of GDP | : | : | : | : | 0.003 | 0.01 | 0.002 | 0.0004 | 0.002 | 0.001 | 0.002 | 0.002 | : | -9.9 | 0.58 | 27 |
| Sales of new to market and new to firm innovations as % of turnover | : | : | : | : | 9.7 | : | 12.4 | : | 9.6 | : | 6.6 | : | : | -6.1 | 14.4 | 26 |
| Knowledge-intensive services exports as % total service exports | : | : | : | : | 14.9 | 14.3 | 12.3 | 11.8 | 12.2 | 15.4 | 13.7 | : | : | -1.4 | 45.1 | 25 |
| Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products | -5.87 | -7.44 | -6.60 | -6.58 | -7.56 | -5.79 | -5.83 | -5.11 | -2.30 | -1.62 | -1.10 | -1.27 | : | - | 4,20 [3] | 21 |
| Growth of total factor productivity (total economy) - 2000 = 100 | 100 | 107 | 111 | 118 | 123 | 126 | 129 | 132 | 130 | 114 | 118 | 122 | 123 | 23 [4] | 103 | 3 |
| **Factors for structural change and addressing societal challenges** | | | | | | | | | | | | | | | | |
| Composite indicator of structural change | 21.6 | : | : | : | : | 27.3 | : | : | : | : | 35.3 | : | : | 5.0 | 48.7 | 21 |
| Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64 | : | : | : | : | : | : | : | : | 7.5 | 8.1 | 8.7 | 8.9 | : | 6.0 | 13.6 | 25 |
| SMEs introducing product or process innovations as % of SMEs | : | : | : | : | 25.3 | : | 19.7 | : | 21.9 | : | 21.4 | : | : | -2.8 | 38.4 | 21 |
| Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | : | : | : | : | -8.8 | 0.39 | 24 [5] |
| Health-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 | 0.06 | 0.04 | : | : | : | : | 19.3 | 0.52 | 23 |
| **EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES** | | | | | | | | | | | | | | | | |
| Employment rate of the population aged 20-64 (%) | 65.6 | 64.2 | 67.2 | 68.9 | 69.0 | 70.6 | 71.6 | 72.9 | 72.0 | 67.2 | 64.4 | 67.2 | : | 0.2 | 68.6 | 17 |
| R&D Intensity (GERD as % of GDP) | 0.59 | 0.67 | 0.66 | 0.67 | 0.75 | 0.75 | 0.79 | 0.81 | 0.80 | 0.84 | 0.80 | *0.92* | : | *4.1* | *2.03* | 19 |
| Greenhouse gas emissions - 1990 = 100 | 39 | 41 | 42 | 42 | 44 | 46 | 47 | 51 | 49 | 40 | 42 | : | : | 3 [6] | 85 | 1 [7] |
| Share of renewable energy in gross final energy consumption (%) | : | : | : | : | 17.1 | 16.9 | 16.9 | 16.6 | 17.9 | 20.0 | 19.7 | : | : | 2.4 | 12.5 | 10 |
| Share of population aged 30-34 who have successfully completed tertiary education (%) | 42.6 | 21.2 | 23,4 [8] | 25.2 | 31.1 | 37.9 | 39.4 | 38.0 | 39.9 | 40.6 | 43.8 | 45.4 | : | 7.6 | 34.6 | 7 |
| Share of population at risk of poverty or social exclusion (%) | : | : | : | : | : | 41.0 | 35.9 | 28.7 | 27.6 | 29.5 | 33.4 | 33.4 | : | -3.4 | *24.2* | 24 [7] |

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

(4) The value is the difference between 2012 and 2000.

(5) Rank in 2007.

(6) The value is the difference between 2010 and 2000. A negative value means lower emissions.

(7) The values for this indicator were ranked from lowest to highest.

(8) Break in series between 2002 and the previous years. Average annual growth refers to 2002-2011.

(9) Values in italics are estimated or provisional.

## Luxembourg

*The challenge of fostering the emergence of a genuine R&I ecosystem*

***Summary: Performance in research, innovation and competitiveness***

The indicators in the table below present a synthesis of research, innovation and competitiveness in Luxemburg. 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*<br>2011: 1.43% (EU: 2.03%; US: 2.75%)<br>2000-2011: -1.34% (EU: +0.8%; US: +0.2%) | *Excellence in S&T*<br>2010:19.84 (EU:47.86; US: 56.68)<br>2005-2010: +1.29% (EU: +3.09%;US: +0.53) |
| **Innovation and Structural change** | *Index of economic impact of innovation*<br>2010-2011: 0.589 (EU: 0.612) | *Knowledge-intensity of the economy*<br>2010:64.75 (EU:48.75; US: 56.25)<br>2000-2010: +1.4% (EU: +0.93%; US: +0.5%) |
| **Competitiveness** | *Hot-spots in key technologies*<br>Space, Automobiles | *HT + MT contribution to the trade balance*<br>2011: -3.35% (EU: 4.2%; US: 1.93%)<br>2000-2011: n.a. (EU: +4.99%; US:-10.75%) |

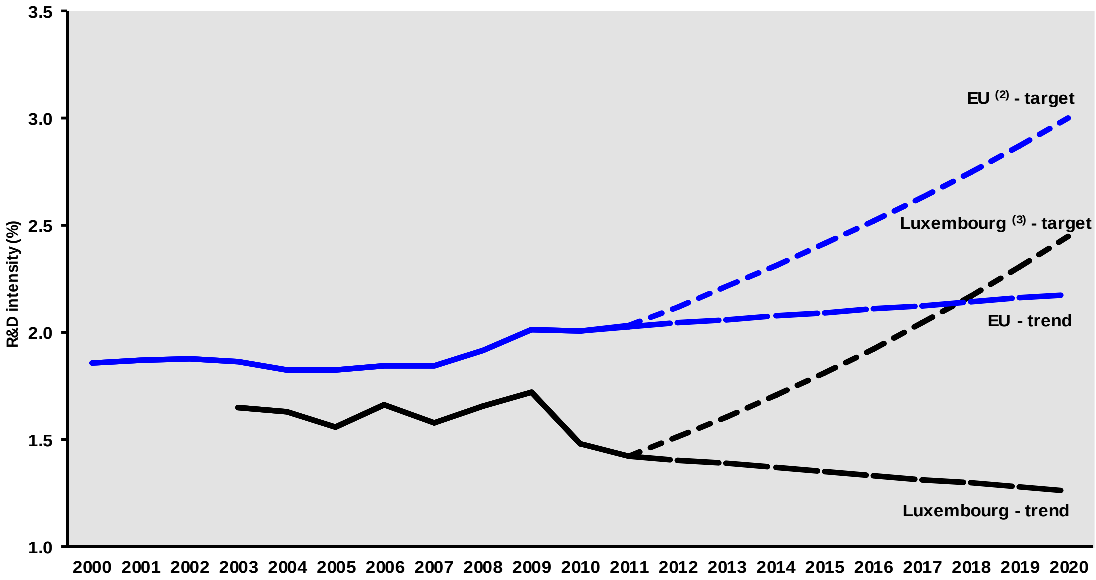
Luxembourg is rapidly building up its public research capacities, from a situation where, 25 years ago, the public research system was non-existent - the oldest public research centres were set up in 1987 and the University of Luxembourg was established in 2003. Public sector R&D intensity has steadily increased from 0.12% of GDP in 2000 to 0.45% of GDP in 2011 but remains well below the EU average of 0.74%. Luxembourg's scientific performance as measured by the share of its scientific publications which are among the top 10% most cited publications worldwide (10.1%, not far from the EU average of 10.9%) is impressive considering that its public research system has only been in existence since the mid-1980s.

However, as reflected in the decrease of business R&D intensity (from 1.53% in 2000 to 0.98% in 2011) and in the limited level of cooperation between public research institutions and firms, the Luxembourgish research and innovation ecosystem remains very weak. Its public components are not yet able to play any decisive role in fostering innovation-led growth. While the prosperity of the Luxembourgish economy in the last decades has been based on the expansion of the financial sector, its large dependence on this sector is a strong structural risk. In addition to its "sovereignty niches" on which the financial sector expansion is based, the Grand-Duchy crucially needs to develop "competence niches" as a springboard for innovation-led growth.

The Government's resolve to make investment in RDI part of a long-term policy for Luxembourg's economic development and diversification has been translated into continued budgetary efforts as shown by an increase of 38% in real terms of the government budget allocation to R&D between 2008 and 2011. R&D project funding targets thematic priorities selected through a foresight exercise. Many actions are developed to foster public-private cooperation and more generally business R&D and innovation, including for instance a cluster programme, the setting up of business incubators, and the specification of IP/spin-off requirements in the performance contracts of public research organisations.

*Investing in knowledge*

**Luxembourg - R&D intensity projections, 2000-2020 (1)**




*Source:* DG Research and Innovation - Economic Analysis Unit
*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 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) LU: This projection is based on a tentative R&D intensity target of 2.45% for 2020.

Luxembourg is not at all on track to reach its R&D intensity target for 2020 of 2.3% – 2.6%, as its R&D intensity is on a declining trend. This declining trend is explained by the sharp decrease in business R&D intensity (from 1.53% of GDP in 2000 to 0.98% in 2011). Public sector R&D intensity on the contrary steadily increased from 0.12% in 2000 to 0.45% in 2011. This fourfold increase reflects the willingness of the Grand-Duchy to build up its public research capacities from a situation where, 25 years ago, the public research system was in fact non-existent. In fact, the first public research centres were created in 1987 and the University of Luxembourg was established in 2003. These efforts have continued in recent years as shown by an increase of 38% in real terms of the government budget for R&D between 2008 and 2011.

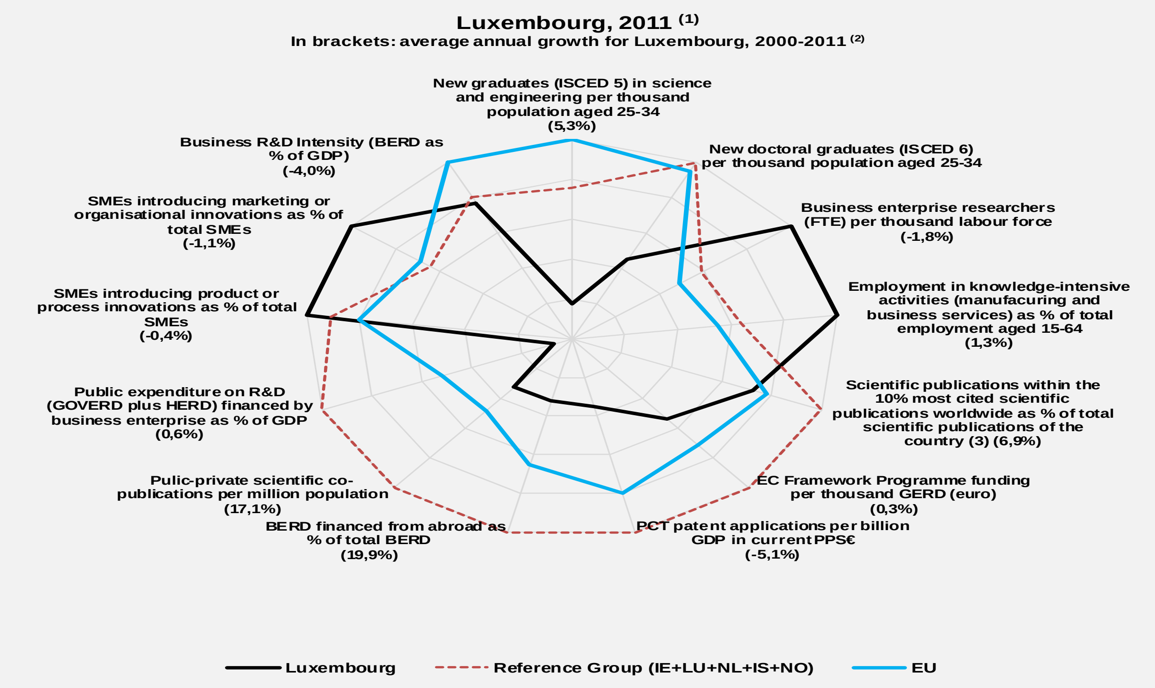
If Luxemburg is to reach its 2020 R&D intensity target, the contribution from the private sector should increase. Only 45% of Luxembourgish private investment in R&D is made in the manufacturing sector, compared to 23% in financial services and about 30% in other services[7]. The level of R&D investment in financial services tripled between 2003 and 2007; however thereafter it dropped by 27% between 2007 and 2009.

Private and public R&D investment can also receive support by co-funding from the European budget, in particular through successful applications to the seventh Framework Program for research and the Structural Funds. Up to early 2012, 124 Luxembourgish participants had been partners in an FP7 project, with a total EC financial contribution of € 31 million. This represents € 61 per head of population, which is 35% higher than the EU average. The success rate of Luxembourgish applicants is 19.5%, in line with the EU average success rate of 21.6%. Moreover, over the FEDER programming period 2007-2013, € 19 million (37.7% of the total FEDER fund for Luxembourg) was allocated to research, innovation and entrepreneurship in Luxembourg.

[7] However it must be borne in mind that these other services include *R&D services* to the manufacturing sector.

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

The graph below illustrates the strengths and weaknesses of Luxemburg'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.

The situation of the Luxembourgish research system is marked by the contrast between public sector R&D and private sector R&D:

- The Luxembourgish public research system is very young, but is developing fast (see section *Investing in knowledge* above). Its scientific performance as measured by the share of its scientific publications which are among the top 10% most cited scientific publications worldwide[8] is positive and the share of business enterprise researchers is impressive. This is mainly due to a policy of attracting outstanding foreign researchers to work in Luxembourg.
- Taking into account the structure of the Luxembourgish economy (marked by the lowest share of manufacturing in all EU Member States), Luxembourg business R&D intensity (close to the EU average) has to be considered as being in fact relatively high. This high level is explained by the combination of significant R&D activities in the financial sector with the long-standing presence in the Grand-Duchy of several large R&D centres of multinational manufacturing companies (such as ArcelorMittal, Goodyear and DuPont de Nemours) and of smaller "home-grown" technologically innovative companies (such as IEE, Paul Wurth and Rotarex).

The performance of Luxembourg on the two indicators on cooperation between public research institutions and firms is well below the EU average, reflecting the current disconnections between the long–standing private sector R&D centres and a public research system which is in the course of development.

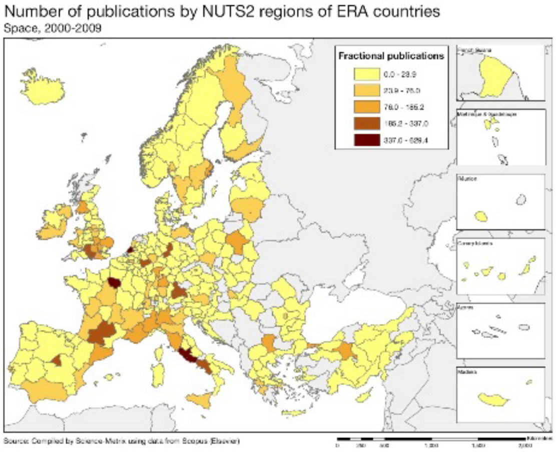
[8] 10.1%, not far from the EU average of 10. 9% and similar to the performances of France and Italy

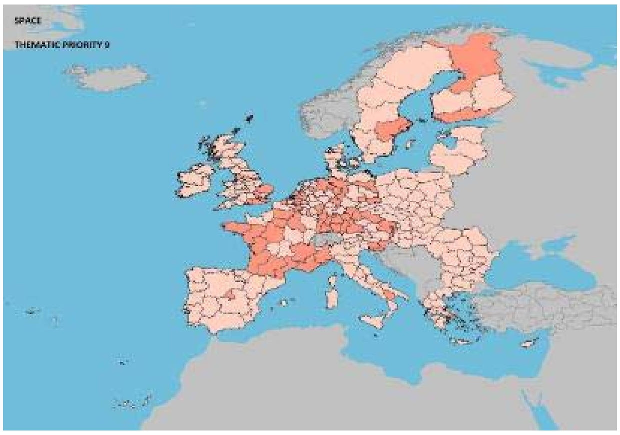
### *Luxembourg's scientific and technological strengths*

The maps below illustrate six key science and technology areas where Luxembourg has real strengths in a European context. The maps are based on the number of scientific publications and patents produced by authors and inventors based in the regions.

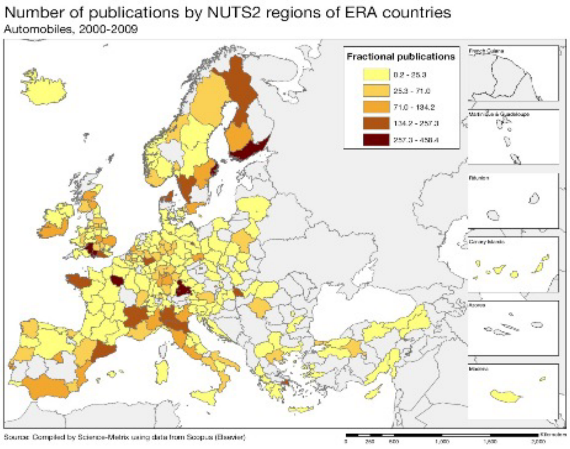
*Strengths in science and technology at European level*

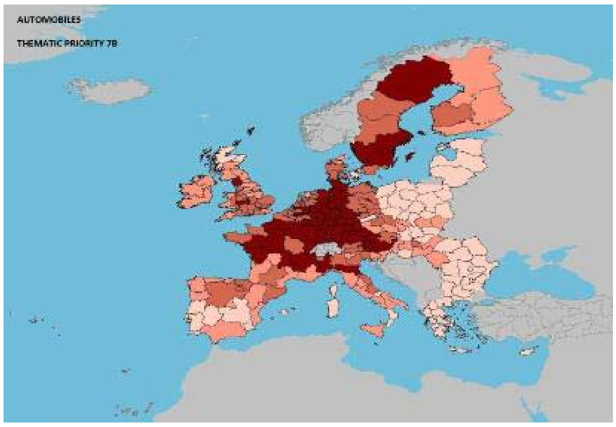
***Scientific production*** **Space** ***Technological production***



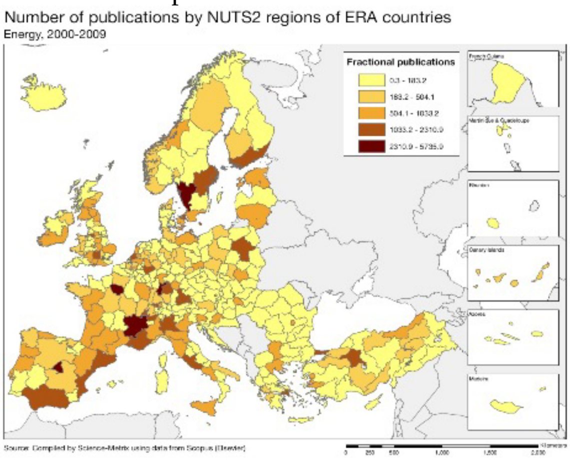



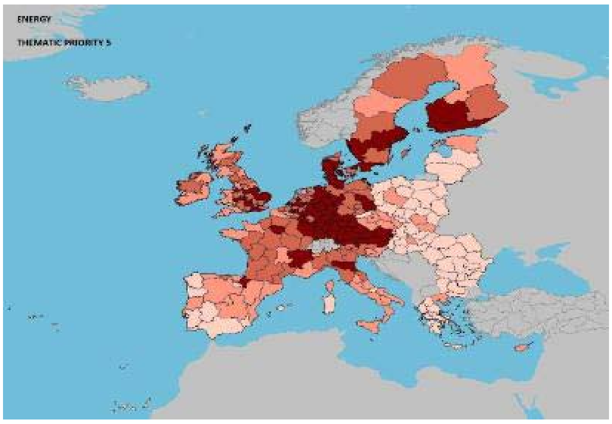

***Scientific production*** **Automobile** ***Technological production***



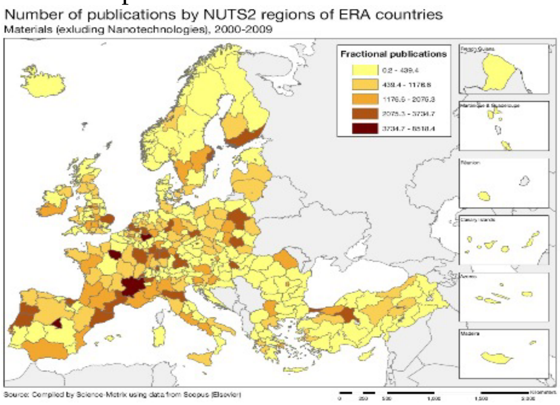

Scientific production **Energy** Technological production

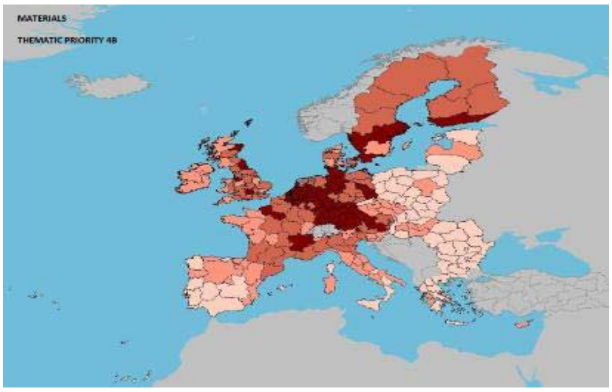


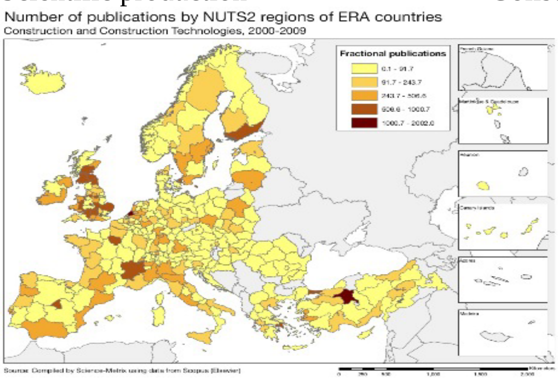

Source: DG Research and Innovation – Economic Analysis unit
Data: Science Metrix using Scopus (Elsevier), 2010; European Patent Office, patent applications, 2001-2010

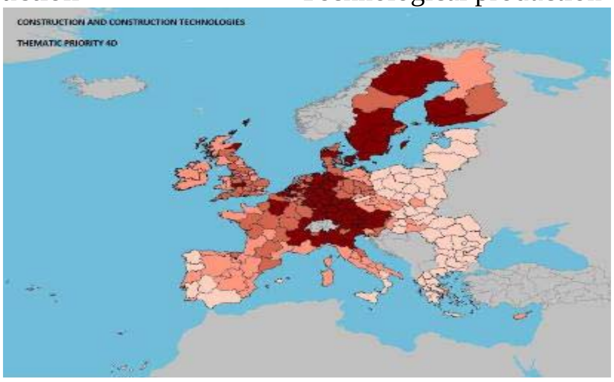
Scientific production **Materials** Technological production



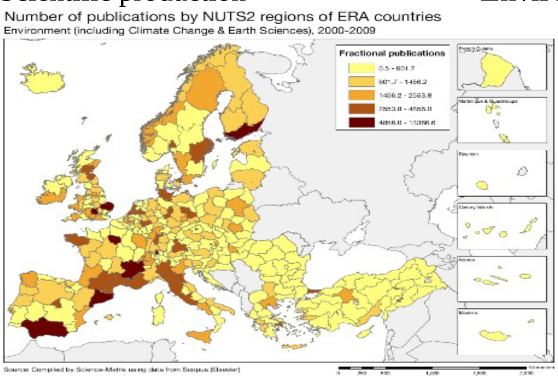



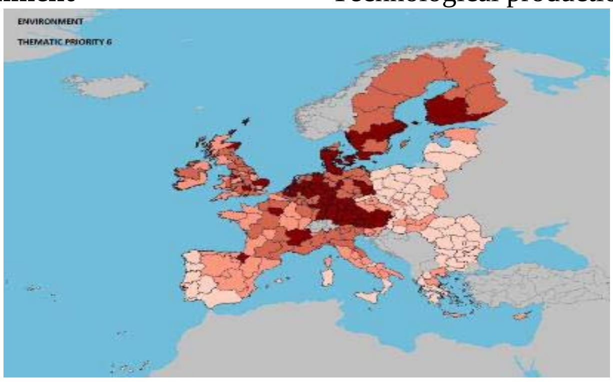

Scientific production **Construction** Technological production




Scientific production **Environment** Technological production




Due to the limited size of its public research system, Luxembourg does not have any visible strengths on the "Scientific production" maps. However, specialisation indices calculated on the basis of the number of scientific publications (classified by FP themes) reveal three areas of specialisation for Luxembourg: ICT (specialisation index of 2.67), socio-economic sciences (specialisation index of 1.92) and environment (specialisation index of 1.65).

Based on EPO patents classified in the same way, Luxembourg has very strong specialisation in two areas:

- Space (RTA[9]: 5.7): The creation in Luxembourg in 1985 of the Société Européenne des Satellites (SES), a landmark for satellite telecommunications and now a major player in this sector, has led to the development of a Space-related industrial cluster in Luxembourg.
- Automobiles (RTA: 5.25): This reflects the presence of a very significant cluster of technologically innovative companies supplying the automotive industry (such as IEE and Delphi Automotive Systems).

[9] Revealed Technological Advantage

Other areas of technological specialisation are energy (RTA: 1.63), materials (RTA: 1.49), construction (RTA: 1.45) and environment (RTA: 1).

***Policies and reforms for research and innovation***

The steady increase in the public R&D budget reflects the government's resolve to make investment in RDI part of a long-term policy for Luxembourg's economic development and diversification. Luxembourg’s national RDI strategy is founded on multi-annual planning and focuses on targeted priorities. Following the establishment of the public research centres (PRCs) and of the University between 1987 and 2003, key steps have been the OECD review of Luxembourg’s national research system in 2006 and a Foresight Study in 2006-2007 that identified the thematic domains which now make up the CORE public research funding programme. A major result of the OECD review was the recommendation to implement performance contracts between the Ministry and the National Research Fund (FNR), the University, the PRCs and Luxinnovation. A second set of contracts was executed for the period of 2011-2013, following the initial set for 2008-2010. The CORE programme 2008-2013 of the FNR National concentrates its funding on five priority fields: innovation in services, sustainable resource management, new functional and intelligent materials and surfaces and new sensing applications, biomedical sciences, and societal changes for Luxembourg. In 2011, the programme funded 28 projects at a cost of € 16.2 million.

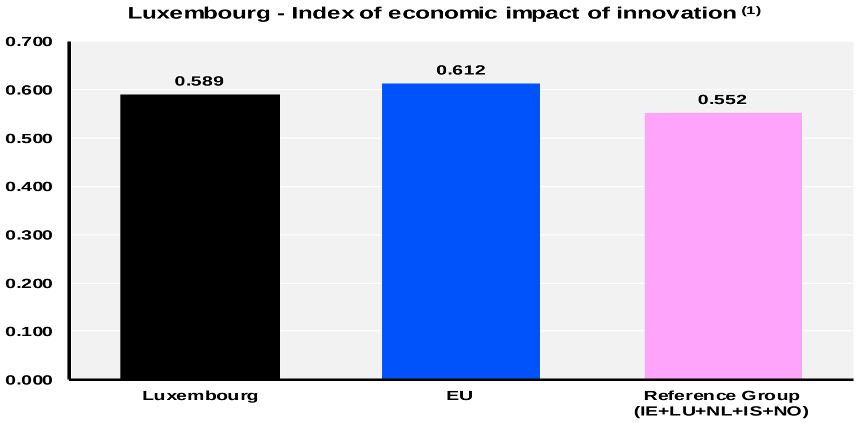
Human resources are a key focus of Luxembourgish research policy. At the end of 2011, the aid programme for research training of the FNR (AFR 2008-2013) had supported 442 and 106 young researchers in their PhD and post-PhD studies respectively. Programmes ATTRACT and PEARL 2008-2013 of FNR aim at attracting young and top researchers to work in the country; the cost involved was € 3.8 million in the years 2008-2010 with € 13.7 million foreseen for 2011-2013.

Many initiatives have been developed to foster private R&D, public-private cooperation, innovation and entrepreneurship:

- The law of 5 June 2009 provides state aid for the private sector with a special focus on SMEs and services sector innovation. The law of 18 February 2010 provides public aid to the private sector in the field of eco-innovation. The law on IP tax incentives (21 December 2007) encourages companies to patent and license the results of their R&D work, and also fosters spin offs and start-ups based on IP.
- Recent reform measures have encouraged the development of small innovative companies. These measures include: IP/spin-off requirements in PRCs performance contracts, the creation of a Master's degree in Entrepreneurship and Innovation, the setting up of business incubators, the creation of a partnership with a business accelerator located in Silicon Valley (Plug and Play Tech Centre) in order to help start-ups in Luxembourg to gain access to the United States market.
- The massive (€565 million) infrastructure project Cités des Sciences aims at reinforcing relations between research, education and innovation, by hosting on one site all the major public R&D institutes of Luxembourg, as well as private and start-up companies, a new technical school, the university campus, the National Archives and some cultural centres. It will provide facilities for public-private partnerships and a business incubator.
- Luxembourg has set up a cluster programme around five thematic clusters (in materials, ICT, space, bio-health, eco-innovation).
- The Luxembourgish government founded a Luxembourg Future Fund to support the diversification and sustainable development of the economy. The Fund will invest directly or via other funds in innovative SME's in a start-up or development phase in technology sectors (ICT, clean technologies…). The Luxembourg state will invest € 120 million in the Fund via the Société Nationale de Crédit et d’Investissement and the European Investment Fund will contribute a further € 30 million. In addition, the government will invest in health sciences and technology via an existing private fund.

### *Economic impact of innovation*

The index below is a summary index of the economic impact of innovation composed of five of the Innovation Union Scoreboard's indicators[10].




*Source:* DG Research and Innovation - Economic Analysis Unit (2013)
*Data:* Innovation Union Scoreboard 2013, Eurostat
*Note:* (1) Based on underlying data for 2009, 2010 and 2011.

The share of the Grand-Duchy's employment in knowledge-intensive activities (24. 8 %) is the highest of all EU Member States and nearly the double of the EU average. The share of knowledge-intensive services in services export is also the highest of all EU Member States. These situations are due to a very strong specialisation in the financial services sector, which has been Luxembourg's main growth engine since the early 1980s. Its expansion has allowed the Luxembourgish economy to flourish despite the decline of its key manufacturing sectors, especially the steel industry. The limited role of high-tech and medium-tech manufacturing in the Luxembourgish economy explains the low scores of the Grand-Duchy on the other indicators parts of the index. Manufacturing represents only 6.5% of total value added, the lowest share of all EU Member States.

It is however uncertain to what extent the financial sector will be able to continue to play such an important role in driving Luxembourgish prosperity in the future. Even if financial activities around the world would remain as buoyant after the crisis as they were before, the question arises as to whether Luxembourg will be able to preserve and continue to develop the competitive advantages in terms of fiscal, legislative and regulatory environment, that have made it an attractive environment for this type of activity. Thus, although the Luxembourgish financial sector is relatively healthy, the large dependence of the economy on this industry is a strong structural risk.

As indicated by the OECD in its 2007 review of Luxembourg, it is therefore crucial for the Grand-Duchy that, in addition to its "sovereignty niches" on which the financial sector expansion is based, it also develops "competence niches" as a springboard for innovation-led growth, both in areas of existing activities or in new areas that can contribute to the much-needed diversification of its economy.

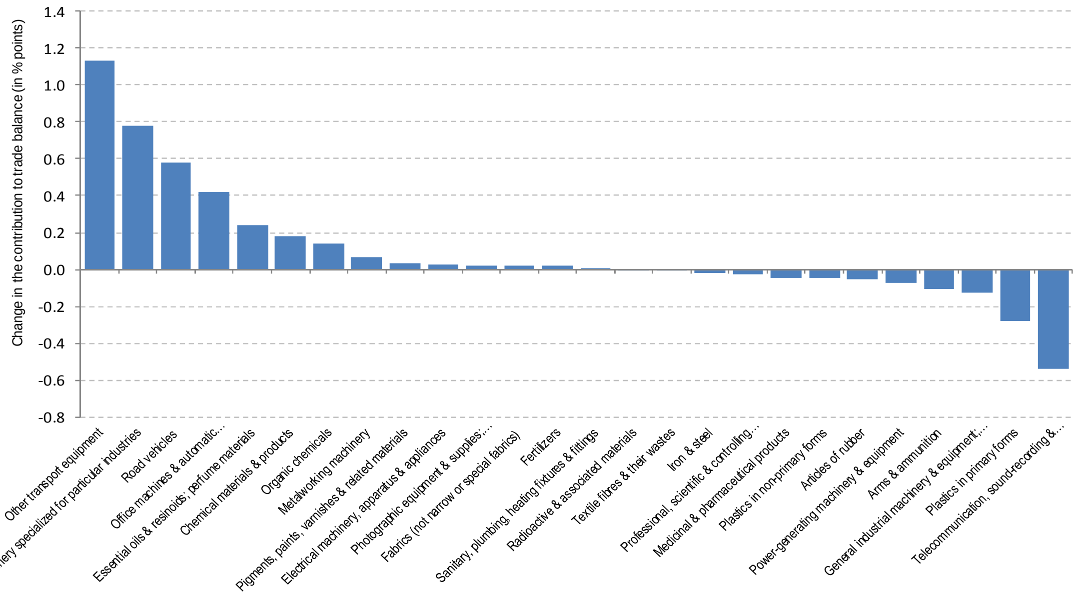
The development of a top-quality public research base is a key building block for such a strategy. Good framework conditions for innovation are also required. The situation of the Grand-Duchy in this regard is relatively good. Credit tightening has been less pronounced in Luxembourg than elsewhere in the Eurozone and SMEs continued to enjoy good access to finance. In Luxembourg early stage venture capital investment as a % of GDP is close to the EU average. Luxembourg has the third highest score of the EU Member States in the "International property rights index" compiled by the Property Rights Alliance.

10 See Methodological note for the composition of this index.

### *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 in these products.

**Evolution of the contribution of high-tech and medium-tech products to the trade balance for Luxembourg between 2000 and 2011**




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.

Although its goods balance is structurally in deficit, Luxembourg has a large trade surplus thanks to its very strong position in financial services, especially in asset management. Thanks to the continuing expansion of its exports of financial services, Luxembourg has gained market shares overall since 2000. Luxembourg also gained market shares in non-financial services, while it lost shares in goods markets[11]. This has led to a situation where the fees earned by asset managers alone constitute around half the total of Luxembourgish exports. Non-financial services represent about 30% of Luxembourgish exports, while the share of goods in Luxembourgish exports has been reduced to about 20%, down from 45% in 1995.

Luxembourg has a trade deficit in high-tech and medium-tech products which has grown slightly over the last decade. However, the evolution between 2000 and 2010 of the contribution of HT and MT products to the trade balance is positive for many product sectors, as shown in the graph above. However, taking into account the limited role the manufacturing and export of HT and MT products plays in the Luxembourgish economy, the graph above has to be interpreted with caution. For instance, the fluctuations of the trade balance in the other transport equipment category are in fact driven by the large yearly variations of the level of imports in the subcategory aircraft and associated equipment, spacecraft (including satellites) and spacecraft launch vehicle, parts thereof.

[11] Luxembourgish exports of goods increased during the first decade of the millennium by an annual average of 3.5% in value and 1.4% in volume, well below world levels.

# Key indicators for Luxembourg

| LUXEMBOURG | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average annual growth [1] (%) | EU average [2] | Rank within EU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENABLERS** | | | | | | | | | | | | | | | | |
| **Investment in knowledge** | | | | | | | | | | | | | | | | |
| New doctoral graduates (ISCED 6) per thousand population aged 25-34 | : | : | : | : | : | : | : | : | : | : | 0.81 | : | : | : | *1.69* | 22 |
| Business enterprise expenditure on R&D (BERD) as % of GDP | 1.53 | : | : | 1.47 | 1.43 | 1.35 | 1.43 | 1.32 | 1.29 | 1.31 | 1.00 | *0.98* | : | *-4.0* | *1.26* | 14 |
| Public expenditure on R&D (GOVERD + HERD) as % of GDP | 0.12 | 0.15 | : | *0.18* | 0.20 | 0.21 | 0.23 | *0.26* | 0.37 | 0,42 [3] | 0.48 | *0.45* | : | *4.0* | *0.74* | 20 |
| Venture Capital [4] as % of GDP | : | : | : | : | : | : | : | 0.11 | 0.98 | 0.22 | 0.21 | 0.52 | : | 46.1 | 0,35 [5] | 3 [5] |
| **S&T excellence and cooperation** | | | | | | | | | | | | | | | | |
| Composite indicator of research excellence | : | : | : | : | : | 18.6 | : | : | : | : | 19.8 | : | : | 1.3 | 47.9 | 22 |
| Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country | 5.9 | 6.5 | 3.1 | 4.9 | 5.4 | 7.8 | 7.7 | 9.1 | 10.1 | : | : | : | : | 6.9 | 10.9 | 13 |
| International scientific co-publications per million population | 118 | 132 | 119 | 243 | 338 | 375 | 565 | 636 | 790 | 1072 | 1257 | 1428 | : | 25.5 | 300 | 3 |
| Public-private scientific co-publications per million population | : | : | : | : | : | : | : | 19 | 25 | 30 | 33 | 36 | : | 17.1 | 53 | 11 |
| **FIRM ACTIVITIES AND IMPACT** | | | | | | | | | | | | | | | | |
| **Innovation contributing to international competitiveness** | | | | | | | | | | | | | | | | |
| PCT patent applications per billion GDP in current PPS€ | 2.8 | 1.5 | 1.5 | 1.2 | 2.0 | 1.5 | 1.7 | 1.1 | 1.7 | 1.7 | : | : | : | -5.1 | 3.9 | 14 |
| License and patent revenues from abroad as % of GDP | : | : | : | : | 0.59 | 0.78 | 0.92 | 0.77 | 0.62 | 0.75 | 0.91 | 0.78 | : | 4.1 | 0.58 | 6 |
| Sales of new to market and new to firm innovations as % of turnover | : | : | : | : | 15.6 | : | 12.4 | : | 8.9 | : | 8.3 | : | : | -10.0 | 14.4 | 21 |
| Knowledge-intensive services exports as % total service exports | : | : | : | : | 75.4 | 78.4 | 81.3 | 81.8 | 78.9 | 76.9 | 78.3 | : | : | 0.6 | 45.1 | 1 |
| Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products | -5.68 | -5.31 | -5.31 | -3.78 | -4.55 | -5.11 | -4.26 | -5.16 | -5.52 | -3.61 | -4.44 | -3.35 | : | - | 4,20 [6] | 24 |
| Growth of total factor productivity (total economy) - 2000 = 100 | 100 | 97 | 97 | 95 | 95 | 97 | 97 | 98 | 93 | 87 | 87 | 86 | 84 | -16 [7] | 103 | 27 |
| **Factors for structural change and addressing societal challenges** | | | | | | | | | | | | | | | | |
| Composite indicator of structural change | 56.3 | : | : | : | : | 59.5 | : | : | : | : | 64.7 | : | : | 1.4 | 48.7 | 2 |
| Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64 | : | : | : | : | : | : | : | : | 23.8 | 25.1 | 26.1 | 24.7 | : | 1.3 | 13.6 | 1 |
| SMEs introducing product or process innovations as % of SMEs | : | : | : | : | 49.1 | : | 44.7 | : | 41.5 | : | 47.9 | : | : | -0.4 | 38.4 | 3 |
| Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.79 | 0.29 | 0.30 | 0.43 | 0.71 | 0.55 | 0.52 | 0.23 | 0.36 | : | : | : | : | -9.3 | 0.39 | 8 |
| Health-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.01 | 0.07 | 0.30 | 0.10 | 0.18 | 0.11 | 0.15 | 0.14 | 0.16 | : | : | : | : | 42.9 | 0.52 | 16 |
| **EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES** | | | | | | | | | | | | | | | | |
| Employment rate of the population aged 20-64 (%) | 67.4 | 67.7 | 68.2 | 67.2 | 67.7 | 69.0 | 69.1 | 69.6 | 68.8 | 70.4 | 70.7 | 70.1 | : | 0.4 | 68.6 | 11 |
| R&D Intensity (GERD as % of GDP) | 1.65 | : | : | 1.65 | 1.63 | 1.56 | 1.66 | *1.58* | 1.66 | 1.72 | 1.48 | *1.43* | : | *-1.3* | *2.03* | 15 |
| Greenhouse gas emissions - 1990 = 100 | 75 | 79 | 85 | 88 | 99 | 101 | 100 | 95 | 94 | 90 | 94 | : | : | 19 [8] | 85 | 16 [9] |
| Share of renewable energy in gross final energy consumption (%) | : | : | : | : | 0.9 | 1.4 | 1.4 | 2.7 | 2.8 | 2.8 | 2.8 | : | : | 20.8 | 12.5 | 26 |
| Share of population aged 30-34 who have successfully completed tertiary education (%) | 21.2 | 23.9 | 23.6 | 17,3 [10] | 31.4 | 37.6 | 35.5 | 35.3 | 39.8 | 46,6 [11] | 46.1 | 48.2 | : | 1.7 | 34.6 | 2 |
| Share of population at risk of poverty or social exclusion (%) | : | : | : | : | 16.1 | 17.3 | 16.5 | 15.9 | 15.5 | 17.8 | 17.1 | 16.8 | : | 0.6 | *24.2* | 4 [9] |

*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 2009 and the previous years. Average annual growth refers to 2009-2011.

(4) Venture Capital includes early-stage, expansion and replacement for the period 2000-2006 and includes seed, start-up, later-stage, growth, replacement, rescue/turnaround and buyout for the period 2007-2011.

(5) Venture Capital: EU does not include EE, CY, LV, LT, MT, SI, 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 2000.

(8) The value is the difference between 2010 and 2000. A negative value means lower emissions.

(9) The values for this indicator were ranked from lowest to highest.

(10) Break in series between 2003 and the previous years.

(11) Break in series between 2009 and the previous years. Average annual growth refers to 2009-2011.

(12) Values in italics are estimated or provisional.

## Malta

*Building up a knowledge-based economy in a specialisation strategy*

***Overall performance in research, innovation and competitiveness***

The indicators in the table below present a synthesis of research, innovation and competitiveness in Malta. 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*<br>2011: 0.73% (EU: 2.03%; US: 2.75%)<br>2000-2011: +4.68% (EU: +0.8%; US: +0.2%) | *Excellence in S&T*<br>2010: 17.53 (EU:47.86; US: 56.68)<br>2005-2010: +4.07% (EU: +3.09%;US: +0.53) |
| **Innovation and Structural change** | *Index of economic impact of innovation*<br>2010-2011: 0.35 (EU: 0.612) | *Knowledge-intensity of the economy*<br>2010: 54.45 (EU:48.75; US: 56.25)<br>2000-2010: +2.67% (EU: +0.93%; US: +0.5%) |
| **Competitiveness** | *Hot-spots in key technologies*<br>ICT, Bio-medical technologies | *HT + MT contribution to the trade balance*<br>2011: 0.92% (EU: 4.2%; US: 1.93%)<br>2000-2011: -14.37% (EU: +4.99%; US:-10.75%) |

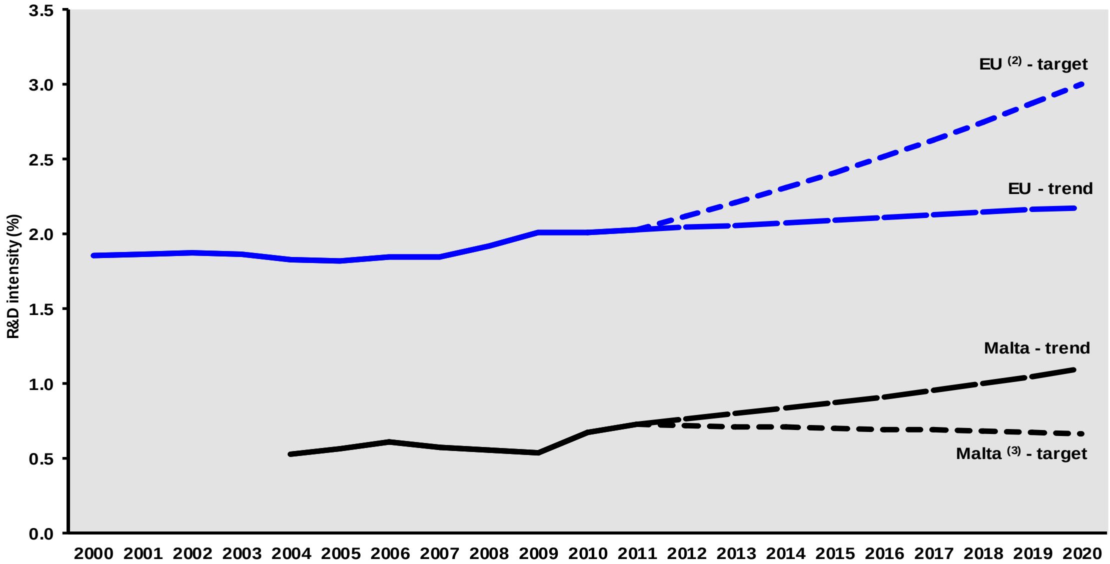
The stated aim of the Maltese government is to build a knowledge -based economy with research and innovation at its core. This can only be achieved in the long term and its success will depend on the implementation of the policies outlined in the draft National Strategic Plan for Research and Innovation -2020. However, it is clear that progress is being made. This is shown by the increase in R&D intensity from 0.63% in 2010 to 0.73% in 2011, an increase which is underpinned by significant increases in public and private expenditure on R&D. The total number of researchers (full-time equivalent) has also increased, by 19% between 2009 and 2010. Performance and economic output indicators all show positive development over the last decade, in particular the indicator on structural change of the economy which has increased at almost six times the rate of the EU average.

However, Malta remains amongst the lowest ranked Member States in some key areas. In 2010, Malta had 3.3 researchers (full-time equivalent) per thousand labour force compared to an EU average of 6.5. Only four Member States had lower values. Malta has the lowest public expenditure on R&D as % of GDP in the EU (0.25% compared to an EU average of 0.75% in 2010). Although 59% of R&D expenditure in Malta is performed by business enterprise (a share which was only slightly lower than the EU average of 62% in 2010), more than 80% of all business enterprise expenditure on R&D is spent by foreign-owned companies.

Malta's key challenges are to build up R&I capacity, to move towards a self-sustaining R&I system (which implies specialisation in order to achieve a critical mass) and to create an enabling environment for research to market, innovation and entrepreneurship, particularly for SMEs. A fundamental challenge for Malta is to stimulate indigenous private sector R&I. The strategic principles adopted to address these challenges are outlined in Malta's draft National Strategic Plan for Research and Innovation 2020. These include increased focus on priority areas, specialisation in a select number of areas of economic importance, coordinating public and private resources, expanding the science, technology, engineering and mathematics human capital base and building strong links between knowledge institutions and business.

*Investing in knowledge*

**Malta - R&D intensity projections, 2000-2020 (1)**




*Source:* DG Research and Innovation - Economic Analysis Unit
*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 2000-2011 in the the case of the EU and for 2004-2011 in the case of Malta.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) MT: This projection is based on a tentative R&D intensity target of 0.67% for 2020.

Malta's R&D intensity increased from 0.67% in 2010 to 0.73% in 2011. This means that Malta has already achieved its R&D intensity target for 2020 and if the current trend continues should reach an R&D intensity of more than 1% in 2020. The increase in R&D intensity between 2009 and 2010 was mainly due to an increase of 41% in R&D performed by the higher education sector. Funding of R&D by each of the three main sources (government, business and abroad) has increased by 20% or more between 2009 and 2010.

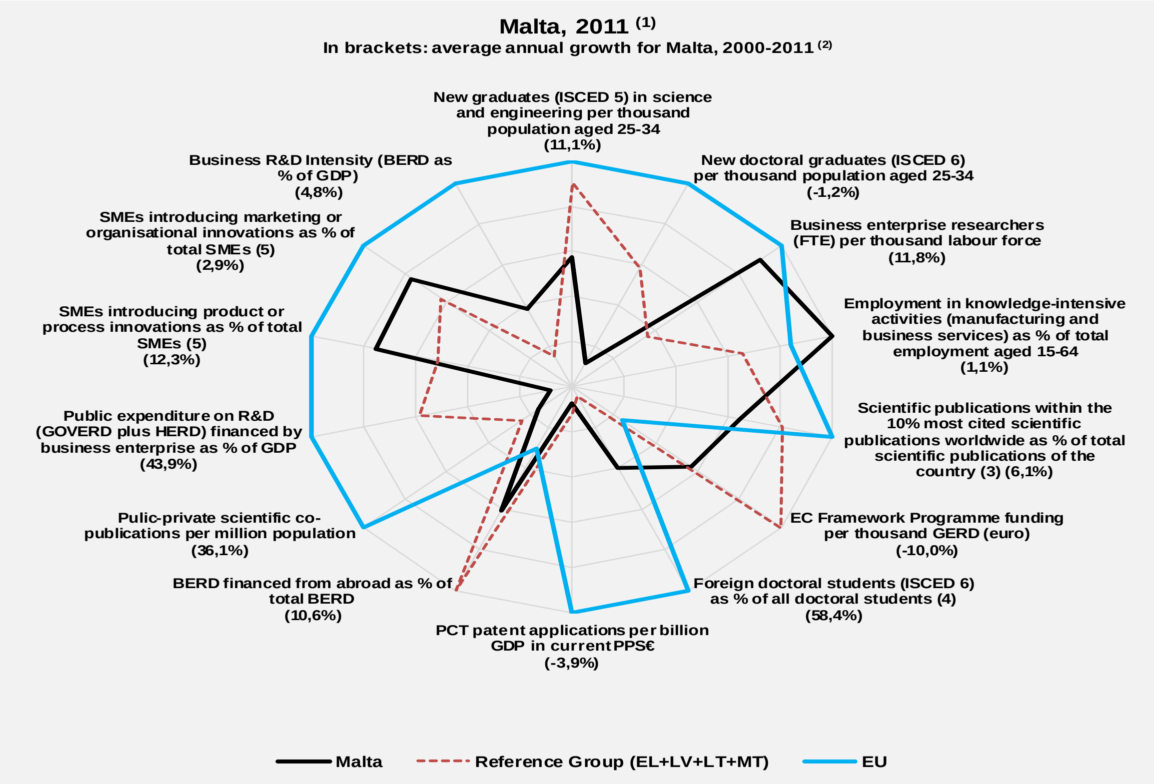
In spite of the economic crisis, public expenditure on R&D increased by 35.1% between 2009 and 2010. This was due to an increase of 4.2 million euro in higher education expenditure on R&D. Government intramural expenditure on R&D decreased slightly between 2009 and 2010. Government funding of R&D has increased steadily between 2005 and 2010 at an average annual real growth rate of 7.7%. However, the government budget for R&D which increased from € 9.4 million to € 14.3 million between 2009 and 2010 has decreased by 19% between 2010 and 2011. This development is a cause for concern in view of the likely negative impact on future R&D intensity.

Malta is ranked nineteenth in the EU in terms of business enterprise expenditure on R&D as % of GDP with a value of 0.37% in 2010 compared to an EU average of 1.23%. The share of R&D performed by business enterprise in Malta has decreased from 66% in 2005 to 59% in 2010. R&D financed by business enterprise increased in real terms between 2005 and 2010 at an average annual growth rate of 6.3%. Most of Malta's business R&D is carried out by a small cluster of foreign-owned companies. 43% of R&D carried out by foreign-owned companies is performed by US owned companies.

Malta relies heavily on support from the EC Framework Programme and Structural Funds for the achievement of its R&I objectives. FP7 projects in Malta have been awarded €11(1) million to date. The success rate of Maltese applicants for FP7 funding is 19.1% compared to an EU average of 22.0%. Malta will also receive around € 60 million for innovation and RTD from the Structural Funds 2007-2013. One of the objectives of the draft National Strategic Plan for R&I 2020 is to put in place an appropriate national framework to exploit opportunities for participation in EU R&I funding programmes.

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

The graph below illustrates the strengths and weaknesses of Malta'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) EL is not ncluded in the reference group.

Despite a clear strategy, Malta is still below the EU average for most indicators. Although the supply of human resources for science and technology is below both the EU and the reference group averages, the average annual growth in the numbers of graduates per thousand population aged 25 -34 is quite high. Malta's share of employment in knowledge-intensive activities is higher than the EU average reflecting the dominance of high-tech multinationals in the private sector.

Knowledge creation as reflected in the production of highly-cited scientific publications and public-private scientific co-publications and in the number of PCT patent applications is far below the EU average indicating a low scientific base, although the establishment of the University of Malta Knowledge Transfer Office in 2009 is already contributing to the reversal of this trend. Indeed, since its inception, the office has taken over the maintenance of the 3 patents owned by University and oversaw the filing of 8 additional patents with the Malta Patent Office, the UK IP Office and WIPO. Malta's reliance on the EC Framework Programme as a source of funding is shown in its above average level of EC funding. Innovative activity by SMEs is above the reference group average but below the EU average.

***Malta's scientific and technological strengths***

Malta, which is the smallest Member State in the EU in terms of population, produces the smallest number of scientific publications in the EU and is in the lowest size category for publications in every field of science. Historically, Malta makes very few patent applications to the EPO, however a positive trend can be noticed over the last decade. The expansion of Malta's science, technology, engineering and mathematics human capital base and the building of links between knowledge institutions and the private sector as outlined in the draft National Strategic Plan for Research and Innovation should stimulate more activity in these areas.

R&D in Malta is concentrated around a cluster of large firms specialising in ICT, manufacture of machinery, manufacture of chemicals and medical instruments and the generic pharmaceuticals industry. E-gaming is an emerging area which has attracted a number of international companies to Malta. The setting up of a new Life Sciences Centre (to be named the BioMalta Campus) is designed to develop Malta into a regional centre of excellence in life sciences and the bio-medical industry. The Life Sciences Centre will seek to attract foreign direct investment into research and development and innovation in the biotechnology and life sciences sectors and will provide support to the local industrial community. The Life Sciences Centre will be operational in 2014.

***Policies and reforms for research and innovation***

Malta's draft National Strategic Plan for R&I 2020 responds adequately to the country's challenges in the field of R&I. It is strongly business oriented and aims to build up R&I capacity by concentrating efforts on areas of economic importance. Resource concentration and smart specialisation in specific sectors is a key a part of the Maltese R&I strategy. The Plan proposes a set of tailored aid schemes for enterprises to provide support for particular target groups such as SMEs and start-ups. A new commercialisation programme to help technology owners move their technologies closer to market was launched in 2012. Efforts are being made to use government expenditure on R&D to leverage an increase in business R&D expenditure, particularly through a varied set of incentives to promote R&D and innovation in the enterprise sector.

A first draft of the National R&I Plan was issued for public consultation in late 2011 and work on the updating and finalisation of this plan is currently on-going.

The draft Plan proposes to address the serious shortfall in human capital for R&I by investing in human resource development at all levels of education. Scholarship schemes supporting post-graduate studies in Malta and abroad are in place and are synchronised with areas of national priority. The draft Plan proposes the setting up of fiscal incentives to highly qualified and skilled foreign workers who are required for industrial sectors of economic importance and to those persons carrying out research or marketing an invention or technology in Malta. Malta is investing in the construction of a new National Interactive Science Centre in order to enhance science-related education and training. It will help to expand the science, engineering and technology human capital base. The Centre will open in 2014.

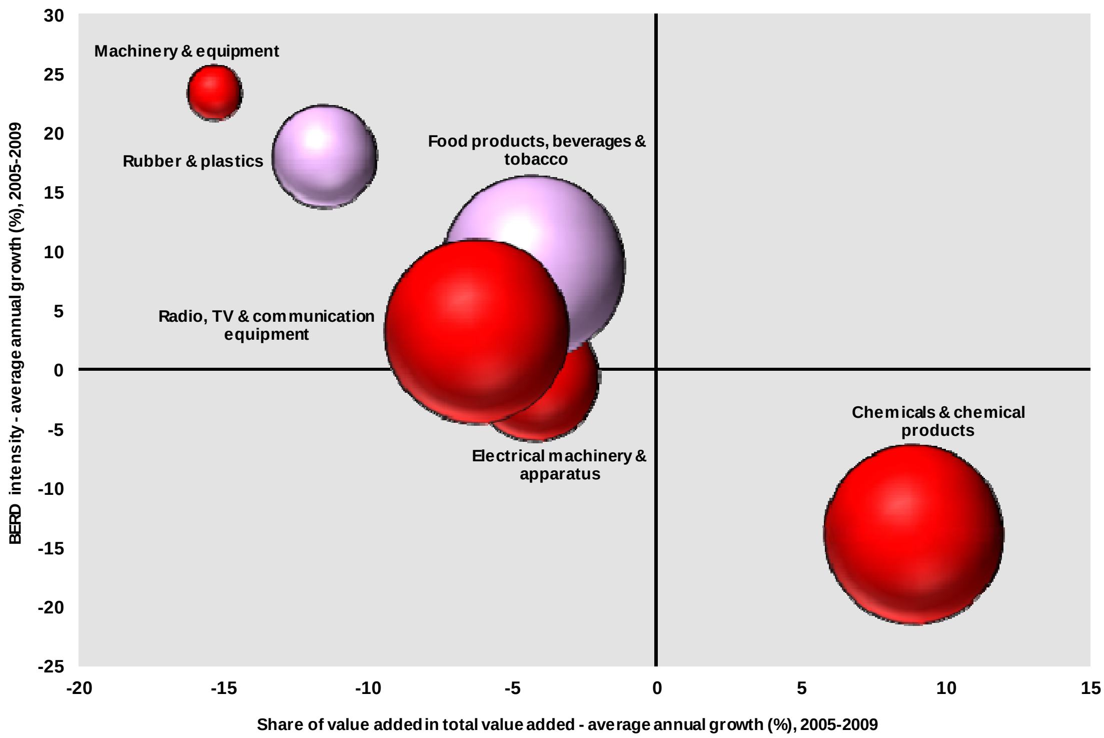
The European Research Area (ERA) dimension in Malta's national research and innovation system is limited in the extent of policies and measures specifically addressing this aspect. Some success has been achieved through the putting in place of a legal framework for inward mobility of third country researchers and the very good participation rates in the sixth and seventh EC Framework Programmes. International cooperation is one of the pillars of the draft National Strategic Plan for R&I, and a number of priority measures to be implemented in the short term are identified.

Malta aims to support both research based and non-research based innovation through identifying key issues and opportunities and providing an appropriate enabling and support framework to potential innovators. The draft National Strategic Plan for R&I recommends several measures for the support of innovation, including an innovation voucher scheme, a risk fund to enable the pooling of private funding to support start-up companies, as well as established companies aiming at expansion and an investment readiness programme to enable SMEs to innovate by addressing the lack of availability of risk capital for businesses at their seed, start-up and early-growth stages.

*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 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 in the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

**Malta - Share of value added versus BERD intensity - average annual growth, 2005-2009**



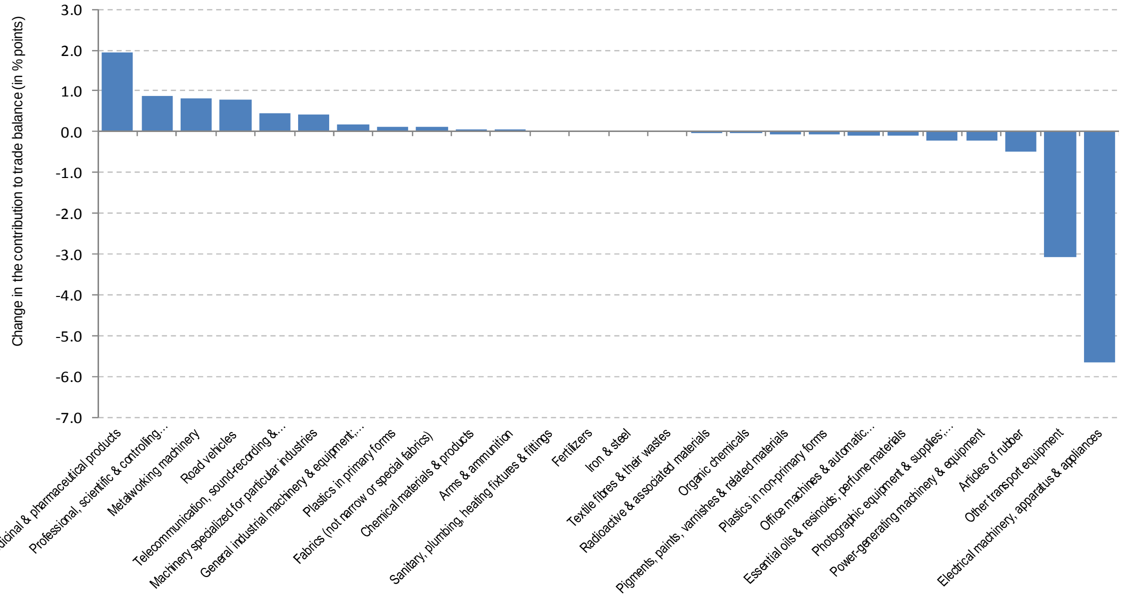

*Source:* DG Research and Innovation - Economic Analysis unit
*Data:* Eurostat
*Note:* (1) High-Tech and Medium-High-Tech sectors are shown in red.

In Malta, the services sector accounts for around 80% of total value added. The share of manufacturing in total value added has declined steadily over the last decade to 13.6% in 2010. Between 2005 and 2009 the shares of value added decreased for all of the sectors on the graph with the exception of chemicals and chemical products. Although the share of value added for chemicals and chemical products increased, BERD intensity (business expenditure on R&D as % of value added) decreased because business expenditure on R&D for this sector stagnated between 2005 and 2009. BERD intensity for machinery and equipment increased by almost 25% per annum between 2005-2009. In fact, BERD intensity is showing positive progress for all sectors with the exception of chemicals and chemical products.

### *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.

**Evolution of the contribution of high-tech and medium-tech products to the trade balance for Malta between 2000 and 2011**




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 the trade balance was positive for each year over the period 2000-2010. Electrical machinery, apparatus and appliances is the sector with the most significant increase in its contribution to the trade balance. Medicinal and pharmaceutical products also show a notable increase. The sector with the biggest decrease is other transport equipment followed by power-generating machinery and equipment. The contributions of most other sectors have either slightly positive or slightly negative evolutions.

Growth in total factor productivity for Malta has been negative throughout the last decade (see Table below). Malta's employment rate has increased from 57.2% in 2000 to 61.5% in 2011 although this is still well below the EU average of 68.6%. Malta has ambitious targets for 2020 in terms of addressing greenhouse gas emissions and the share of renewable energy in energy consumption. However, it is still too early to assess the impact of the measures being taken to achieve these targets.

# Key indicators for Malta

| MALTA | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average annual growth[1] (%) | EU average[2] | Rank within EU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENABLERS** | | | | | | | | | | | | | | | | |
| **Investment in knowledge** | | | | | | | | | | | | | | | | |
| New doctoral graduates (ISCED 6) per thousand population aged 25-34 | 0.13 | 0,22 [3] | 0.15 | 0.09 | : | 0.09 | 0.07 | 0.15 | 0.18 | 0.31 | 0.19 | : | : | -1.2 | *1.69* | 27 |
| Business enterprise expenditure on R&D (BERD) as % of GDP | : | : | : | : | 0.35 | 0.38 | 0.41 | 0.38 | 0.37 | 0.34 | 0.42 | *0.49* | : | *4.8* | *1.26* | 19 |
| Public expenditure on R&D (GOVERD + HERD) as % of GDP | : | : | 0.20 | 0.18 | 0.18 | 0.19 | 0.21 | 0.20 | 0.19 | 0.20 | 0.25 | *0.24* | : | *2.4* | *0.74* | 27 |
| Venture Capital as % of GDP | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| **S&T excellence and cooperation** | | | | | | | | | | | | | | | | |
| Composite indicator of research excellence | : | : | : | : | : | 14.4 | : | : | : | : | 17.5 | : | : | 4.1 | 47.9 | 25 |
| Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country | 4.4 | 4.9 | 0.4 | 2.8 | 3.6 | 6.2 | 8.2 | 5.3 | 7.1 | : | : | : | : | 6.1 | 10.9 | 19 |
| International scientific co-publications per million population | 60 | 72 [4] | 71 | 106 | 103 | 219 | 198 | 177 | 244 | 208 | 292 | 328 | : | 16.5 | 300 | 22 |
| Public-private scientific co-publications per million population | : | : | : | : | : | : | : | 2 | 1 | 2 | 6 | 8 | : | 36.1 | 53 | 23 |
| **FIRM ACTIVITIES AND IMPACT** | | | | | | | | | | | | | | | | |
| **Innovation contributing to international competitiveness** | | | | | | | | | | | | | | | | |
| PCT patent applications per billion GDP in current PPS€ | 0.4 | 0.7 | 0.3 | 0.5 | 0.4 | 0.8 | 0.7 | 1.1 | 1.0 | 0.3 | : | : | : | -3.9 | 3.9 | 26 |
| License and patent revenues from abroad as % of GDP | : | : | : | : | 0.05 | 0.80 | 2.25 | 0.69 | 0.52 | 0.571 | 0.36 | 0.30 | : | 28.7 | 0.58 | 12 |
| Sales of new to market and new to firm innovations as % of turnover | : | : | : | : | 22.2 | : | 28.6 | : | 15.2 | : | 7.4 | : | : | -16.7 | 14.4 | 24 |
| Knowledge-intensive services exports as % total service exports | : | : | : | : | 12.5 | 12.0 | 15.4 | 17.8 | 14.5 | 13.3 | 13.6 | : | : | 1.5 | 45.1 | 26 |
| Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products | 5.07 | 5.71 | 4.43 | 4.69 | 4.42 | 7.72 | 7.52 | 9.46 | 10.73 | 9.61 | 3.21 | 0.92 | : | - | 4,20 [5] | 17 |
| Growth of total factor productivity (total economy) - 2000 = 100 | 100 | 96 | 98 | 97 | 95 | 96 | 97 | 97 | 99 | 97 | 98 | 98 | 99 | -1 [6] | 103 | 23 |
| **Factors for structural change and addressing societal challenges** | | | | | | | | | | | | | | | | |
| Composite indicator of structural change | 41.8 | : | : | : | : | 47.4 | : | : | : | : | 54.5 | : | : | 2.7 | 48.7 | 9 |
| Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64 | : | : | : | : | : | : | : | : | 15.7 | 15.7 | 16.0 | 16.2 | : | 1.1 | 13.6 | 5 |
| SMEs introducing product or process innovations as % of SMEs | : | : | : | : | 14.4 | : | : | : | 25.9 | : | 29.0 | : | : | 12.3 | 38.4 | 18 |
| Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.11 | 0.27 | 0.19 | 0.00 | : | : | : | : | 8.9 | 0.39 | 11 [7] |
| Health-related technologies - patent applications to the EPO per billion GDP in current PPS€ | 0.00 | 0.16 | 0.00 | 0.15 | 0.04 | 0.00 | 0.00 | 0.19 | 0.00 | : | : | : | : | 2.8 | 0.52 | 15 [7] |
| **EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES** | | | | | | | | | | | | | | | | |
| Employment rate of the population aged 20-64 (%) | 57.2 | 57.2 | 57.7 | 57.8 | 57.9 | 57.9 | 57.6 | 58.5 | 59.1 | 58.8 | 60.1 | 61.5 | : | 0.7 | 68.6 | 24 |
| R&D Intensity (GERD as % of GDP) | : | : | : | : | 0.53 | 0.57 | 0.62 | 0.58 | 0.56 | 0.54 | 0.67 | *0.73* | : | *4.7* | *2.03* | 21 |
| Greenhouse gas emissions - 1990 = 100 | 128 | 134 | 136 | 145 | 144 | 149 | 148 | 154 | 152 | 148 | 149 | : | : | 21 [8] | 85 | 26 [9] |
| Share of renewable energy in gross final energy consumption (%) | : | : | : | : | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | : | : | 26.0 | 12.5 | 27 |
| Share of population aged 30-34 who have successfully completed tertiary education (%) | 7.4 | 12.9 | 9.3 | 13,7 [9] | 17.6 | 18.4 | 21.6 | 21.5 | 20.9 | 21.0 | 21.5 | 21.1 | : | 5.5 | 34.6 | 25 |
| Share of population at risk of poverty or social exclusion (%) | : | : | : | : | : | 20.2 | 19.1 | 19.4 | 19.6 | 20.2 | 20.3 | 21.4 | : | 1.0 | *24.2* | 13 [9] |

*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 2001 and the previous years. Average annual growth refers to 2001-2010.
(4) Break in series between 2001 and the previous years. Average annual growth refers to 2001-2011.
(5) EU is the weighted average of the values for the Member States.
(6) The value is the difference between 2012 and 2000.
(7) Rank in 2007.
(8) The value is the difference between 2010 and 2000. A negative value means lower emissions.
(9) The values for this indicator were ranked from lowest to highest.
(10) Break in series between 2003 and the previous years. Average annual growth refers to 2003-2011.
(11) Values in italics are estimated or provisional.