European Commission

Background Report

Specific Support on the Development of the Human Capital for Research and Innovation in Latvia

Horizon 2020 Policy Support Facility

Research and Innovation

Background Report – Specific Support to Latvia

European Commission
Directorate G – Research & Innovation Outreach
Unit G1 – European Research Area & Country Intelligence

Contact (H2020 PSF Specific Support for Latvia):
Dr. Karina Firkaviciute, Policy Officer, Unit G1 – Karina.FIRKAVICIUTE@ec.europa.eu

Contact (H2020 PSF coordination team):
Magda de CARLI, Head of Unit G1 – Magda.DE-CARLI@ec.europa.eu
Stéphane VANKALCK, PSF Head of Sector, Unit G1 - Stéphane.VANKALCK@ec.europa.eu
European Commission
B-1049 Brussels

Manuscript completed in July 2019.

Luxembourg: Publications Office of the European Union, 2019

PDF ISBN 978-92-76-08994-0 doi:10.2777/264675 KI-AX-19-008-EN-N

EUROPEAN COMMISSION

Background Report

Specific Support on the Development of the Human Capital for Research and Innovation in Latvia

Prepared by the independent experts:

Anete Vingre

Reda Nausedaite

Dominik Beckers

2019 Directorate-General for Research and Innovation EN

Table of Contents

1 INTRODUCTION....4
1.1 Overview of the Latvian Economy....4
1.2 Research and Innovation System in Latvia....19
1.2.1 Key Challenges....19
1.2.2 Research Performers....22
1.3 Research and Innovation Policies and Governance in Latvia....24
1.3.1 Key Players of Research and Innovation Governance in Latvia 25
1.3.2 Main Policy Planning Documents and Initiatives....28
2 ANALYSIS OF RELEVANT STATISTICAL DATA....33
2.1 Research and Development Expenditure....33
2.2 Science and Technology Human Resources Statistics....36
3 BIBLIOMETRIC INDICATORS....46
4 POLICY FRAMEWORK AND MEASURES FOR THE ATTRACTION AND DEVELOPMENT OF HUMAN CAPITAL IN RESEARCH AND DEVELOPMENT....52
4.1 Recent Systemic Reforms....52
4.2 Direct Measures for Human Capital Development....53
4.3 Indirect Measures for Human Capital Development....55
4.4 Cooperation with Science Diaspora....56
5 BIBLIOGRAPHY....59
6 ABBREVIATIONS....62
APPENDIX A POLICY INSTRUMENTS TARGETING SCIENTIFIC COMPETITIVENESS, CAPACITY OF INNOVATION AND INCREASING BUSINESS COMPETITIVENESS....63
APPENDIX B FWCI OF DIFFERENT SCIENCE FIELDS (SCOPUS, SCIVAL DATA)....76

List of Figures

Figure 1. GDP growth trend in Latvia....5
Figure 2. Employment rates of recent graduates (aged 20-34) not in education and training, by educational attainment level, 2018....6
Figure 3. Structure of the economy....7
Figure 4. Latvian exports....8
Figure 5. Evolution of Latvian exports 2010-2017....9

Figure 6. FDI stock in Latvia by country, billion euro and per cent 10
Figure 7. Manufacturing by technology intensity 11
Figure 8. Entrepreneurial framework conditions in Latvia 13
Figure 9. Entrepreneurial behaviour and attitudes in the Baltic countries 14
Figure 10. Global competitiveness index for Latvia, 2018 15
Figure 11. Breakdown of the 'Innovation capability' pillar for Latvia 16
Figure 12. Global competitiveness index for the Baltic countries 17
Figure 13. International long-term migration 18
Figure 14. Progress of RIS3 indicators 21
Figure 15. Governance of the research and innovation system in Latvia 26
Figure 16. Policy planning documents for research, development and innovation 29
Figure 17. Gross domestic expenditure on R&D 33
Figure 18. R&D expenditure per sector of activity in 2017 (m EUR) 34
Figure 19. Success rates in EU Framework programmes 35
Figure 20. BERD percentage of GDP 36
Figure 21. Number of full-time R&D personnel, planned vs. actual (in FTE) 37
Figure 22. R&D personnel by sector and year, (in FTE) 38
Figure 23. Percentage of workforce employed in science in 2016 38
Figure 24. Researchers by field of science, FTE, 2016 39
Figure 25. Number of doctoral graduates 40
Figure 26. Doctorate holders by age and gender, 2017 41
Figure 27. Graduates of doctoral studies by field of education (academic year 2016/2017) 41
Figure 28. Doctoral graduates across disciplines, 2015 42
Figure 29. International mobility in post-PhD career, 2016 43
Figure 30. Latvia's European Innovation Scoreboard performance for 'Human resources' 44
Figure 31. Latvia compared to other Baltic countries on European Innovation Scoreboard performance for 'Human resources' 44
Figure 32. Latvia's European Innovation Scoreboard performance for 'Employment impacts' 45
Figure 33. Latvia compared to other Baltic countries on European Innovation Scoreboard performance for 'Employment impacts' 45
Figure 34. Number of publications in Latvia, Lithuania and Estonia in the period 2012-2017 (normalised per 1000 population) 46
Figure 35. Number of publications in different fields of science, Latvia 47
Figure 36. FWCI in Latvia, Lithuania and Estonia 47
Figure 37. Web of Science documents and citation (total), Latvia 48
Figure 38. Academic-corporate collaboration 49

Figure 39. Academic-corporate collaboration in different science fields in Latvia 49
Figure 40. International collaboration in Latvia, Lithuania and Estonia 50
Figure 41. International collaboration of different science fields, Latvia 50
Figure 42. Collaboration countries of Latvian scientists (darker colours present higher numbers of co-publications) 51
Figure 43. Return plans of Latvia's science diaspora 57
Figure 44. Policy instruments supporting competitiveness of science 63
Figure 45. Policy instruments targeting capacity for innovation 68
Figure 46. Policy instruments targeting overall business competitiveness 74
Figure 47. FWCI medical sciences 76
Figure 48. FWCI agricultural sciences 76
Figure 49. FWCI engineering and technologies 77
Figure 50. FWCI humanities 77
Figure 51. FWCI natural sciences 78
Figure 52. FWCI social sciences 78

1 INTRODUCTION

This report provides background information on the Latvian research and innovation (R&I) system with specific focus on the human capital needs. It includes an overview of Latvia's current R&I performance and national priorities and targets designed to help develop the research and innovation system, as well as recent achievements in fulfilling the defined objectives. The report summarises information on the governance of the Latvian research and innovation system and the landscape of research performers. It also includes a section on simple bibliometric analysis. Details on the most relevant research and development (R&D) and human resources statistics are provided by outlining the key indicators. Lastly, current initiatives and measures targeting human resources (HR) development in research and innovation are described.

Latvia's R&I performance has been reviewed in several recent studies. These provide a comprehensive picture of how well the system is functioning and the main challenges faced. Among others, these studies were consulted in preparing this background report and provide further detail on Latvia's research funding system and research performers:

European Commission. 2018. Latvian Research Funding System Final Report. Horizon 2020 Policy Support Facility. Available here: https://rio.jrc.ec.europa.eu/en/policy-support-facility/specific-support-latvia

European Commission. 2017 (a). Latvian Research Funding System Background Report. Horizon 2020 Policy Support Facility. Available here: https://rio.jrc.ec.europa.eu/en/policy-support-facility/specific-support-latvia

Kulikovskis, G., Petraityte, D. and Stamenov, B. 2018. RIO Country Report 2017: Latvia. Available here: https://rio.jrc.ec.europa.eu/en/country-analysis/Latvia/country-report

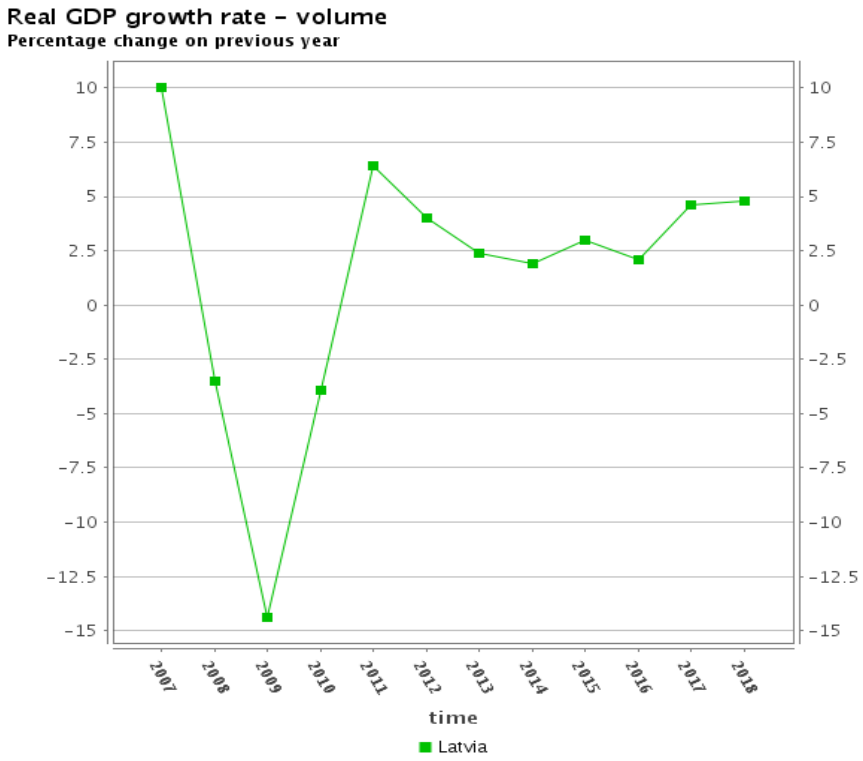
Arnold, E., Knee, P., Angelis, J., Giarraca, F., Griniece, E., Jávorka, Z., Reid, A. 2014. Latvia - Innovation System Review and Research Assessment Exercise: Final Report. Available here: http://izm.gov.lv/images/zinatne/ZISI/Latvia-systems-review_2014.pdf

1.1 Overview of the Latvian Economy

After building its economy following the restoration of independence, in 2008 Latvia was faced with a severe economic downturn. During the economic crisis, Latvia carried out a radical reform programme in return for European Union (EU) and International Monetary Fund (IMF) financial

assistance. These measures helped to stabilise the economy and led to a return to economic growth in 2011 (GDP increased by almost 5%). Recovering well from this period of economic instability, Latvia's economy is now performing well. As illustrated in Figure 1, the growth rate of the economy has been positive since 2011 and, in 2018, was among the highest in the EU – 4.8% (Ministry of Finance, 2019). GDP growth has been fuelled by consumer optimism and inflow of EU funds (European Commission, 2019). Growth is strong and broad-based, but is expected to level out at around 3.5% by 2020 (OECD, 2018).

Figure 1. GDP growth trend in Latvia

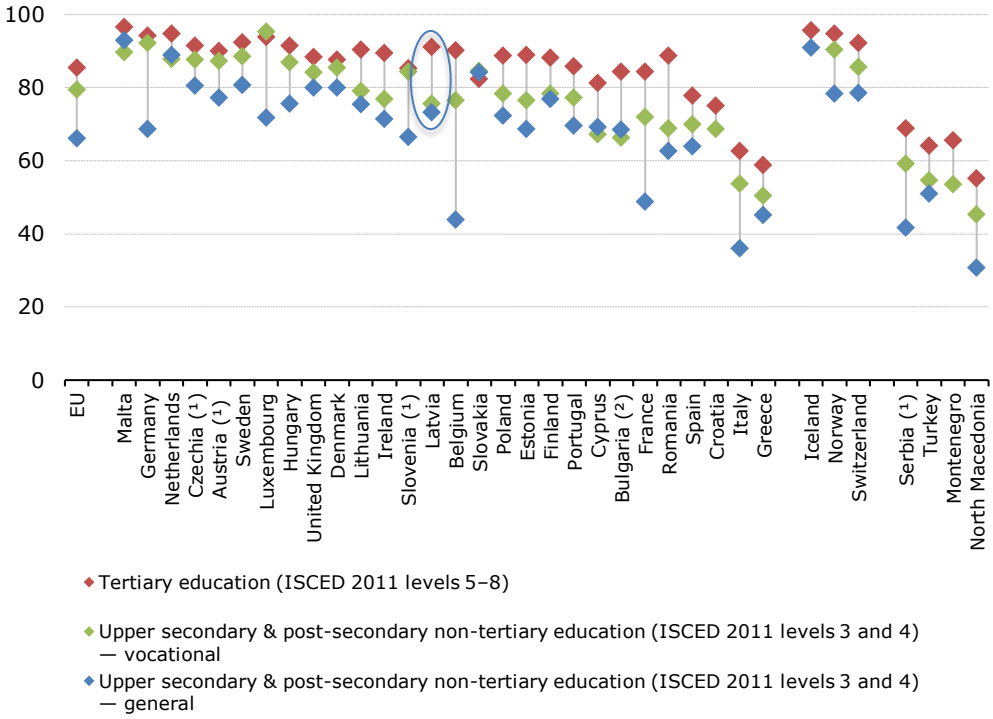


Source: Eurostat

Public debt made up 35% of the GDP in 2018 (40.7% of GDP in 2014) and is among the lowest in the EU.

In 2018, unemployment dropped to 7.9% (it was above 20% ten years earlier). Employment of recent tertiary education graduates is at 91%, which is above the EU average of 86% (Figure 2).

Figure 2. Employment rates of recent graduates (aged 20-34) not in education and training, by educational attainment level, 2018

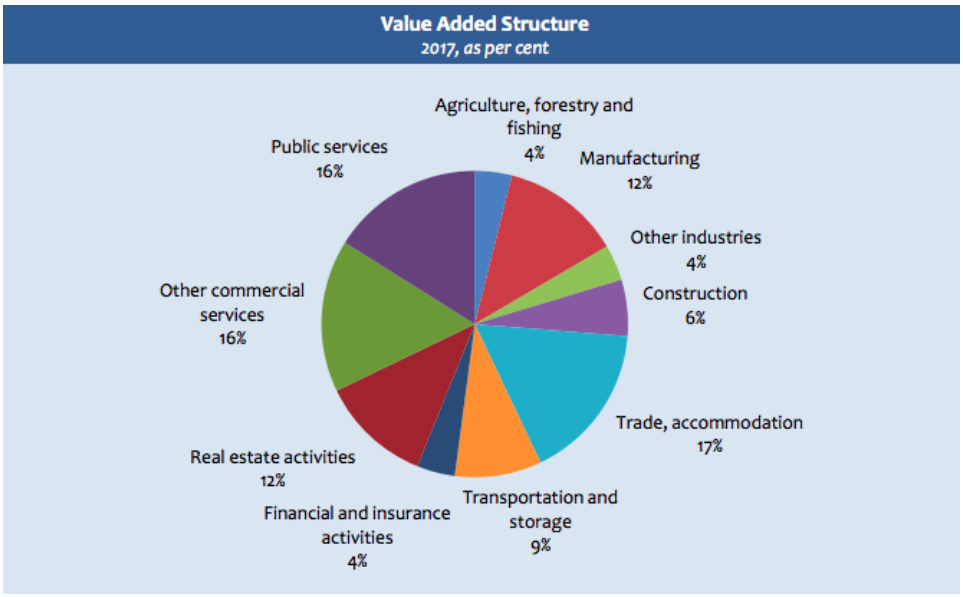


Source: Eurostat

The country benefits substantially from European Structural and Investment Funds. The total funding amount available for the country in the period 2014-2020 is EUR 4.51 billion.

The service sector is the largest contributor to Latvia's economic structure. Manufacturing and other industry comprise 16% (see Figure 3 below). The construction, metallurgy, industrial food-processing, and mechanical engineering sectors are developing well. These sectors have increased their export share as well as their share in GDP growth. Transportation and ICT are also important sectors for the economy. Agriculture makes up 4% of the GDP and employs 7.3% of the population. In 2008, tradable sectors (agriculture, forestry, industry, and transport) constituted only 26% of the total value added. In 2010, the share of the tradable sectors reached 33% and has remained close to 30% since then.

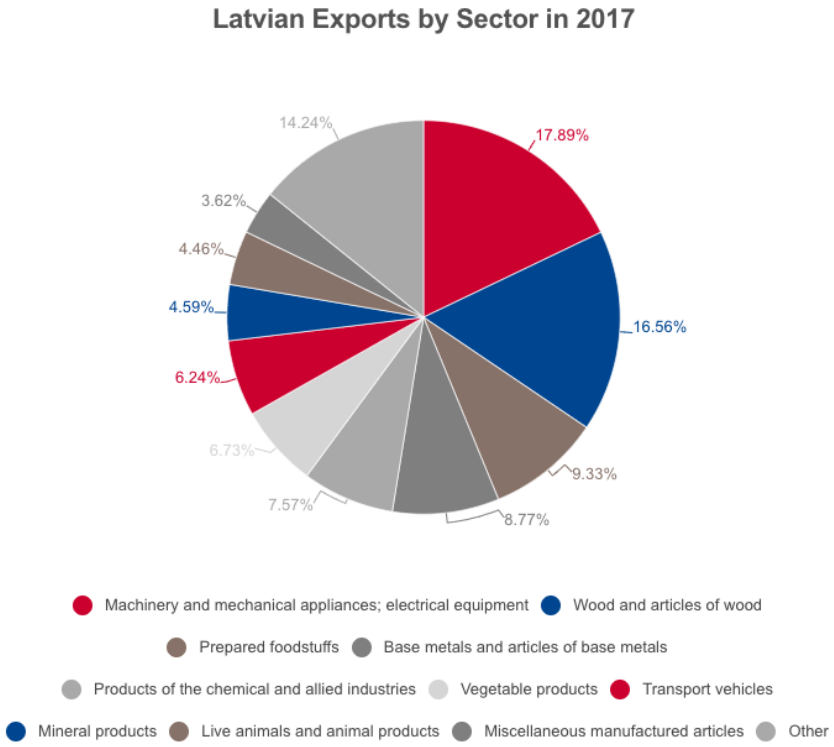
Figure 3. Structure of the economy



Source: Ministry of Economics

As illustrated in Figure 4 below, exports are dominated by machinery and mechanical appliances, electrical equipment (17.8%), wood and articles of wood (16.5%), prepared food (9.3%), base metals and metal products (8.7%) and products of the chemical industries (7.5%). Foreign trade has consistently increased. In 2017, the value of total exports increased by 11%. In 2017, exports to EU countries made up to 71% of the total volume of Latvian exports (Investment and Development Agency of Latvia); more than two-thirds in goods and the rest in services. This proportion has not significantly changed in recent years (Ministry of Economics, 2018 (a)). Exports performed strongly in 2018, but weakening foreign demand and a structural decline in some of Latvia's service exports suggest a slowdown (European Commission, 2019).

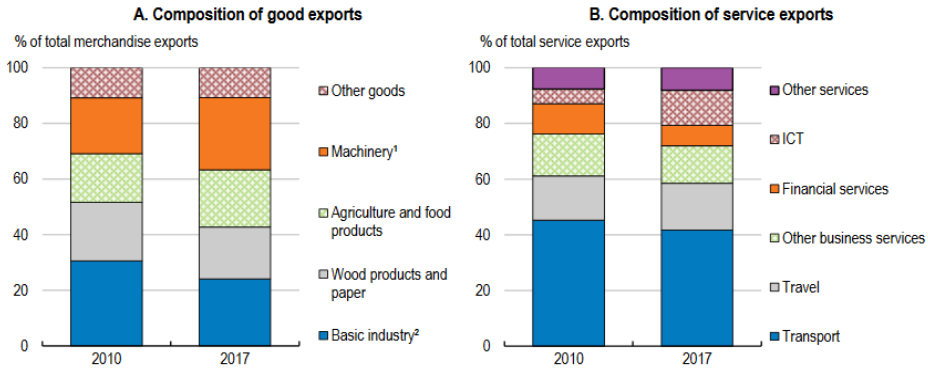
Figure 4. Latvian exports



Source: Investment and Development Agency of Latvia

Regarding long-term changes to export dynamics, during the period of 2010-2017 exports in goods saw growth in machinery exports, including mechanical appliances, electrical equipment, transport vehicles, optical instruments and apparatus (incl. medical), and growth in agriculture and food product exports. During the same period, exports from 'basic' industry – covering chemical and allied industries, plastics and related articles, rubber products, base metals and related articles, and mineral products – has decreased. For service exports, ICT had the largest growth recorded for the period followed by slight growth in travel. Transport services registered a slight overall decrease during the period while financial service exports decreased more substantially.

Figure 5. Evolution of Latvian exports 2010-2017



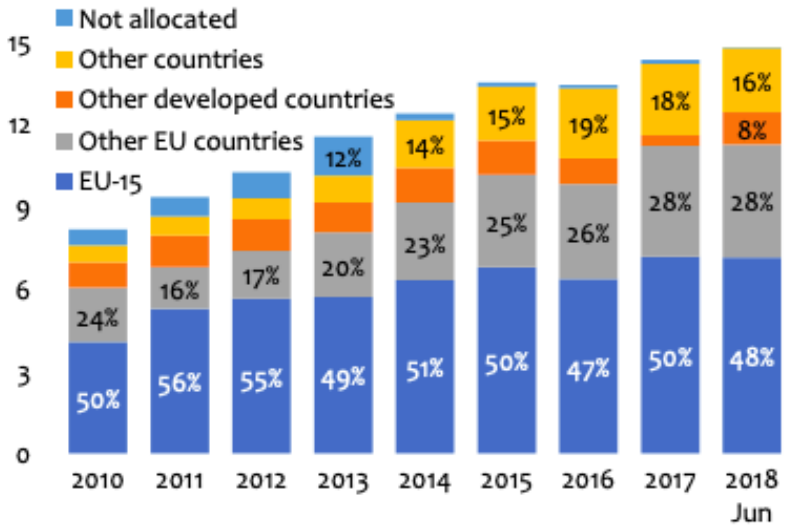
1. Includes mechanical appliances; electrical equipment; transport vehicles; optical instruments and apparatus (inc. medical); clocks and watches; musical instruments.
2. Includes products of the chemical and allied industries; plastics and articles thereof; rubber and articles thereof; base metals and articles of base metals; and mineral products.

Source: OECD

Foreign Direct Investment (FDI) flows in the Latvian economy are more moderate compared to the years of rapid growth. From 2011 to 2016, the volume of FDI was almost halved compared to the annual average in 2004-2007. At the end of June 2018, the accumulated FDI in the Latvian economy amounted to EUR 14.8 billion. As illustrated in Figure 6, investments from EU countries dominate in the geopolitical structure of FDI in Latvia. Currently, the largest investor in the Latvian economy is Sweden. At the end of June 2018, Swedish business investments accounted for 19.2% of the total accumulated FDI in Latvia. Mostly, these include investments in financial intermediation. Investors from the Netherlands, Cyprus, Germany, Norway, Russia, Estonia, Lithuania, Denmark, and Luxembourg also form a large share of the total accumulated FDI in Latvia. At the end of June 2018, these country investments accounted for almost 80% of the total accumulated FDI in Latvia (Ministry of Economics, 2018).

In terms of the sectoral structure, the share of accumulated FDI is higher for investments in financial intermediation (24% of total accumulated FDI), trade (16%), real estate activities (15%), and manufacturing (12%) (Ministry of Economics, 2018). These sectoral trends are stable and have not changed since 2012. Foreign investment is concentrated mostly in large companies with limited knowledge exchange, but recently partnerships with local companies, start-ups and some universities are more common. Examples include cooperation with start-up ecosystem players in supporting bootcamps, competitions, providing testing opportunities, and organising courses, internships and other exchange opportunities for students of higher education institutions (HEI).

Figure 6. FDI stock in Latvia by country, billion euro and per cent



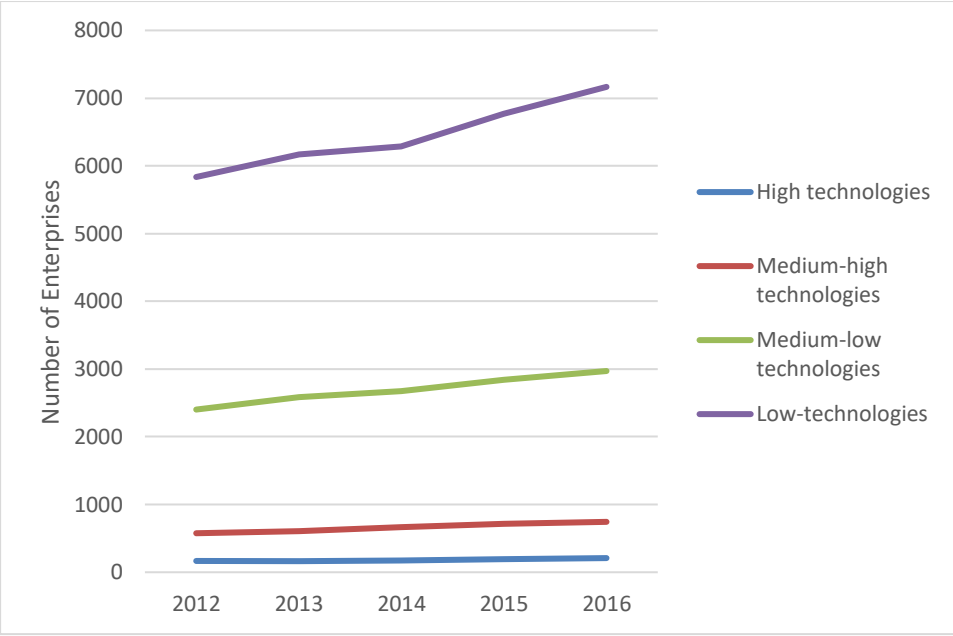
Source: Ministry of Economics, 2018

The results of the survey of foreign investors indicate a positive assessment of the Latvian investment environment in general. However, there are shortcomings weakening the investment environment, for example, unfavourable demographic trends, labour availability problems, and issues with the healthcare and legal system (Ministry of Economics, 2018). Recently, the Foreign Investors Council in Latvia published a position paper on the need to improve the governance of higher education institutions in Latvia and address the challenge of human resource supply.

Productivity growth rates in Latvia are among the highest in the EU, reaching 4.7% in 2017. Since 2011, productivity has grown by 14.7%. However, in 2017, the productivity level in Latvia was only 46.8% of the EU average, one of the lowest in the bloc. According to the European Semester Country Report Latvia 2018 (European Commission, 2018 (a)) Latvia's productivity growth has been good, but innovation performance lags behind. Competitiveness indicators demonstrate that the Latvian economic model is based primarily on low-cost competitive advantages. The key prerequisite for sustainable economic growth is to boost the level of productivity based on technological innovations, improved production process management and reallocation of existing resources to produce greater added value products (Ministry of Education and Science, 2018).

As illustrated in Figure 8, the numbers of high and medium-high technology manufacturing companies are low, but there has been a slight upward trend since 2012.

Figure 7. Manufacturing by technology intensity



Source: Central Statistical Bureau of Latvia, 2019

The population of Latvia is approximately 2 million of which around a half or 1 million people are economically active. The decline in economic activity caused by the financial crisis had a negative impact on employment indicators – the number of economically active people and the employment rate decreased. The registered unemployment rate has continuously decreased from 17.3% in March 2010 to 6.3% in April 2019 (Ministry of Economics, 2018 (b)). The most significant workforce shortage in the higher education group is expected to come from specialists in engineering, science and ICT. By 2025, the deficit of adequately skilled workers could exceed 17000 – mostly in such areas as energy, computer sciences, construction and civil engineering, as well as in electronics and automatics (Ministry of Economics, 2018 (b)). State Employment Agency data show that most vacancies (69%) in the first quarter of 2019 were registered in professions requiring a medium level of qualification followed by occupations with a low level of qualification (17%). Some 14% of the total number of registered vacancies are for highly-qualified professions (Ministry of Economics, 2018 (b)).

Latvia scores reasonably well on international business environment rankings. The latest data from the Global Entrepreneurship Monitor (GEM) – for Latvia the data is available for 2018 – provides data about the framework conditions and entrepreneurship. National GEM reports are analysed within a framework of 12 conditions considered important for entrepreneurship:

- **Entrepreneurial finance** – measures the extent to which experts (involved in the GEM study) perceive that there are enough funds for current and potential entrepreneurs to engage in entrepreneurial pursuits.
- **Government policies: support and relevance** – the indicators assess the extent to which experts (involved in the GEM study) believe national governments demonstrate support for entrepreneurs.
- **Government policies: taxes and bureaucracy** – reflect the degree to which experts (involved in the GEM study) have measured the current tax system supportive of entrepreneurs.
- **Government entrepreneurship programmes** – evaluates whether and how public agencies are providing specific support programmes for entrepreneurs.
- **Entrepreneurship education at school stage** – evaluates the degree to which entrepreneurship subjects are included in school programmes.
- **Entrepreneurial education at post-school stage** – evaluates the degree to which entrepreneurship subjects are part of post-school programmes (higher education, vocational education, etc.).
- **R&D transfer** – presents the evaluation of R&D transfer from universities and research centres to the business sector.
- **Commercial and professional infrastructure** – represents the supply and affordability of both individual professionals and businesses providing services to entrepreneurs.
- **Physical infrastructure** – analyses the availability of communication, transportation, and business operations nationally and internationally. This includes: high-speed internet and mobile phone service, real estate, reliable utilities, and advanced highways, railways, ports, and airports.
- **Internal market dynamics** – analyses whether there is a free and open market where no entity exerts power to influence or set prices, and where changes in demand are met with changes in supply, and vice versa.

- **Internal market burdens** – evaluates the overall state of a market in terms of the absence of burdens entrepreneurs encounter upon entering markets, and whether regulations are in place that can facilitate these efforts.
- **Cultural and social norms** – evaluates whether and how society perceives entrepreneurship within the culture through behaviour, beliefs, language and customs.

The report reveals that the country's strongest points in terms of entrepreneurship framework conditions are 'Physical infrastructure' (with a score of 4.11; global average at 3.76) and 'Commercial and legal infrastructure' (with a score of 3.61; global average at 2.94).

Figure 8. Entrepreneurial framework conditions in Latvia

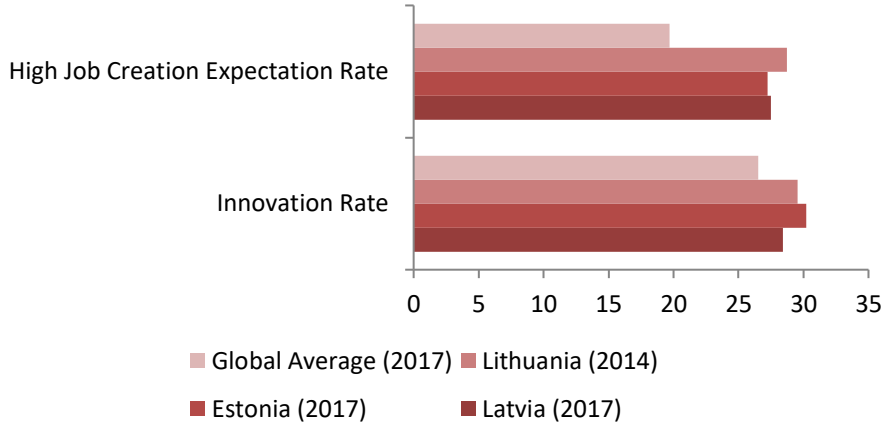
Source: Global Entrepreneurship Monitor, 2018 (the scale is explained above)

However, when comparing Latvia's current performance with data from 2017, only four out of the 12 indicators have seen an increase ('Physical infrastructure' from 4.07 to 4.11; 'Commercial and legal infrastructure' from 3.46 to 3.61; 'Internal market burdens or entry regulation' from 2.62 to 2.75 and; 'R&D transfer' from 2.31 to 2.32). The remaining eight indicators have all seen decreases in 2018 when compared to the situation in 2017 (Global Entrepreneurship Monitor, 2018).

In terms of entrepreneurial behaviour, particularly connected to innovation and employment, in 2017 the indicator for 'Innovation rate' (percentage of entrepreneurs who indicate that their product or service is new to at least some customers **and** that few/no businesses offer the same product) saw a decrease when compared to 2016. Similarly, when considering impact on employment (and human capital involved in innovation) the indicator for 'High job creation expectation rate' (percentage of entrepreneurs who expect to create six or more jobs in five years) was lower in 2017 when compared to 2016.

Looking at how Latvia compares to the other Baltic countries, regarding entrepreneurial behaviour both Latvia and Estonia display similar situations for 'High job creation expectation rate' while in terms of 'Innovation rate', Estonia is further ahead (Estonia at 30.2 while Latvia is at 28.41). While Lithuania displays better results for both indicators, it should be noted that the latest available data for Lithuania is for 2014. It is also notable that for these indicators, all three Baltic countries are above the global average.

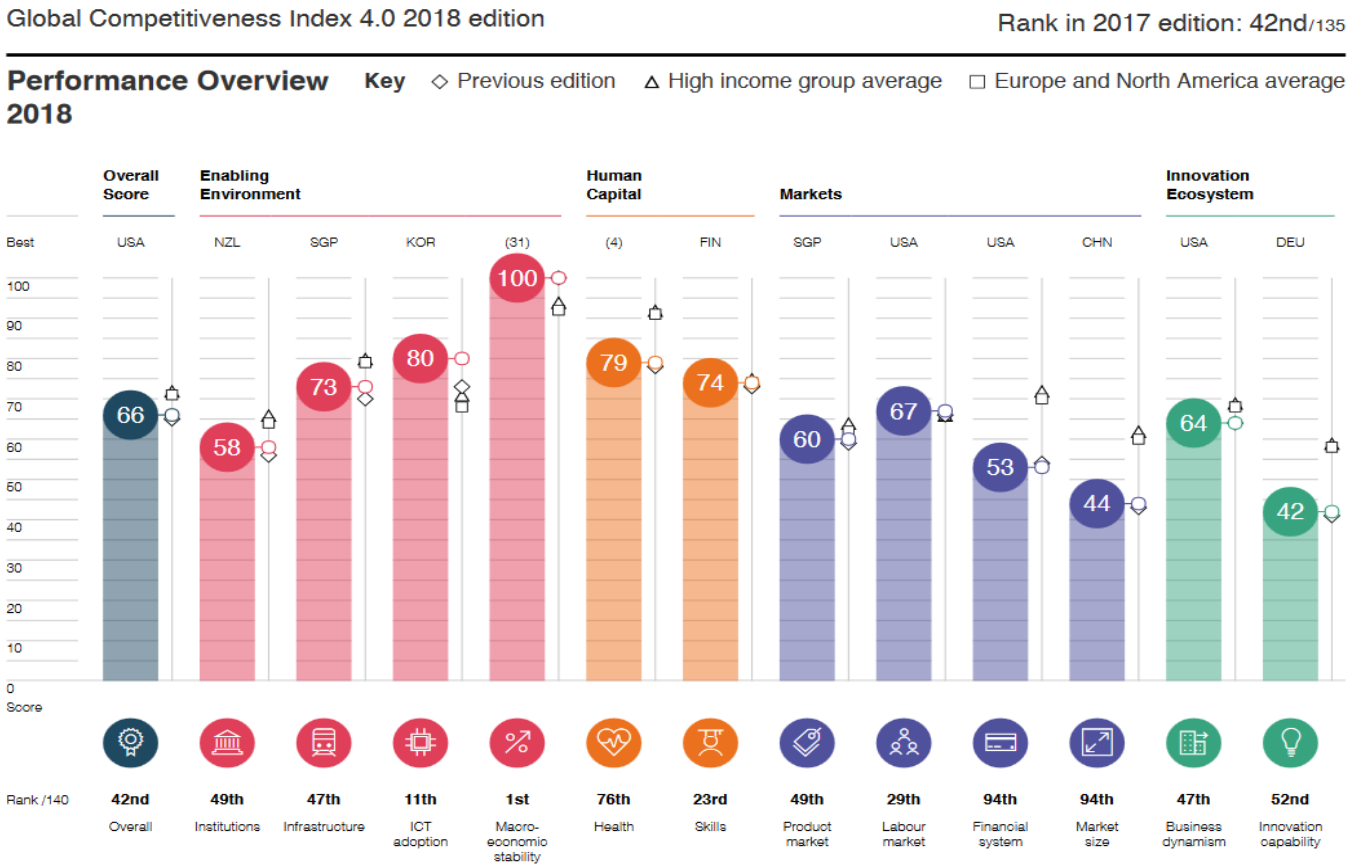
Figure 9. Entrepreneurial behaviour and attitudes in the Baltic countries



Source: Global Entrepreneurship Monitor, 2018

Taking this a little further, the World Economic Forum's Global Competitiveness Report 2018 ranks Latvia in 42nd place out of 140 (up from 44th place in 2016). In fact, the 2018 data suggests that 11 of the 12 pillars have seen an increase in their score, with the sole exception being the 'Financial system' which went down from 54.2 to 53.5. Latvia scores highest in terms of 'Macro-economic stability', reaching the maximum score of 100 (up from 99.5) and sharing 1st place with 31 other countries (all Baltic countries score the maximum 100). In fact, pillars that are classified under 'Enabling environment' show some of the highest scores for the country, with pillars under 'Human capital' with comparably high scores.

Figure 10. Global competitiveness index for Latvia, 2018

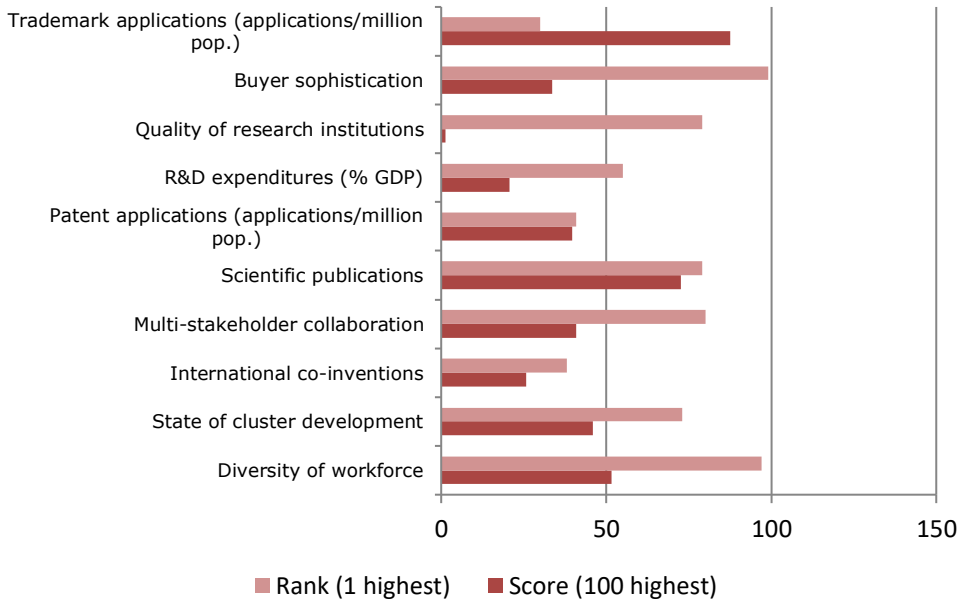


Source: Global Competitiveness Index 4.0 2018 edition, 2018

Of the 12 main pillars that form the index, 'Innovation capability' scores lowest (the same situation was visible in 2016 when innovation was recognised as Latvia's weakest point. However, 'Innovation capability' has seen slight improvement, going up from 41.3 to 42.0. Both Lithuania and Estonia have achieved better results in this pillar, with Lithuania scoring 47.4 and Estonia scoring 52.5. When breaking the 'Innovation capability' pillar into smaller categories, Latvia achieves the best results for 'Trademark applications' (87.6) and 'Scientific publications' (72.6). The lowest score is observable in terms of 'Quality of research institutions' (1.3) and 'R&D expenditures (% GDP)' (20.5).

A further breakdown of the 'Innovation capability' pillar reveals how Latvia scores across the ten smaller categories. Note that the figure below presents both the score (100 being the highest) and Latvia's global ranking (in this case, 1 is the highest score because it shows a country being at the top of the 140 countries evaluated in the Global Competitiveness Index 4.0.). To that end, Latvia achieves the best results for 'Trademark applications' (87.6) and 'Scientific publications' (72.6). The lowest score is observable in terms of 'Quality of research institutions' (1.3) and 'R&D expenditures (% GDP)' (20.5).

Figure 11. Breakdown of the 'Innovation capability' pillar for Latvia

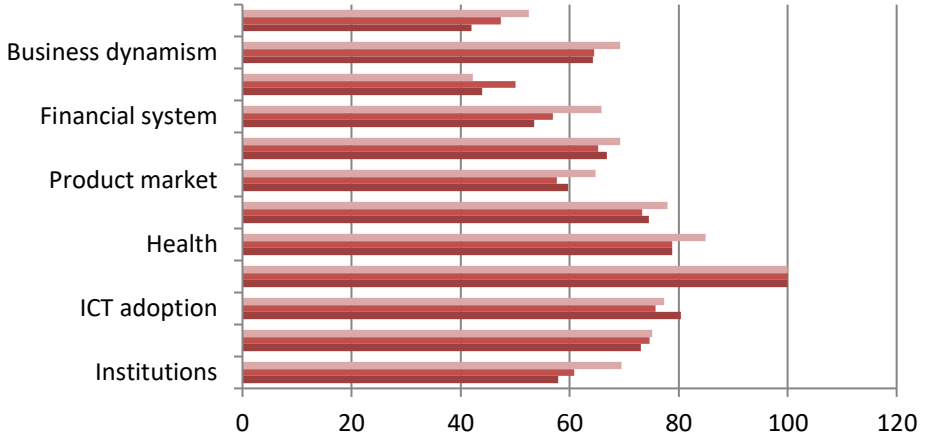


Source: Global Competitiveness Index 4.0., 2018

However, when factoring how Latvia compares globally, 'Buyer sophistication' is the lowest rank (99th place) with 'Diversity of workforce' following closely (97th place). Interestingly, while 'Scientific publications' scored well, in terms of global ranking it shares the 3rd lowest position for Latvia together with 'Quality of research institutions' (both at 79th place).

When comparing Latvia to the other Baltic countries, Latvia outperforms Estonia in 'Market size' (Latvia scores 44.0 while Estonia scores 42.3) and 'ICT adoption' (80.4 versus 77.4).[1] Similarly, Latvia also outperforms Lithuania in terms of 'ICT adoption' (80.4 versus 74.5), but also in 'Skills' (80.4 versus 73.3), 'Product market' (59.8 versus 57.7), and 'Labour market' (66.8 versus 65.2).

Figure 12. Global competitiveness index for the Baltic countries

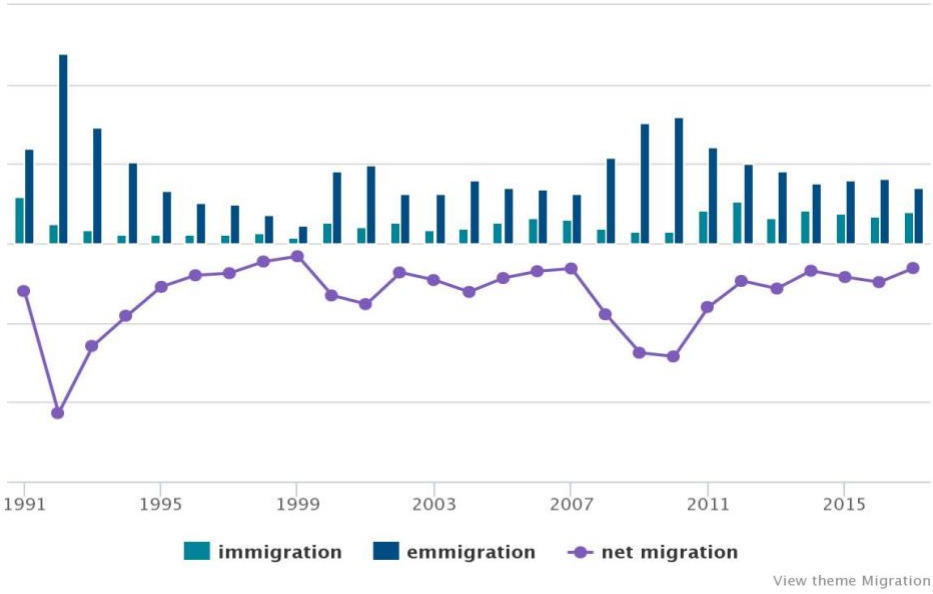


	Institutions	Infrastructure	ICT adoption	Macroeconomic stability	Health	Skills	Product market	Labour market	Financial system	Market size	Business dynamism	Innovation capability
Estonia	69.5	75.2	77.4	100	84.9	78	64.8	69.3	65.9	42.3	69.3	52.5
Lithuania	60.9	74.7	75.8	100	78.8	73.3	57.7	65.2	56.9	50.1	64.5	47.4
Latvia	57.9	73.1	80.4	100	78.8	74.5	59.8	66.8	53.5	44	64.3	42

Source: Global Competitiveness Index 4.0 2018 edition, 2018

Demographic challenges have a negative impact on overall economic development. Latvia has a negative population growth rate (-1.07% in 2017). Latvia's population is projected to continue declining by around 1% annually, but the decline in the working age population is set to intensify (European Commission, 2019). The country faces an large emigration issue. In the period 2000-2016 Latvia lost the largest share of its population (about 20%) of all EU countries. Natural decline is driven by high mortality rates and low fertility rates (European Commission, 2018 (c)). As illustrated in Figure 13 below, since 1990 net migration to Latvia has been negative. High emigration rates affect the labour market, because it is mainly the working-age population that is experiencing a dramatic fall (Organisation for Economic Cooperation and Development, 2016). Due to demographic challenges and emigration, businesses are raising concerns about unfilled vacancies, especially in the ICT sector, construction, metalworking and other industrial sectors.

Figure 13. International long-term migration



Source: Central Statistical Bureau of Latvia.

To summarise, Latvia's economy is stable in terms of macroeconomic performance and demonstrates good growth rates, but improvements are needed in terms of its competitive advantage and production modernisation in order to sustain long-term growth creation.

1.2 Research and Innovation System in Latvia

1.2.1 Key Challenges

After Latvia regained independence it had to restructure to become a market economy and businesses had to enter Western markets. The economy shifted more towards services. Small and medium-sized enterprises (SMEs) make up the major part of the economy and businesses have to produce higher value added products/services to improve the economy's general competitiveness. Partly because SMEs dominate the economy, private R&D investment (further detail is provided in section 2.1.) and share of high- and medium-technology companies in Latvia is low. Partly due to this, business sector collaboration with science is insufficient (OECD, 2019) and is a long-standing challenge for Latvia's research and innovation system to overcome. Public-private co-publication numbers are low and so are the numbers of researchers employed by the business sector. With few exceptions, universities have a weak entrepreneurial culture (European commission, 2018 (b)). Several policy instruments have addressed these problems over time, but have had limited success. Further policy effort is needed to address this challenge.

The science sector also had to re-orientate and has suffered from long-term underfunding and systemic problems. Since 2015, some structural reforms have been performed to deal with the fragmentation of research-performing institutions. Despite some reform efforts, fragmentation of R&D and higher education systems remains one of the key challenges. In 2014, the Ministry of Education and Science launched international a Research Assessment Exercise to assess all research-performing units in terms of scientific quality, relevance, socio-economic impact, research environment and development potential. Peer-review panels concluded that more than half of the assessed institutions are only satisfactory local players, 22 units were assessed as weak, and only 33 institutions were evaluated as strong national players, with 15 regarded as excellent research performers (Arnold et al, 2014). After the assessment, a decision was made to withdraw funding from those institutions with the lowest scores. The best-performing institutions received additional funding. The higher education sector in Latvia is also fragmented. Some 16 public and 13 private HEIs operated in Latvia in 2017. The numbers have slightly decreased over time (in 2004, 20 public and 16 private HEIs operated in Latvia), but the system is still overcrowded and there is a strong opposition to reforms.

Due to demographic challenges, high emigration rates and underfunding for research and innovation, Latvia's R&I system suffers from insufficient supply of human resources. Full-time R&D staffing is decreasing and is currently below the EU average. The number of new doctorates increased as a result of EU funds support measures, but is again considered insufficient. Also the numbers of STEM graduates and doctorates are below the EU average. With policy measures, some improvements have been made (see section 2.2. for further detail), but overall the progress is

insufficient and the numbers are too low to achieve economic transformation towards more value added.

Latvia's R&I system suffers from several governance-related problems. The core governance problem is fragmentation of institutional structure. Previous reviews have highlighted the need for a single implementing agency (European Commission, 2017 (a)). Currently, the implementation of research and innovation support measures is dispersed across five institutions with none of them acting as the lead innovation agency. This hampers synergies across policy measures. Research and innovation suffers from lack of political attention and the will to invest, which is partly caused by limited societal awareness of these matters.

In 2017, the Ministry of Education and Science, in cooperation with other ministries, carried out a monitoring of the progress in implementing the Smart Specialisation Strategy of Latvia (RIS3). The monitoring report concludes that there is some progress in several indicators. The summary of achievements for most relevant indicators is provided in Figure 14 below. Latvia has managed to reach the position of what is considered a 'moderate innovator' in the European Innovation Scoreboard, productivity in the manufacturing sector has slightly increased, as too the percentage of the population aged 30-34 with tertiary education. Thanks to some structural reforms, the number of state-funded R&D institutions has decreased. At the same time, many indicators show no progress at all. For example, investments in R&D are not progressing as planned and, based on recent trends, will not reach the target of 1.5% by 2020.

The successful take-up rate of EU Framework programme funding is decreasing, but this should be interpreted with caution, because it is affected by high competition and budgetary changes. The average success rate of project applications in the Horizon 2020 is 12.17%, which indicates that Latvia's performance is equivalent and even slightly higher than the EU average (Ministry of Education and Science, 2018 (b)).

Full-time R&D personnel is not progressing (Ministry of Education and Science, 2018 (b)). For several indicators, targets set for 2020 most likely will not be achieved.

Beyond statistical indicators, the implementation of RIS3 is seen to be generating positive results in terms of structural reforms, e.g. reducing the fragmentation of research institutions and designing stimulus to achieve research excellence. Here, it is believed that EU-funding programmes that provide investments in R&D, if successfully implemented, will provide some input in capacity building and research excellence.

More detailed analysis of R&D expenditure, human resources statistics and analysis of bibliometric indicators is provided in sections 2 and 3 of this report.

Figure 14. Progress of RIS3 indicators

RIS3 INDICATORS	2008	2009	2010	2011	2012	2013	2014	2015	ACTUAL	PROGRESS	2020
Position in European Innovation scoreboard (EIS position)	modest	modest	modest	modest	modest	modest	modest	modest	moderate (2017)	▲	moderate
Productivity in manufacturing sector (t. EUR per worker)	15.6	15.7	18.5	19.9	20.3	20.3	21.4	22.4	23.6 (2016)	▲	29
% of population 30-34 years old with a tertiary education diploma	26	31	33	36	37	41	40	41	43 (2016)	▲	40
Number of state funded R&D institutions	39	40	40	41	41	41	40	29	22 (2017)	▲	20
Number of peer-reviewed research papers (SCOPUS)	857	922	1032	1731	1565	1656	1601	1978	1820* (2016)	▲	1500
Success rate in EU framework programs (%)	23	21	20	23	16	19	18.8	7.45	12.7 (2016)	▼	30
R&D expenditure (% of GDP)	0.62	0.46	0.6	0.7	0.66	0.6%	0.69	0.62	0.44 (2016)	▼	1.5%
Number (FTE) of R&D personnel	6533	5485	5563	5432	5593	5396	5739	5570	5120 (2016)	▼	7000
Number of tertiary education graduates (in thousands)	24.2	26.0	26.5	24.8	21.5	21.6	17.4	17.0	15.8 (2016)	▼	24.6

Source: Ministry of Education and Science, 2018 (b)

1.2.2 Research Performers

Most research in Latvia is performed in higher education institutions and public research institutes. Private R&D constitutes only 0.14% of R&D and employs only a minor share of R&D personnel.

The Law on Scientific Activity differentiates between scientific institutes in Latvia, dividing them into four categories:

Public agency – established by a decision of the relevant public person decision-making institution and operating with the transferred property and financial resources at its disposal; it can launch competitions, enter into contracts, and determine payment for the services provided in the fields of research and the improvement of scientific qualifications;

Derived public entity – established by a decision of the Cabinet of Ministers that determines the movable and immovable property to be transferred into the possession or use of the institute; the institute's Council of Science is the decision-making body that approves the by-laws and budget of the scientific institute; it may also establish, reorganise and liquidate institutions, found, reorganise and liquidate capital companies, and make decisions regarding participation in associations, foundations and capital companies. All main state scientific institutes are derived public entities;

Structural unit of a higher education institution.

Private law legal entity or its structural unit – may also be founded as a state or local government capital company.

Scientific institutions are listed in the Register of Scientific Institutions. Currently, 67 institutions are listed in the register. This is down from 150 institutions listed in 2011 and 78 in 2017. This rationalisation has been achieved mainly through the amendment in 2013 of the Law of Scientific Activity which stipulates that universities can register as research performers, either for the whole university or its structural unit. Due to this amendment, the number of university structural units included in the register has fallen. In addition, further mergers, closures and clarifications concerning institutions' actual engagement in research activities have shrunk the initial list of scientific institutions (European Commission, 2017 (a)). According to the Law on Scientific Activity, a scientific institution should comprise at least five persons with PhD degrees in the corresponding field of science.

To acquire a more precise understanding and reduce the excessive fragmentation of the research system, in 2011, the Ministry of Education and Science launched an international Research Assessment Exercise (RAE). The assessment comprised an evaluation of scientific activities in 150 research units listed in the Register of Scientific Institutions (status in 2011). The performance of each unit was assessed in five dimensions: scientific quality, impact on science, economic and social impact, research environment and infrastructure, and development

potential[2]. The RAE's aims were to provide detailed reasoning and recommendations for the consolidation of scientific institutions and better science-industry collaboration to serve as a basis for reforming the research system (European Commission, 2017 (a)).

The overall scores awarded by the peer-review panels showed that the performance of 15 Latvian research institutions was assessed as excellent and good, and 33 institutions were evaluated as strong national players. More than half – or 77 research units – were judged to be satisfactory local players, and the performance of 22 research units was assessed as weak. Around ten research units listed in the Scientific Activity Registry did not perform research activities, and thus were not evaluated. While this was the first time such an assessment exercise had been carried out, and scientific institutions had to follow an important learning curve on how best to present their organisation, a decision has been made to withdraw base funding from those units that received an overall score of 1 and 2, thereby incentivising them to explore consolidation and restructuring options. The best-performing scientific institutions (those receiving 5 and 4) have been allocated additional funding totalling EUR 11 million in 2015 to prepare their development strategies, which set the base for further reforms aimed at increasing scientific capacity and excellence (European Commission, 2017 (a)).

The exercise concluded that in mathematics and natural sciences there are comparatively strong and well-established research institutions, although there are both low and comparatively high performers. This strength represents an important economic opportunity. Engineering and computer science is surprisingly fragmented, with a great deal of activity at levels below international norms, but with important high spots, too. Research units in life sciences are mainly national players, but there are also high performers with a handful of units that can perform at international levels for quality and relevance. Agricultural research was assessed as being overly inward and focusing on national needs, and would benefit from a more international perspective. Social sciences are highly fragmented and not very mature in Latvia as many of the sub-disciplines have only been developed during the post-Soviet period. Research groups in humanities, however, represent a slightly higher quality and scientific relevance due to more established research traditions and organisations (Arnold et al., 2014).

Higher education institutions play an important role in the Latvian R&I system with around 58% of researchers concentrated in this sector. The HE system also demonstrates problems relating to excessive fragmentation. According to MoES data, there were 49 HEIs operating in Latvia in 2017. This number includes 16 state HEIs and 12 state colleges, and 13 HEIs as well as eight colleges established by legal entities (Ministry of Education and Science, 2018 (c)). However, the two main universities – the University of Latvia (UL) and Riga Technical University (RTU) – account for more than 40% of researchers and academic staff working

2 For more details on the assessment methodology see Arnold et al., 2014.

within the HEI sector (European Commission, 2017 (a)). Higher education remains fragmented despite the incentives for consolidation and gradual strengthening of quality assurance, supported by EU funds. Nevertheless, the number of study programmes grew by a third between 2005 and 2017, while student population declined by 38% (European Commission, 2019).

Private research performers have a minor role. The private sector is dominated by SMEs. Foreign direct investment levels are satisfactory, but most FDI is not R&D intensive, thus does not contribute to transformation towards more R&D intensity in economy. Large, state-owned companies perform little R&D and are reluctant in developing cooperation with start-ups (Ministry of Economics, 2019). Most start-up companies do not declare any R&D spending (Ministry of Economics, 2019).

1.3 Research and Innovation Policies and Governance in Latvia

The Ministry of Education and Science and the Ministry of Economy mostly lead research and innovation policymaking in Latvia. Although the Head of the Government leads the Research and Innovation Strategic Council, which is a strategic coordinating institution, the role of the council is not very strong. This is illustrated by the fact that, for example, in 2018 not a single council meeting was held. The two ministries mostly determine the policy agenda. Therefore, sometimes the governance suffers from lack of systemic perspective and coordination of effort. This has somewhat changed since the introduction of the RIS3, which requires some systemic perspective on the achievement of defined goals. On the political level, the research and innovation policy is not high on the agenda and this has resulted in underfunding and lack of political attention and leadership in supporting necessary reforms.

Recently, there have been improvements in terms of involvement of sectoral ministries in planning and implementing State Research Programmes. Since the end of 2018, sectoral ministries can have their own state research programmes in the fields in which they operate. Before 2018, there was no research budget for sectoral ministries and only the Ministry of Education and Science could plan and implement State Research Programmes.

Policy implementation suffers from fragmentation as six agencies are involved in funding various research and innovation projects. This inhibits institutional capacity building, organisational learning and high-quality funding processes. An example of this is uncoordinated peer-reviews to select projects for funding. Several agencies have separate systems and do not have the critical mass to sustain a well-coordinated network of experts (European Commission, 2018 (b)).

A broad variety of instruments to promote science and innovation exists (see Appendix A). Policy instruments for science include support for research projects, internationalisation, research infrastructure, post-doctoral research and others. The majority of the successful research-industry cooperation focuses around the Competence Centres scheme, which draws industry to work together with research institutions. Other innovation programmes providing vouchers, technology transfer, training and other development programmes are available (European Commission, 2019).

The following sub-sections present key players of research and innovation governance and the main policy planning documents and initiatives. Policy instruments for science competitiveness, increasing innovation capacity and business development are presented in Appendix A. Policy measures targeting human resources are described in section 4.

1.3.1 Key Players of Research and Innovation Governance in Latvia

The governance of Latvia's research and innovation system and its main players at political, advisory, policy, administrative, support and performers level is illustrated in Figure 15, and key players and their roles are described below.

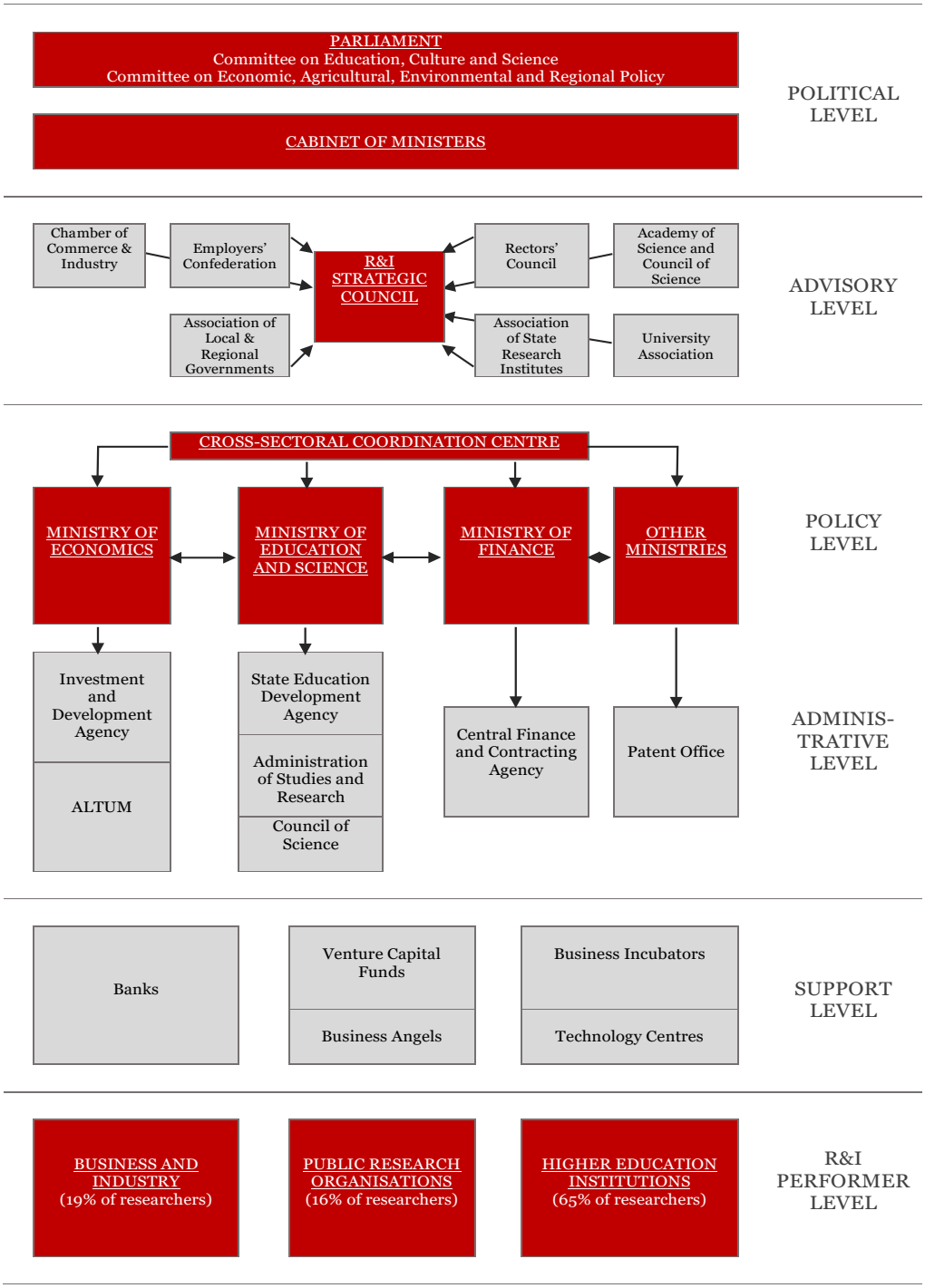
Saeima, Latvia's Parliament, and the Cabinet of Ministers are the two high-level political institutions that make decisions on research and innovation policies and funding. Sometimes the thematic commissions of the Parliament organise hearings and discussions about relevant policy topics, but this serves mostly as a discussion forum. The Cabinet of Ministers approves regulations related to R&I policy. Both institutions decide on such matters as the budget for research and innovation policy and assessments of research institutions, and they determine the research priority directions every four years.

The Research and Innovation Strategic Council was established in 2014. It aims to provide a coordinated approach towards research and innovation policy implementation and brings together the key R&I players. The prime minister leads the Council and takes the initiative to organise the Council meetings. Other ministers participate according to the topics discussed. Higher education institutions, public research organisations, the Academy of Science and organisations representing businesses, and local governments are also active members of the Council. Although the Council provides a platform for discussing major policy decisions between key players, recently its activity has been minimal. As previously mentioned, in 2018 the Council was not active and not a single meeting took place. Before 2018, the meetings were more or less regular, and such topics as implementation and progress in the Smart Specialisation Strategy and with adapting regulations for EU structural funds investments were discussed.

The Cross-Sectoral Coordination Centre is the body responsible for development of mid-term and long-term policy strategies and coordination of sectoral policies with these documents. The centre has developed the National Development Plan of Latvia for 2014-2020 and is currently coordinating work on the upcoming plan for 2027. These long-term policy planning documents also address the topics of research and innovation, and the centre coordinates other policies and their correspondence with the goals defined in long-term policy documents.

The Ministry of Education and Science (MoES) is the key player in research and higher education policy planning. The Ministry designs key policy documents and coordinates the implementation of the policy measures. Among others, the Ministry also is in charge of developing, implementing and monitoring the RIS3.

Figure 15. Governance of the research and innovation system in Latvia



Source: Kulikovskis et al., 2015, adapted by the authors

The Ministry of Economics is another key player in research and innovation policy. It is responsible for policies related to business support and innovation, and designs and monitors Structural Funds programmes for business competitiveness and innovation capacity.

Other ministries can be involved in research and innovation policy planning in their respective fields of competence. Recently, the role of sectoral ministries has increased in planning State Research Programmes that deal with the topics of respective ministries. The Ministry of Finance is responsible for annual budget planning and is the Managing Authority of EU Structural Funds. The Ministry of Finance is active in research and innovation policy planning to ensure progress towards achieving goals defined in the RIS3.

The Central Finance and Contracting Agency is part of the Ministry of Finance and implements EU Structural fund support measures. Although several measures are administered by other agencies with a more direct role in research and innovation matters, the Central Finance and Contracting Agency is also responsible for implementing R&I-related measures. The agency is experienced in administering Structural funds, but has to build competence in research and innovation matters.

The State Education Development Agency is the largest agency with the greatest role in implementing R&I support measures, under the Ministry of Education and Science. Besides implementing support measures for research and innovation, it also administers other international programmes, for example, BONUS programme, EUREKA, COST, and ERASMUS+. Due to simplification efforts, implementation of several EU Structural Funds programmes has been shifted to the Central Finance and Contracting Agency, but some specific programmes are still managed by the State Education Development Agency, because it holds the required competence. One such programme is support for post-doctoral research, because implementation of the programme requires access to international research networks, close relations and familiarity with HEIs and research institutions.

The Latvian Council of Science was created in 1990 with the task of formulating and coordinating science policy and acting as a research council, assessing applications for research funding and allocating money according to the competition. The Council provides advice on R&D and higher education policy formulation and implementation, representing the voice of the academic research community, for instance, by providing input to the formulation of State Research Programmes. The Council is a collegial body of scientists comprising representatives from 14 institutions. It operates through five expert commissions which act as assessment panels for proposals for scientific research projects and programmes. It is in charge of the formulation and continual improvement of evaluation criteria for assessing research projects and research-performing institutions. In practice, it tends to function as a funding agency of the MoES, evaluating fundamental or applied research projects and distributing funds in accordance with the procedures specified by the Cabinet of Ministers (European Commission, 2017 (a)).

The Administration of Study and Research (ASR) is an agency of the MoES. Its main task for science involves administrative and financial oversight of the implementation of state-funded fundamental and applied research projects, as well as interacting with, and supporting, the Latvian Council of Science. Each year, the ASR submits a report to the MoES on the utilisation of state-budget resources allocated to state-funded research programmes and projects (European Commission, 2017 (a)).

Investment and Development Agency of Latvia (LIDA) is an administrative agency under the responsibility of the Ministry of Economy. Its main objectives are to facilitate foreign investment and increase the competitiveness of Latvian entrepreneurs, thereby promoting business development. In 2004, LIDA became one of the main funding agencies responsible for administering EU funds and implementing state support programmes in entrepreneurship and innovation. Currently, it is focusing predominantly on the implementation of national programmes regarding export promotion. In addition, the Latvian Tourism Agency has been merged with LIDA. There appears to be less of a focus on innovation, while the Agency continues to implement some strategic Structural Funds co-financed initiatives like innovation vouchers, business incubators, and technology transfer programmes.

The JSC Development Finance Institution Altum (ALTUM) is a financing institution that is fully owned by the state and has three ministries as its shareholders (the Ministry of Finance, Ministry of Economy and Ministry of Agriculture). This new institution was created in April 2015 when the Latvian Guarantee Agency (LGA) merged with the State Joint Stock Company Latvian Development Financial Institution Altum (ALTUM) and the State JSC Rural Development Fund (RDF) (Kulikovskis et al., 2015). ALTUM provides alternative risk capital funding for businesses with insufficient collateral. Its objective is to provide efficient and professional support to certain business target groups using various financial instruments (loans, guarantees, investments in risk capital funds, etc.) that are supplemented by non-financial support (consultation, training, monitoring, etc.). The aim of this financing institution is to incentivise entrepreneurial activities and promote the growth and expansion of business operations (European Commission, 2017 (a)).

1.3.2 Main Policy Planning Documents and Initiatives

Most relevant policy planning documents for research, development and innovation in Latvia are summarised in Figure 16 below and described in more detail in the following paragraphs. Policy guiding documents are well developed and provide a comprehensive framework for policy.

Figure 16. Policy planning documents for research, development and innovation

Key policy planning documents				
National Development Plan 2014-2020	National Industrial Policy Guidelines 2014 - 2020	Goods and Services Export Promotion and Attraction of Foreign Investments Guidelines 2014-2020	Education Guidelines 2014-2020	Science, Technological Development and Innovation Guidelines 2014-2020 including Smart Specialisation Strategy

The National Development Plan 2014-2020 (NDP2020), adopted in 2012, is the central medium-term policy planning document in Latvia. The NDP2020 aims to encourage economic growth and competitiveness, and to improve the Latvian population's well-being. The overall objective is to provide targeted and prudent investment of resources in areas that ensure smart specialisation, employment and cohesion. Over a ten-year period, NDP2020 quantitative targets for R&I foresee a significant increase in overall R&D investment to reach the goal of 1.5% of GDP in 2020. Private R&D investment is expected to increase by 11% and the targeted increase in the number of researchers employed in the private sector is around 6.8%. The aim is also to more than double the 2011 level for European patents granted to researchers residing in Latvia. With respect to human resources, the goal is to maintain the current number of students graduating from universities and colleges, and to slightly increase the share of the population (aged 30-34) holding a higher education degree (Cross-Sectoral Coordination Centre, 2012).

Guidelines for Science, Technology Development and Innovations for 2014-2020 set the objective for developing knowledge and innovation capacity, as well as coordinating the innovation system. According to the guidelines, strategic lines of action are:

- to develop human resource capital of science, technology and innovation sector;
- to promote the international competitiveness of science;
- to modernize and integrate research and education sectors, increasing their ability to respond to future challenges;
- to create a more efficient knowledge transfer environment and strengthen corporate absorption and innovation capacity;
- to optimize the management of science, technology and innovation sector (Ministry of Education and Science, 2018 (a)).

Guidelines for the National Industrial Policy for 2014-2020 aim at promoting economic structural changes, increasing the production of goods and services

with high added value, including strengthening the role of industry, allowing modernisation of industry and services, as well as expanding exports. The main action lines are:

- The availability of the workforce and supply of education corresponding to economic development needs, and the development of industrial zones;
- The availability of financing;
- Increasing innovation capacity;
- Promoting exports;
- Reducing energy costs (Ministry of Education and Science, 2018 (a)).

Guidelines for the Development of Education for 2014–2020 aim towards qualitative and inclusive education for the development of personnel, citizen's welfare and sustainable growth. Lines of action are:

- To increase the quality of the education environment by improving the content and developing appropriate infrastructure;
- To promote education-based development of an individual's professional and social skills;
- To improve resource management efficiency by developing institutional excellence (Ministry of Education and Science, 2018 (a)).

Guidelines for Promoting Exports of Latvian Goods and Services and Attracting Foreign Investments for 2013-2019 aim to increase Latvia's economic competitiveness in open product markets by fostering more production and exports by the medium- and high-technology industry. The guidelines focus on external demand-oriented industries by attracting foreign investment (Ministry of Education and Science, 2018 (a)).

In 2014, Latvia's research and innovation governing institutions, led by the Ministry of Education and Science, developed Latvia's Smart Specialisation Strategy (RIS3) for transforming its economy into one focused on higher added value that uses resources more efficiently. The strategy aims at restructuring exports by inducing change and growth in:

- Production and export structure in traditional sectors of the economy;
- Future growth of existing sectors or in products and services with high added value;
- Sectors with significant horizontal impact and potential to transform the national economy.

To induce the change and growth in these sectors, the strategy has outlined seven investment priorities and defined five specialisation areas. The investment priorities are:

- High added value products;
- Productive innovation system;

- Energy efficiency;
- Modern ICT;
- Modern education;
- Advanced knowledge base and human capital in this area, in which Latvia has a comparative advantage and which are important in transforming the national economy;
- Polycentric development.

The knowledge specialisation areas are:

- Knowledge-intensive bio-economics;
- Biomedicine, medical technologies, bio-pharmacy and biotechnologies;
- Smart materials, technologies and engineering systems;
- Smart energetics;
- Information and communication technologies (ICT).

To concentrate public R&D investment in programmes that create future domestic capability, the Strategy has defined three core criteria for allocating public resources:

- Growth of S&T human capital (knowledge and networks), expressed as the increased competence of individuals engaged in projects;
- Scientific excellence, characterised by the level of usefulness of new knowledge in meeting future or present economic and societal challenges;
- Net economic value or today's financial and social benefits that projects will create (Ministry of Education and Science, 2016).

The Law on Scientific Activity determines that investments in research should increase by 0.15% of GDP annually.

Recently (2014-2017), the Ministry of Education and Science and the Ministry of Economy have provided several regulatory improvements to the R&I system. In 2013, a new cabinet regulation 'Procedures for Calculating and Allocating Basic Science Funding to Scientific Institutions' was issued. It regulates the allocation of basic science funding, and it changed the criteria and conditions for this by introducing incentives based on excellence, international competitiveness and cooperation with industry. In 2014, the Cabinet also adopted 'Regulations on Research and Development Activity for the Application of the Enterprise Income Tax'. These regulations lay down the procedures for the application of the enterprise income tax relief if the company has conducted research and development activities (Ministry of Education and Science, 2018).

In 2016, the law 'On Aid for the Activities of Start-up Companies' was adopted to promote the creation of fast-growing technology enterprises or newly created (start-up) companies in Latvia, as well as to promote the commercialisation of R&D results (Ministry of Education and Science, 2018 (a)). Although the law has

been criticised for its narrow focus, the direction of the activity is welcome and necessary.

At the end of 2017, the Ministry of Education and Science defined nine priority directions in science (Ministry of Education and Science, 2017 (a)):

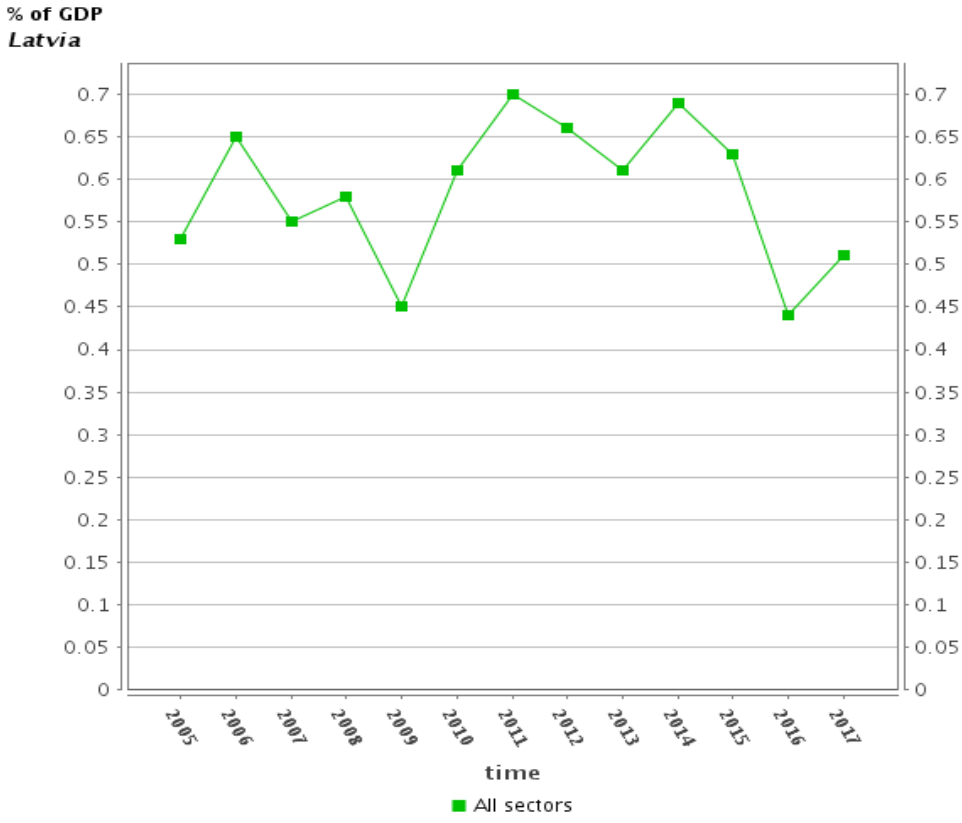
- Technologies, materials and systems engineering for increased added value products and processes, and cybersecurity;
- Strengthening energy supply security, development of the energy sector, energy efficiency, and sustainable transport;
- Climate change, nature protection, and the environment;
- Research and sustainable use of local natural resources for the development of a knowledge-based bioeconomy;
- Latvia's statehood, language and values, culture and art;
- Public health;
- Knowledge culture and innovations for economic sustainability;
- Demographics, sports, open and inclusive society, welfare and social resilience;
- State and public safety, and defence.

2 ANALYSIS OF RELEVANT STATISTICAL DATA

2.1 Research and Development Expenditure

In 2017, the total GERD in Latvia was 0.51% of GDP (see Figure 17). The GERD increased to 0.62% in 2015 (compared to 0.56% in 2007), it then decreased again in 2016 and is still very much below the EU average of 2.03%. The decrease in 2016 is explained by the reduction of private and EU funds/investments (Ministry of Education and Science, 2018). In 2017, the situation slightly improved, because the EU funding programme 2014-2020 (Horizon 2020) started to operate. Nevertheless, investments in R&D are very much below EU average and do not reach the targets set by the policy planning documents (to achieve R&D investment of 1.5% of GDP by 2020).

Figure 17. Gross domestic expenditure on R&D

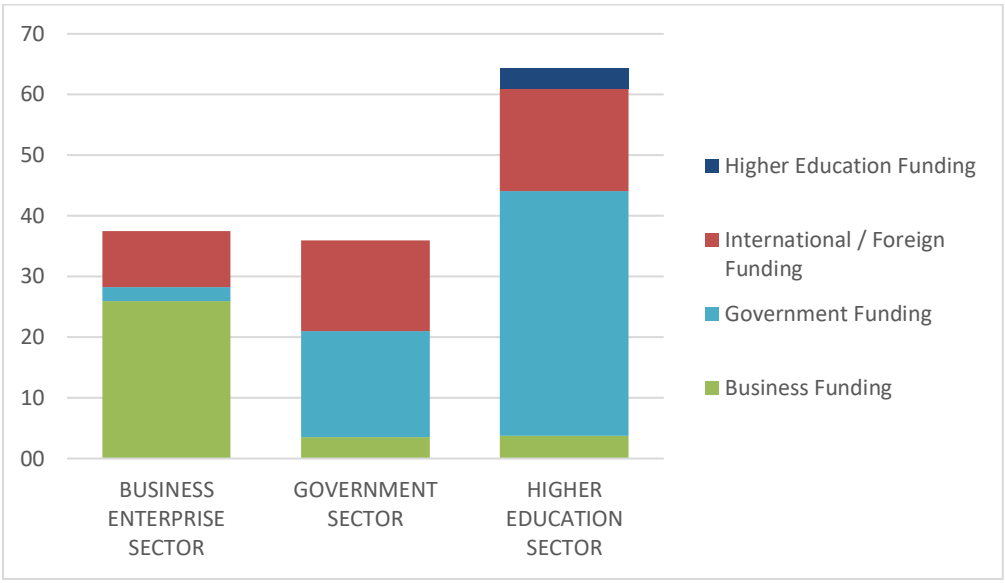


Source: Eurostat

As illustrated in Figure 18, higher education is the largest recipient of state R&D expenditure per sector of activity, and the business sector receives the least. Also the share of funds contributed to state research and education by business enterprises is relatively small. The share of R&D performed by the higher

education sector is the most significant contributor to R&D activity in Latvia, spending more than a half of the total R&D funds (64.4% in 2017).

Figure 18. R&D expenditure per sector of activity in 2017 (m EUR)



Source: Central Statistical Bureau of Latvia

To facilitate an increase in public investment in R&D and develop sectoral human capital, in 2018 the state funding for science and research was increased by EUR 3.4 million. State Research Programmes will be financed not only from the budget of the Ministry of Education and Science, but also from the budget of the relevant sector. Starting from 2018, an additional EUR 2 million are allocated from the budget of the Ministry of Economics for implementing the state research programme in the field of energy (Ministry of Education and science, 2018 (a)).

During the economic crisis, EU Structural funds somewhat compensated for the large reductions in national R&D spending, but also created a dependency on these foreign resources (European Commission, 2017 (a)). EU Structural funds are also now important in addressing key challenges and promoting R&D in the private sector, as well as strengthening links between research and industry. Funds are invested according to the RIS3 that helps to focus investments in a limited/focused number of priorities. EU funds are very important in boosting research excellence and capacity building in Latvia's research and innovation system.

Although EU funds play an important role in funding and increasing Latvia's R&I capacity, the total amounts of these funds invested in Latvia are comparatively lower than in its neighbouring countries. In the programming period of 2014-2020, Latvia reported the lowest allocation of Cohesion Policy funding for research and development among the Baltic States (European Commission, 2016).

An R&D tax incentive was introduced in 2014. The scheme offers a 300% deduction of a range of R&D expenditures, but has not had much of an impact. A tax system reform proposes to replace the R&D tax incentive by a zero corporate income tax on reinvested profits (Kulikovskis, 2017).

To ensure more rapid economic growth, a significant increase of public investment is needed (European Commission, 2018 (b)).

EU-level programmes are important for Latvia's research and provide some additional funding despite high competition and the limited overall funding offered by Horizon 2020. Latvia's success rate in this framework programme is a little above EU average (12%), and while the programme is still on-going, Latvia has managed to implement more projects than in the previous programme.

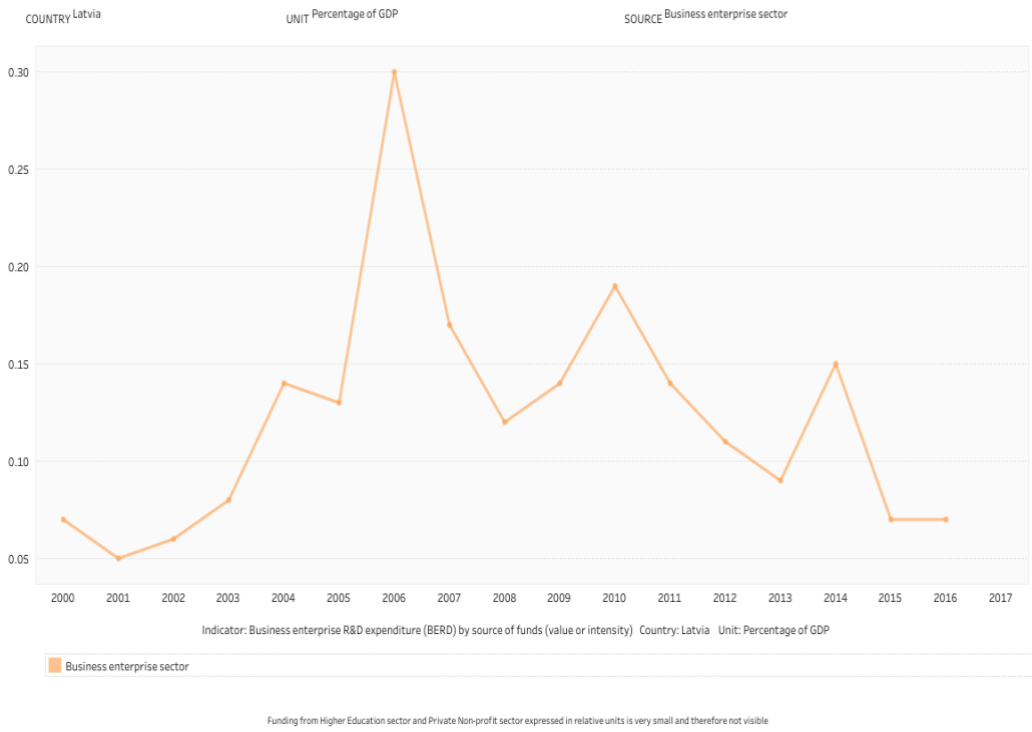
Figure 19. Success rates in EU Framework programmes

	Seventh Framework Programme (2007-2013)	Horizon 2020 (2014-2018)
Number of project applications	1127	1874
Supported projects	240	243
Project coordinators	30	37
Success rate	21.3%	13.0%
Funding (EUR, million)	49.04	54.95

Source: Ministry of Education and Science (b).

In Latvia, BERD is one of the lowest in the EU and, as illustrated in Figure 20, is stagnating in values below 0.2% of GDP. The biggest share of business expenditure on R&D is funded by the sector itself. Manufacturing and business service sectors are the highest spenders of BERD. Top sectors are the pharmaceutical industry, which consists of several big companies, manufacturing of computers, electronic and optical products, and the manufacturing of wood products. In terms of services, sectors such as ICT, financial and insurance are top BERD spenders. The peaks of slightly increased BERD in 2006, 2010 and 2014 can be explained by an inflow of EU Structural fund investments and measures that support R&D in the private sector.

Figure 20. BERD percentage of GDP



Source: EUROSTAT

2.2 Science and Technology Human Resources Statistics

Lack of human resources is one of the key concerns for Latvia's R&I system. Several factors contribute to this: demographic challenges and the age structure of researchers, insufficient R&I funding (thus insecure research careers), lack of mechanisms to attract industry scientists (Kulikovskis et al, 2018) insufficient numbers of STEM and doctoral graduates, problematic human resources governance in HEIs. The main statistical indicators characterising human resources for research and innovation are summarised below.

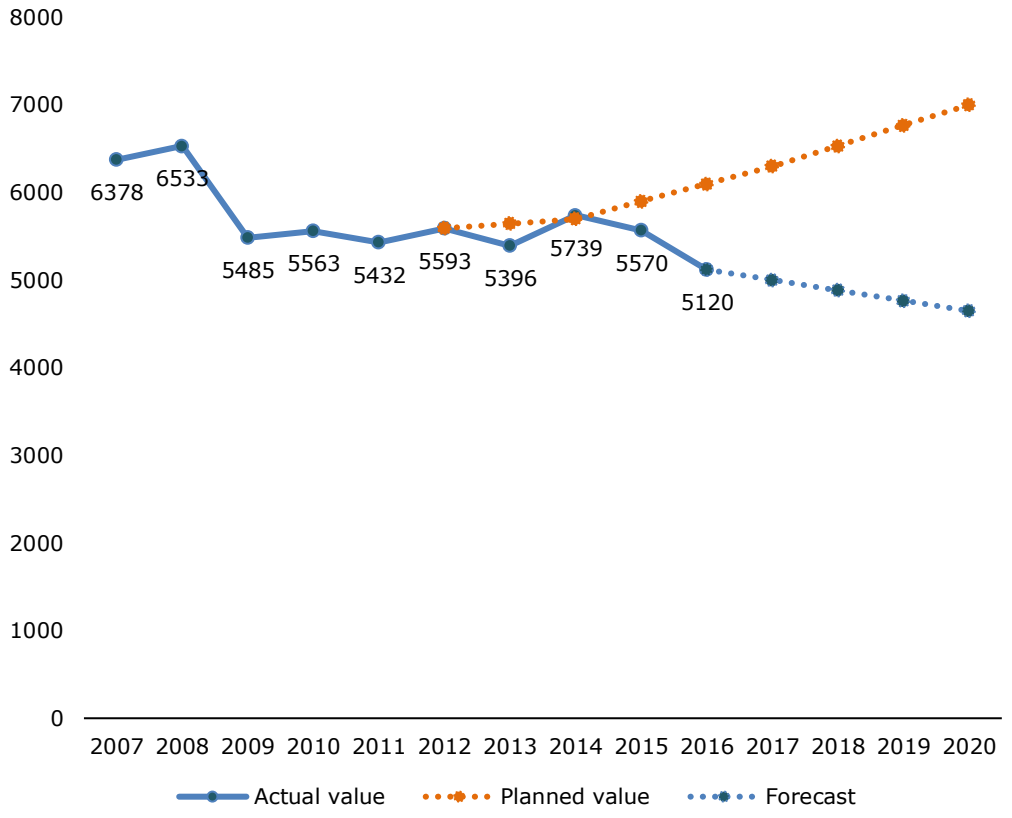
Science and technology human resources are highly affected by demographic challenges and emigration rates. In the period 2009-2016, 120,000 skilled workers[3] left Latvia. This is equivalent to 11.3% of the medium- and high-educated working-age population and 17.4% of the high-educated population (European Commission, 2018 (c)).

[3] Defined as outflow of of working-age population with completed medium or high education (ISCED levels 3-4, 5+).

In 2016, the total number of researchers (full-time equivalent or FTE) was 5,379 of which 15% were employed by industry (Ministry of Education and Science, 2018 (b)). Figure 21 below illustrates that the number of FTE R&D personnel is low and is decreasing. Figure 19 illustrates that this number is well below the EU average. Figure 22 illustrates the number of R&D personnel by sector. The HE sector employs most of the R&D personnel, and this trend has not changed much over time.

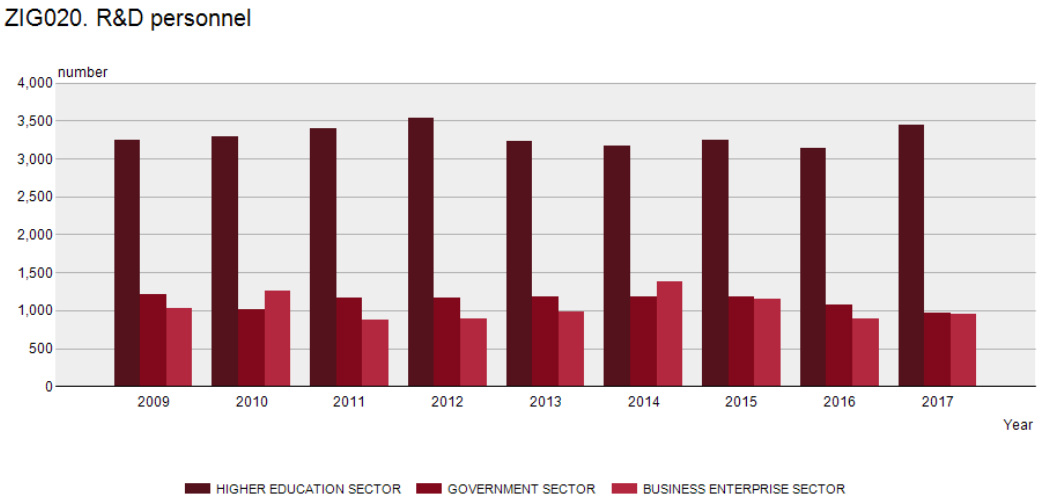
The number of full-time R&D personnel is too low to achieve the targets defined in policy planning documents and to support successful economic transformation towards more value-added results. Furthermore, forecasts for this indicator indicate that there will be further decline. Insufficient increase in public and private R&D funding has a negative impact on science and technology human resources, because it prevents scientific institutions from establishing and filling new R&D positions.

Figure 21. Number of full-time R&D personnel, planned vs. actual (in FTE)



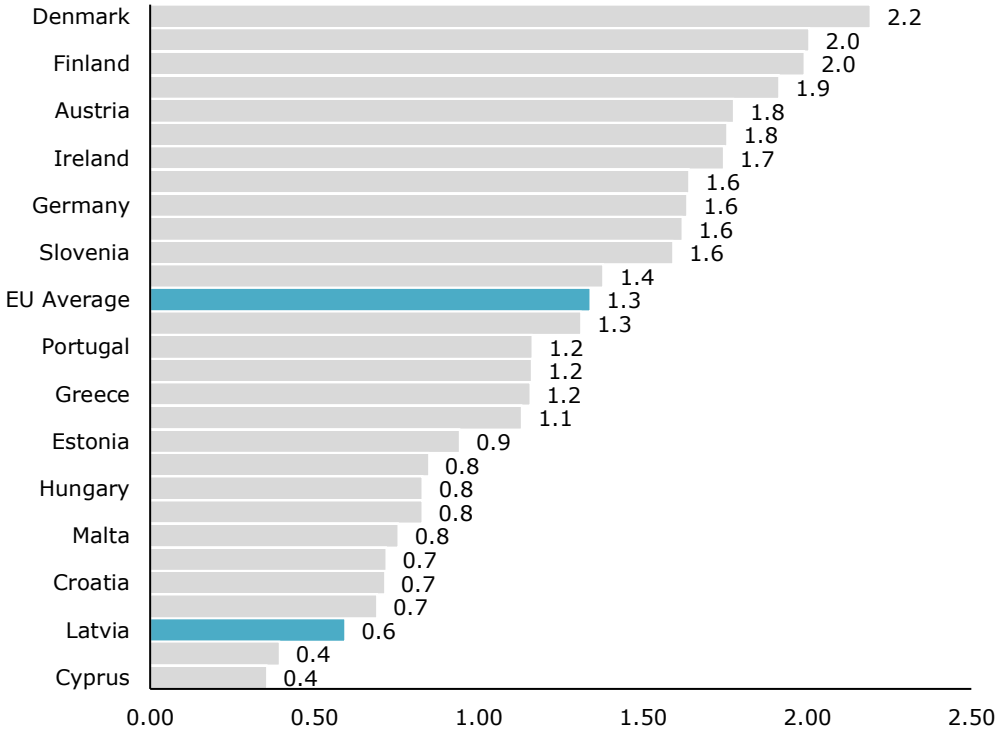
Source: Ministry of Education and Science, 2018 (b).

Figure 22. R&D personnel by sector and year, (in FTE)



Source: Central Statistical Bureau of Latvia

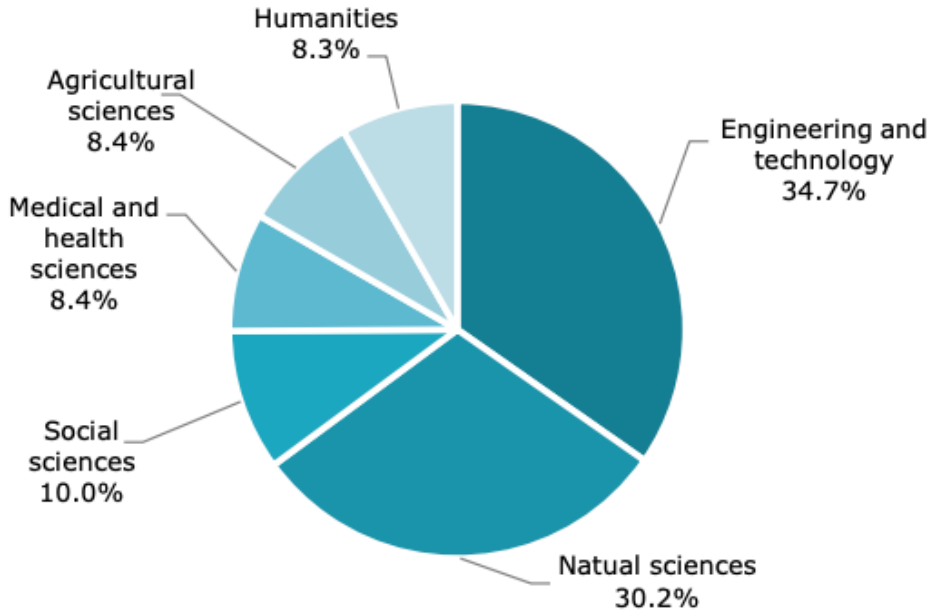
Figure 23. Percentage of workforce employed in science in 2016



Source: Ministry of Education and Science, 2018 (b)

Figure 24 illustrates the distribution of FTE researchers in different science fields, led by engineering and technology (34.7%) and natural sciences (30.2%).

Figure 24. Researchers by field of science, FTE, 2016



Source: Central Statistical Bureau of Latvia, 2018.

Latvia is struggling to produce enough graduates science, technology, engineering and medicine (STEM). The number of STEM graduates in 2017 per thousand of population was 12.7 (the EU average is 19.1). The proportion of students studying in STEM study programmes has gradually increased, which is explained by the reallocation of study places within which STEM study places are given a higher priority. However, the trends of recent years show that the rate of increase in the number of graduates in STEM study programmes has been significantly slower and has not increased in the last three years. In the academic year of 2016/2017, 19.8% of graduates were studying in a STEM programme, and this is below EU average (25%). Trends in recent years can be partly explained by high dropout rates in STEM programmes. This is caused by weaknesses in secondary education (Ministry of Education and Science, 2018 (a). Insufficient numbers of STEM graduates is one of the reasons for a shortage of human resources for research and innovation in Latvia.

The numbers of doctorates increased considerably during the period 2011-2013 when doctoral students received substantial support from EU Structural funds measure that provided scholarships for doctoral studies. Figure 25 below illustrates that the number of PhD graduates was doubled between the period 2011-2014 compared to 2010 and before, when there was no support for doctoral studies. The funding measure is no longer available and this is evident in decreased numbers of graduates from 2016 onward. Overall, however,

production of graduates in recent years has been good, but is overshadowed by brain drain problems and population loss.

Figure 25. Number of doctoral graduates

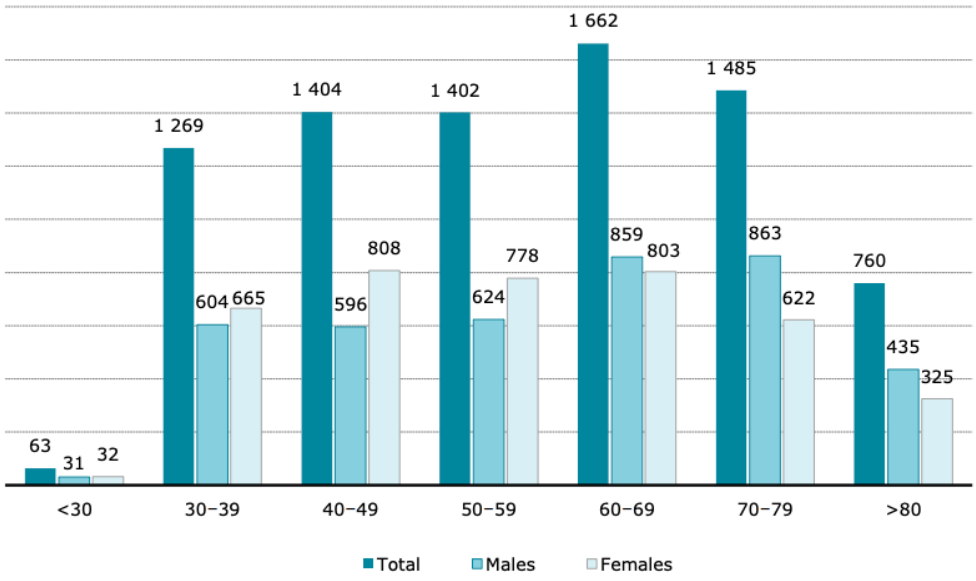
Source: Ministry of Education and Science

Although EU Structural funds for doctoral research and demographic shifts, including a slight improvement in the average age of researchers, have helped to turn out more PhDs, the overall ageing of the research workforce (see Figure 26) is still a concern in Latvia and contributes to a shortage of human resources for R&I in Latvia. A large share (more than half) of the people with a doctorate degree represent the age groups of 60-69 and 70-79, which means that many researchers are approaching retirement and there will be insufficient numbers of doctoral graduates to replace them.

Several institutions have especially high numbers of researchers above 65. Those are: the Institute of Electronics and Computer Sciences, State Institute of Wood Chemistry, and Institute of Solid State Physics. The largest technical HEI, Riga Technical University, has a high share of researchers aged below 35. Most of the research institutes have insufficient numbers of researchers in the age group 45-65 (Fidea, Technopolis Group, 2017). The situation is slightly better in the private sector where most of the R&D personnel are concentrated in the 25-44.

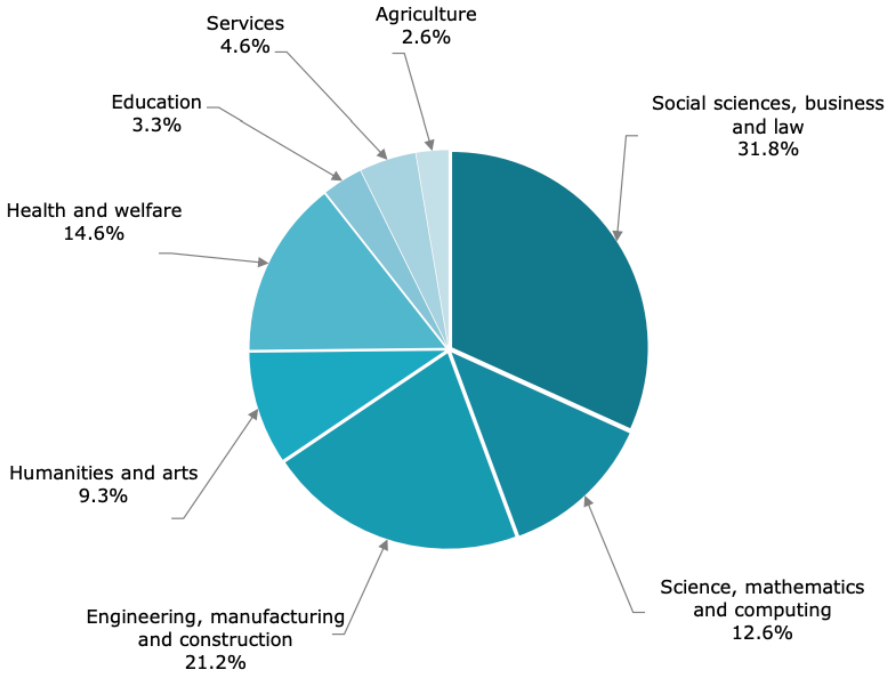
Doctoral graduates in STEM programmes per thousand of the population in Latvia came to 0.2 in 2017 (the EU average is 1). The breakdown of doctoral graduates by field of education in the academic year 2016/2017 is presented in Figure 27, below. Social sciences, business and law have the largest share (31.8%) of doctoral graduates, followed by engineering, manufacturing and construction (21.2%), and health and welfare (14.6%).

Figure 26. Doctorate holders by age and gender, 2017



Source: Central Statistical Bureau of Latvia, 2018.

Figure 27. Graduates of doctoral studies by field of education (academic year 2016/2017)



Source: Central Statistical Bureau of Latvia, 2018

In 2015, the Ministry of Education and Science performed an analysis of employment trends among doctorate-holders in Latvia. The total numbers of doctorates across science disciplines and their employment status (full- or part-time employed or inactive) is illustrated in Figure 28 below. Some 8% of all doctoral graduates are economically inactive or looking for a job, and another 23% are employed only part time. A further 60% of doctoral graduates are represented in STEM fields.

Figure 28. Doctoral graduates across disciplines, 2015

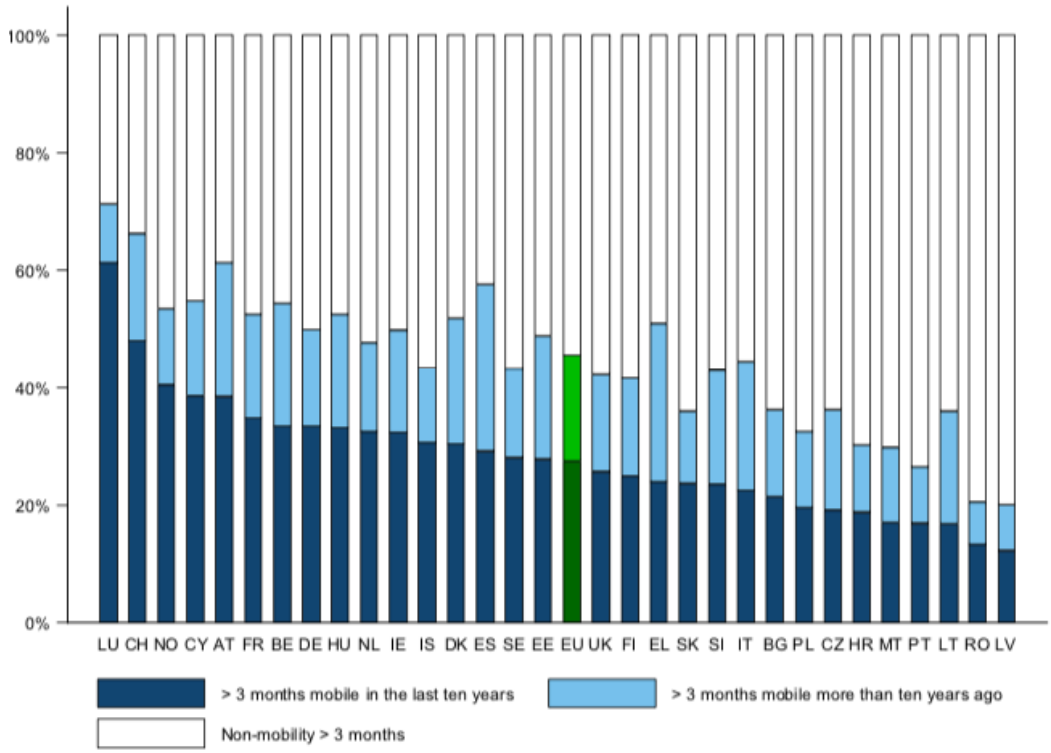
		Employed		
	Total	**Full time**	**Part time**	**Economically inactive or looking for job**
Total	3946	2699	922	326
Life sciences	1086	726	244	116
Engineering	683	444	194	45
Medicine and health sciences	454	366	72	16
Agriculture sciences	156	120	29	7
Social sciences	1014	686	237	91
Humanities	552	356	146	51

Source: Ministry of Education and Science, 2017 (b)

Higher education institutions are quite independent in terms of determining salaries. Legislation only determines the minimum salary for certain academic positions. For example, the minimum salary is EUR 1,552 net for the position of rector, EUR 1,293 for a professor, and EUR 828 for a docent. These minimum salaries are used to calculate funding allocations to HEIs and the research base funding. Positions of researchers and senior researchers are not regulated and generally minimum salary requirements apply to these positions. Although HEIs have high autonomy in determining salaries, budget limitations leave almost no room for manoeuvre. Actual salaries of academics highly depend on the roles and tasks they perform. These can be teaching, research, and administrative work. Each of these tasks are remunerated differently. This prohibits HEIs from paying fixed salaries for one position and providing stable and predictable working conditions (World Bank, 2018).

Latvian researchers are not particularly mobile. As illustrated in Figure 29, the share of internationally mobile researchers (who have been mobile for more than three months in the last ten years) is 12.4%, representing the lowest result in Europe. The number of Latvian researchers funded by Horizon 2020 Marie Sklodowska-Curie Actions is 46 and the total budget awarded to Latvia is EUR 4.12 million. The success rate of Latvia's applicants is 12.71%, which is slightly below the EU average of 13.12%. Some policy measures provide stimulus for international mobility; for example, post-doctoral research criteria requires that the post-doctorate spends at least three months abroad. The Erasmus+ programme is also widely used in the research sector.

Figure 29. International mobility in post-PhD career, 2016



Source: European Commission, 2017 (b)

The R&I system is also not very open to incoming mobility. According to the legal framework, elected academics in public HEIs need to know the Latvian language, which is a major obstacle for attracting foreign talent and internationalising the academic workforce. Incoming mobility is also problematic because of low salaries compared to Western countries (World Bank, 2018).

According to the European Innovation Scoreboard for 2018, Latvia has seen an overall improvement in terms of its 'Human resources' indicator, with 'Population with tertiary education' scoring highest, while 'New doctoral graduates' attaining the lowest score (European Commission, 2018 (d)).

Figure 30. Latvia's European Innovation Scoreboard performance for 'Human resources'

Indicator	Performance relative to EU 2010		Relative to EU 2017
	2010	2017	2017
Human resources (combines the following indicators)	64.7	79.8	66.8
New doctoral graduates	30.8	38.8	27.9
Population with tertiary education	116.4	132.8	117.1
Lifelong learning	44.8	66.7	65.3

Source: European Innovation Scoreboard 2018

When comparing Latvia to other Baltic countries it is evident that both Lithuania and Estonia outperform Latvia in every indicator under 'Human resources' with the sole exception being that Latvia scores higher than Lithuania in terms of 'Lifelong learning'.

Figure 31. Latvia compared to other Baltic countries on European Innovation Scoreboard performance for 'Human resources'

Indicator	Relative to EU 2017 in 2017		
	Latvia	Lithuania	Estonia
Human resources (combines the following indicators)	66.8	96.8	103.8
New doctoral graduates	27.9	36.7	48.7
Population with tertiary education	117.1	209.2	127.0
Lifelong learning	65.3	49.0	164.3

Source: European Innovation Scoreboard 2018

Furthermore, when comparing 2010 and 2017 performance regarding 'Employment impacts', Latvia demonstrates significant improvements across the board, as evident in the following figure. It is especially noteworthy, that the country has nearly doubled the score for ; Employment in knowledge-intensive activities' between 2010 and 2017.

Figure 32. Latvia's European Innovation Scoreboard performance for 'Employment impacts'

Indicator	Performance relative to the EU 2010		Relative to the EU 2017
	2010	2017	2017
Employment impacts (combines the following indicators)	51.6	94.1	93.6
Employment in knowledge-intensive activities	44.2	83.1	75.3
Employment fast-growing enterprises	56.8	102.0	109.0

Source: European Innovation Scoreboard 2018

In fact, when comparing the Baltic countries for 'Employment impacts' in 2017, Latvia outperforms Lithuania for every indicator while Estonia only manages to score higher in terms of 'Employment in knowledge-intensive activities'.

Figure 33. Latvia compared to other Baltic countries on European Innovation Scoreboard performance for 'Employment impacts'

Indicator	Relative to EU 2017 in 2017		
	Latvia	Lithuania	Estonia
Employment impacts (combines the following indicators)	93.6	39.3	74.5
Employment in knowledge-intensive activities	75.3	47.1	91.8
Employment fast-growing enterprises	109.0	32.8	60.0

Source: European Innovation Scoreboard 2018

3 BIBLIOMETRIC INDICATORS

This section describes simple bibliometric indicators based on data extracted from SciVal (based on SCOPUS data) in April, 2019. Data show Latvia's number of publication counts, field-weighted citation impact[4], international collaboration and academic-corporate collaboration (for the period 2013-2018). The Field of Science and Technology (FOS) subject classification was used when selecting the sources. The sources were filtered by peer-reviewed articles and reviews. Estonia and Lithuania are used as benchmark countries to demonstrate Latvia's progress in the context of countries with similar development starting points and path. In addition, InCites data on total numbers of publications and citations in the Web of Science database are presented.

The number of scientific articles per 1000 population published in recognised international databases has increased since 2012. However, the total numbers are below the EU average and results reported by Estonia and Lithuania. The best results are achieved in natural sciences, engineering and agricultural sciences while humanities posted the weakest performance (see Figure 34). The natural sciences most recently documented output of 737 in 2017 is more than twice as high as the second most productive sector, engineering (output of 316 in 2017). Publication growth rates can be explained by several incentives (regulations on science funding, EU funding measures) that were established to improve the publication statistics (Ministry of Education and Science, 2018 (a)).

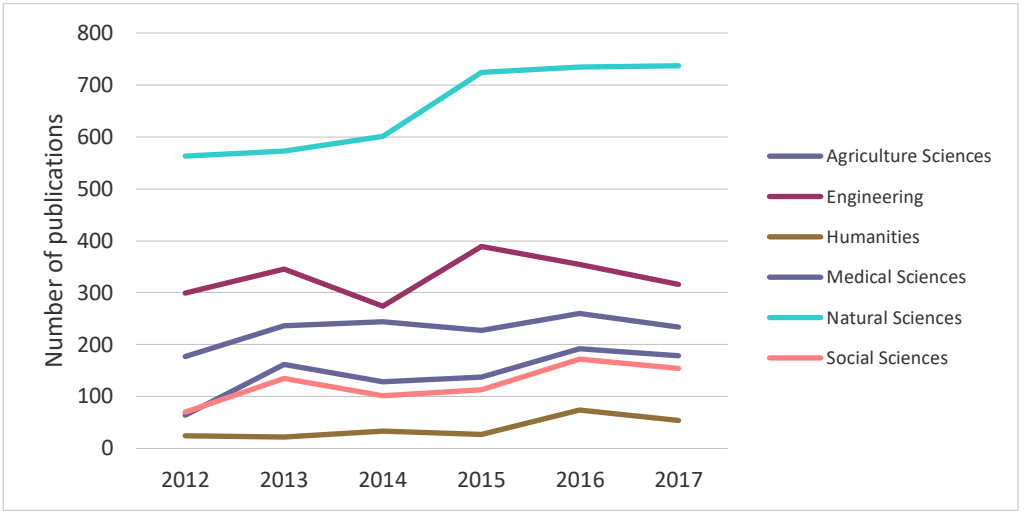
Figure 34. Number of publications in Latvia, Lithuania and Estonia in the period 2012-2017 (normalised per 1000 population)

	2012	2013	2014	2015	2016	2017
Estonia	1.37	1.55	1.68	1.72	1.81	1.88
Latvia	**0.40**	**0.49**	**0.46**	**0.54**	**0.60**	**0.61**
Lithuania	0.80	0.80	0.91	0.95	0.99	1.03

Source: SciVal

[4] Field-Weighted Citation Impact indicates how the number of citations received by an entity's publications compares with the avarage number of citations received by all similar publications in the data universe. FWCI of 1.00 indicates that the publications have been cited exactly as would be expected based on the global average for similar publications.

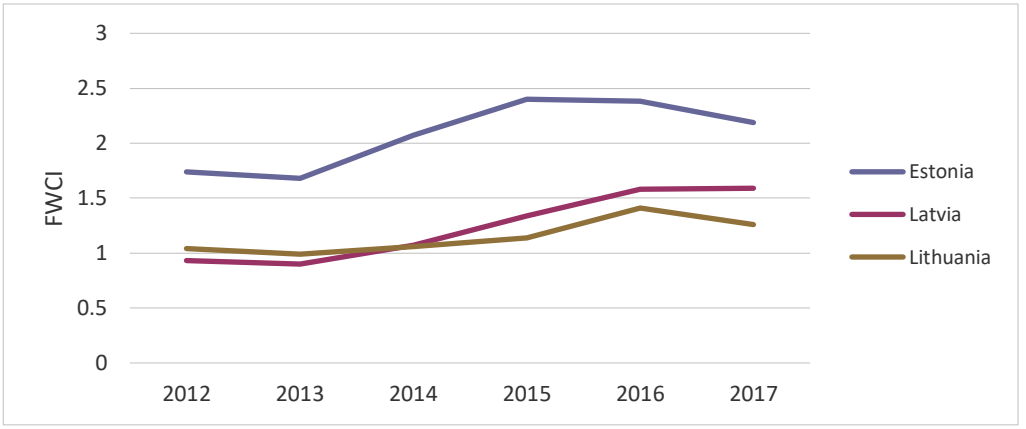
Figure 35. Number of publications in different fields of science, Latvia



Source: SciVal

Figure 36 demonstrates that the increase in numbers of publications described above is also accompanied by increased citation impact on Latvian science publications. It is below Estonia's performance, but above Lithuania's. As illustrated in Figure 32, the medical sciences have an important role in this indicator, because the impact of Latvian scientific publications in this field has seen a significant increase since 2014, above the EU average (Ministry of Education and Science, 2018 (b)). Humanities had the lowest impact.

Figure 36. FWCI in Latvia, Lithuania and Estonia



Source: SciVal

Figure 37 below indicates the total number of publications and citations listed in the Web of Science database. Research fields such as physics, chemistry and clinical medicine recorded the highest numbers of publications, which is in line with SciVal data presented in Figure 35. Clinical medicine, molecular biology and genetics, and physics account for the highest numbers. Citation impact data from SciVal presented in Appendix B demonstrate that medical sciences and, at some point (in 2015), agricultural sciences had an impact above the EU average.

Figure 37. Web of Science documents and citation (total), Latvia

Research Fields	Web of Science Documents	Cites
CLINICAL MEDICINE	833	21,305
MOLECULAR BIOLOGY & GENETICS	150	10,214
PHYSICS	1,204	7,963
CHEMISTRY	855	6,849
MATERIALS SCIENCE	692	5,131
ENVIRONMENT/ECOLOGY	287	4,057
PLANT & ANIMAL SCIENCE	488	3,533
BIOLOGY & BIOCHEMISTRY	227	2,302
IMMUNOLOGY	114	2,225
ENGINEERING	543	2,055
AGRICULTURAL SCIENCES	220	1,827
SOCIAL SCIENCES, GENERAL	284	1,655
PHARMACOLOGY & TOXICOLOGY	151	1,262
ECONOMICS & BUSINESS	113	652
NEUROSCIENCE & BEHAVIOR	62	560
ALL FIELDS	6,767	74,700

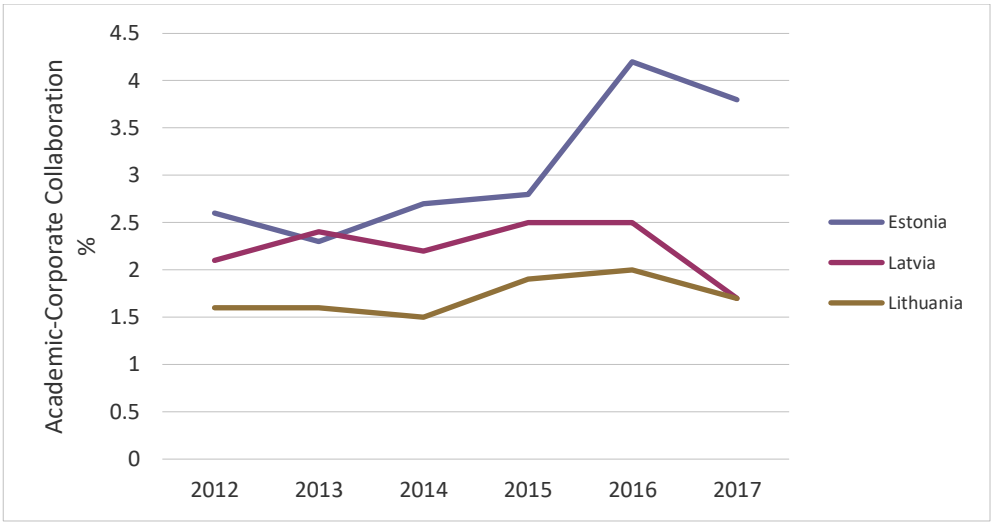
Source: InCites

As illustrated in Figure 38 and 39, the share of academic-corporate collaboration among all publications reached the maximum of 2.5% in 2015 and 2016. This corresponds to data from other recent studies on academic-corporate co-publications, which also concluded that there was an increase in this number in 2015 (Fidea, Technopolis Group, 2017). Unfortunately, a notable decrease was observed in 2017. The improved performance in 2015 and 2016 can be explained by the impact of the Competence Centres programme, which supported collaboration between research institutions and companies. Among other outputs, the programme also produced high numbers of academic-corporate co-publications (Fidea, Technopolis Group, 2017).

The highest academic-corporate collaboration percentage by research field was reported in medical sciences (reaching almost 8% in 2016), followed by the

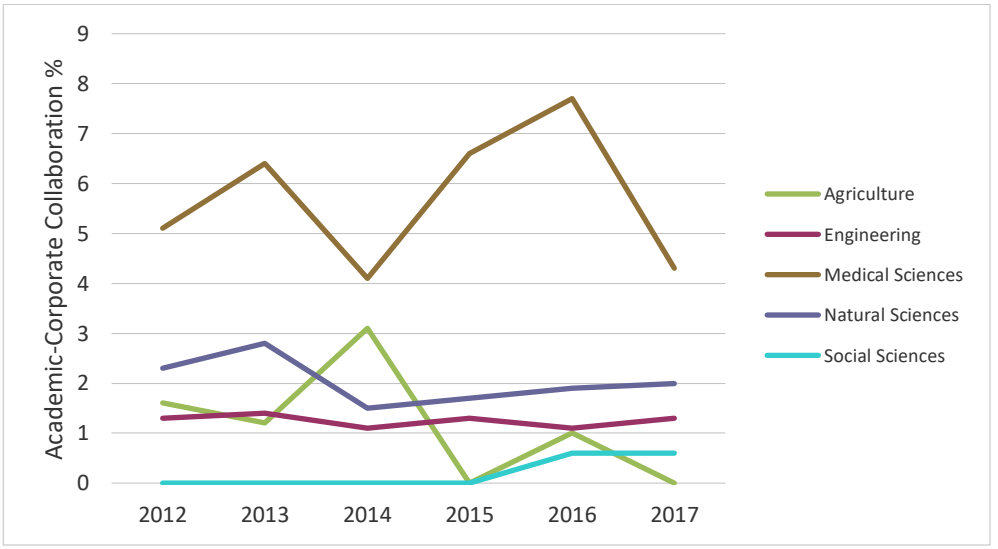
natural sciences and agriculture. The low overall academic-corporate collaboration intensity levels can be explained by low R&D intensity in Latvian manufacturing, with the exception of medical sciences which has comparatively strong and R&D-intensive private companies.

Figure 38. Academic-corporate collaboration



Source: SciVal

Figure 39. Academic-corporate collaboration in different science fields in Latvia

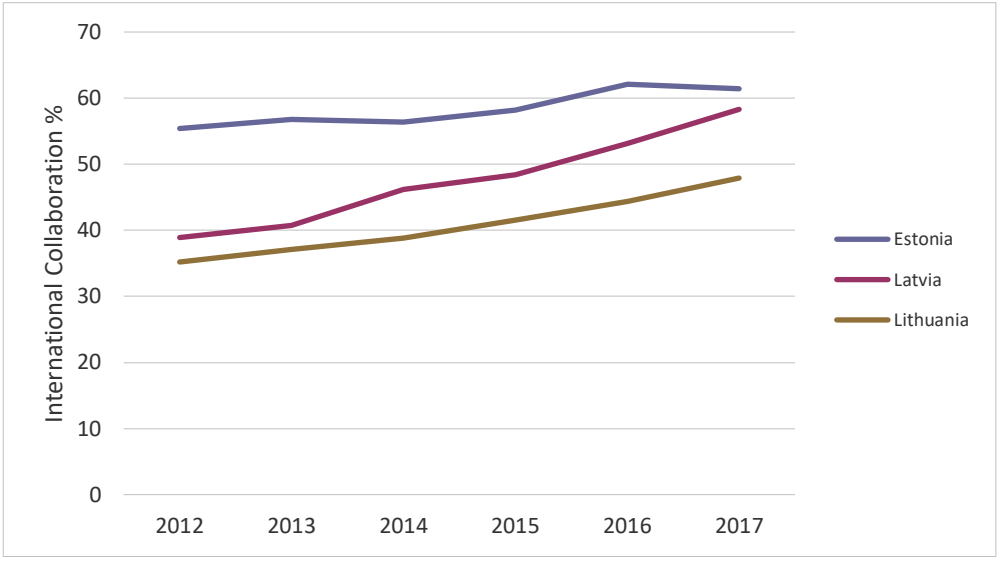


Source: SciVal

As illustrated in Figure 40 and 41, international collaboration has considerably increased since 2012. This was also concluded in a recent study, which focused

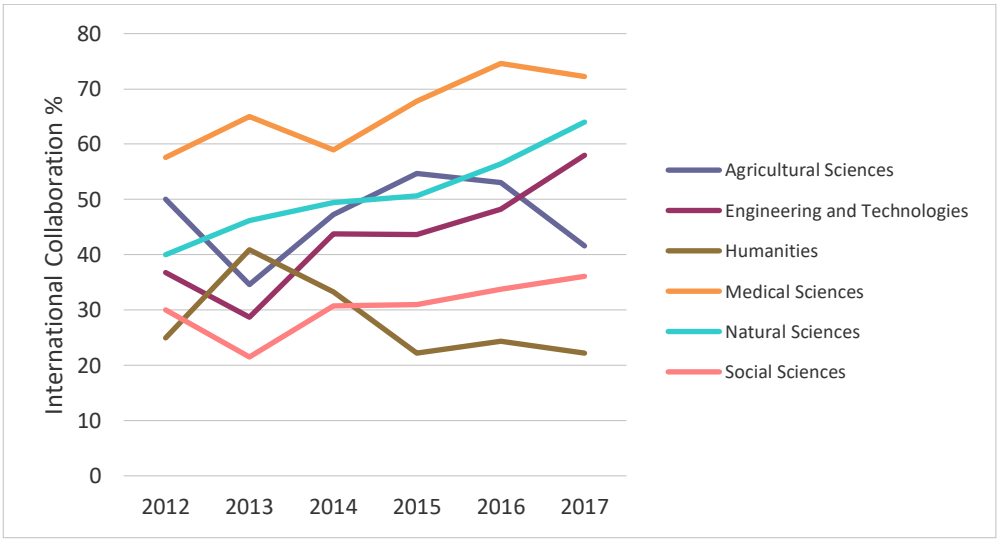
on 21 research institutions of Latvia and their individual performance (Fidea, Technopolis Group, 2017). Medical sciences are the main driving force behind this development alongside the natural sciences, and engineering and technology, which all steadily increased. The humanities managed an increase in 2013, but that reversed in the period 2013-2017, which can be explained by local factors (Arnold et al, 2014).

Figure 40. International collaboration in Latvia, Lithuania and Estonia



Source: Scival

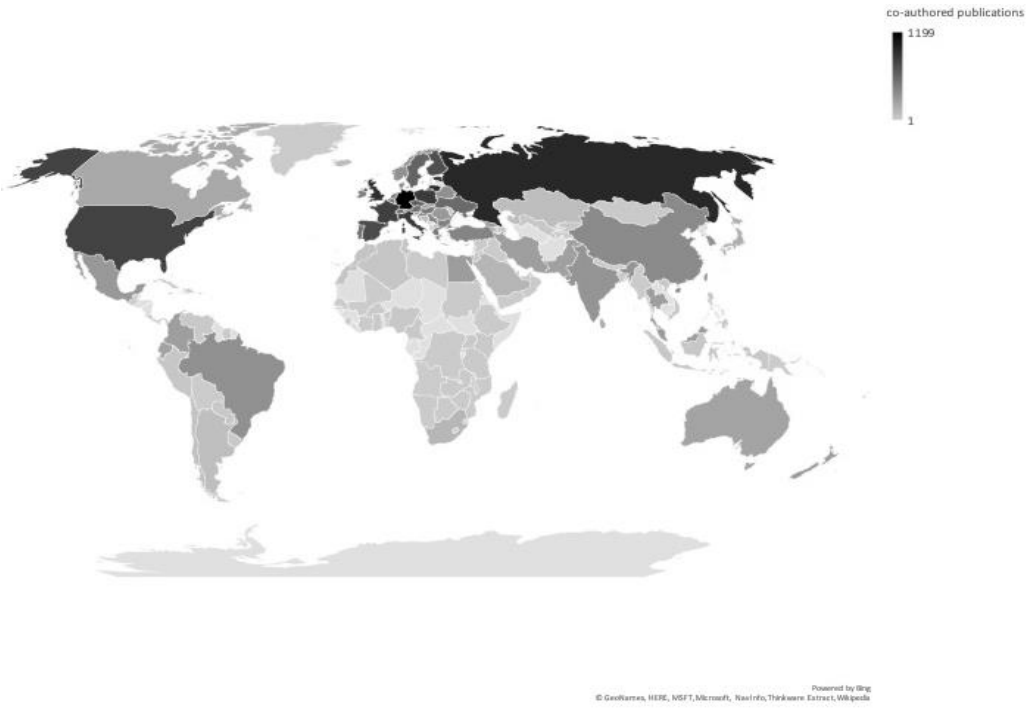
Figure 41. International collaboration of different science fields, Latvia



Source: SciVal

The main partner countries for co-publications with Latvian scientists are illustrated in Figure 42 below. European countries dominate the list with Germany as a leader. This is also confirmed by other recent studies on bibliometric indicators of Latvian research institutions. Germany is also the most important partner to Latvian researchers collaborating in Horizon 2020 projects (Fidea, Technopolis Group, 2017). Neighbouring countries Russia, Lithuania and Estonia are also important partners. This illustrates that there is a tendency in Latvia to cooperate and publish with near neighbours instead of extending networks and building more international collaboration. The USA, former Soviet republics and some Asian countries are also important partners.

Figure 42. Collaboration countries of Latvian scientists (darker colours present higher numbers of co-publications)



Source: SciVal

4 POLICY FRAMEWORK AND MEASURES FOR THE ATTRACTION AND DEVELOPMENT OF HUMAN CAPITAL IN RESEARCH AND DEVELOPMENT

This section summarises and briefly describes the policy framework and measures for attracting and developing human capital in research and development. In section 4.1., recent systemic reforms in Latvia's R&I system are described. Section 4.2. describes measures that directly target human development and section 4.3. describes measures that are not primarily focused on human capital development, but contribute to that nonetheless. Lastly, Section 4.4. briefly discusses recent developments in cooperation with science diaspora and its potential contribution to developing science in Latvia.

4.1 Recent Systemic Reforms

In 2014, following an important research assessment exercise and the publication of a World Bank evaluation of Latvia's HE funding model, several systemic reforms were initiated. These included the consolidation of research structures and development of a performance-based higher education funding model. The broad aim of the reforms is to promote the development of stable human capital in R&D by 2030, and to consolidate the science system into 20 strong national research centres (European Commission, 2017 (a)).

The consolidation of research structures provided change mechanisms for allocating science base funding. State funding is awarded only to competitive scientific institutions with specific minimum criteria for FTE research staff (for universities and research institutions the minimum research staff totals 25 FTE, for other higher education institutions it is 10 FTE, and for higher education institutions specialising in arts, 5 FTE). The introduction of performance criteria allows more funding to be awarded to more research-intensive institutions that show better results. Since 2014, the government has awarded 10% of the additional science base funding to those scientific institutions that performed best in the research assessment exercise (European Commission, 2017 (a)).

The shift to a performance-based HE funding model has provided a better framework for human capital development compared to the situation before. Until 2014, the budget allocation for HEIs was one-dimensional and based on funding for study places instead of performance indicators. The new model is based on incentives for engaging Masters (MA) and PhD students, and young scientists in research, as well as for attracting international funding for research and industry involvement. This reform has resulted in higher numbers of employed young scientists.

Although comprehensive, these reforms have not yet resulted in considerable progress. They were initiated in 2014 and more time and further effort is needed to generate long-term results. For instance, in 2018 the World Bank (2018) came up with several recommendations on academic careers in Latvia:

- Further develop the institutionalising and framing of doctoral education with adequate policies and procedures, including the design and implementation

of clear and consistent processes for the admission, progression, and assessment of doctoral students in a transparent and fair way;

- To support HEIs in their efforts to improve the quality of doctoral education, the Latvian government is tasked with adapting framework conditions where necessary and providing direct support for institutions;
- Providing academics with attractive and conducive working conditions and career opportunities requires that HEIs reconsider their current practices and policies. The overarching objective should be to reduce the risks, volatility, and fragmentation of employment that many academics face under the current system;
- In all areas related to academic careers and working conditions, the efforts of HEIs and the Latvian government need to reinforce each other. Important framework conditions that the government would need to address are the two-track system of teaching-focused and research-focused positions, the overall national academic career framework (in particular, barriers to institutions introducing structured promotion patterns), and regulations that currently hamper the institutions' internationalisation efforts.
- While the development of performance-based salary systems and performance-supporting measures are still at an infant stage, establishing the right preconditions for future activities in this area could prove to be very useful for HEIs later. Basic issues worth considering include developing a concept of performance that accounts for the diversity of academic tasks, and thinking about models that comprise an adequate balance between fixed salary components and performance rewards that are actionable from an administrative and financial management perspective.

Implementation of these recommendations are important in making research an attractive professional choice. The Ministry of Education and Science, which is leading these reforms, often faces reluctance from R&I stakeholders and political decision-makers in Latvia.

4.2 Direct Measures for Human Capital Development

Currently, the most important direct measures for human capital development are government funding for doctoral education and EU Structural investments supporting the implementation of doctoral programmes and postdoctoral research.

At the level of basic and secondary education, diagnostic tests in STEM subjects have recently been introduced to increase higher education enrolment in these fields. This has resulted in a larger share of students in STEM (19.8% in 2016/2017). However, due to weaknesses in secondary education, STEM students also face high drop-out rates. In higher education, 41% of state-funded study positions in higher education institutions are provided in STEM programmes.

Some EU-funded measures in the period 2007-2013 have helped to improve the situation with R&D human capital. For example, the implementation of sub-activity 'Support for the Implementation of Doctoral Study Programmes' resulted

in a significant increase in the number of PhD graduates in recent years. To a large extent as a result of these investments, Latvia was able to improve the age breakdown of human resources in science. The number of scientific workers between the ages of 35 and 44 increased in the period between 2012 and 2015 from 21.1% to 23.4% (Ministry of Education and Science, 2018 (a)). However, no similar measures are available for the current EU funding period (2014-2020), and the state budget for doctoral education is very limited. Efforts have had limited impact on increasing doctoral graduates in STEM studies, because there was no prioritisation of these fields in the measures taken (Fidea, Technopolis Group, 2017).

Government funding for doctoral studies is low. The monthly scholarship does not allow students to focus full time on their studies and students have to work to cover their daily expenses. This can result in poorer quality results which take longer to complete. The process of grant proposals is not launched every year, which means that research funding goes through cycles and it is difficult to plan the intake of doctoral students. The system fails to attract international students. Previous research has raised concerns that doctoral training is undervalued by industry and the opportunities for collaborative doctorates are rare (Sursock, 2016). The World Bank recommends to improve doctoral education by developing its 'institutionalising and framing' in line with policies that provide clear and consistent processes for admission, progression and ongoing assessment of students. Other factors contributing to a successful future for doctoral students include career support measures and 'assistantships' which help graduates build their competence. These need to be addressed by institutions, according to the World Bank (2018).

Until recently, there were no industrial PhD programmes available in Latvia. In May, 2019 Riga Technical University and the largest mobile operator in Latvia, LMT, announced plans to cooperate in starting an industrial PhD programme. Two PhD students from RTU will develop new technologies for the company. The university expects to develop similar collaborations with other companies. The programme is part of the EU-funded support measure 'Innovation grants for students'.

One of the main measures to support human development in science during the 2014-2020 EU funding period has been the support measure 'Support for postdoctoral research'. The total funding dedicated to post-doctoral grants is EUR 60.9 million. The measure aims to develop young scientists' skills and provide opportunities to start a career at scientific institutions and private companies. The measure aims to support approximately 455 post-doctoral (within 5-10 years after receiving doctorate degree) students. The measure provides grants up to EUR 133,806 and 36 months (full-time employment contract with a salary of EUR 2,731 per month) to perform research in Latvia. In addition, EUR 800 per month is available for other expenses. This financial coverage is internationally competitive and potentially makes the measure attractive for young local and foreign researchers. The research can be performed in public or private research organisations at both SMEs and large companies registered in Latvia. Post-doctoral researchers can perform applied and fundamental research, acquire

intellectual property and technology rights, improve their competences with training and participate in international mobility and networking.

According to the results of first two rounds of applications, in total nine companies have submitted project applications, other post-doctoral projects were submitted by public research institutions (State Education Development Agency, 2019). This illustrates a lack of interest in this instrument among private companies. Although it was intended that the measure will also support foreign applicants, in reality this has not materialised, because several of the application documents have to be submitted in Latvian. As a result, in the first round of applications only 11 post-doctoral researchers that have received their PhD degree abroad were supported. Though this number increased in the second call, reaching 31 applications from foreign post-doctoral researchers (State Education Development Agency, 2019). Potentially, the number will further increase in the 3rd round because of the efforts to raise awareness about the measure abroad.

The Innovation vouchers measure is available to private companies for acquiring services from research institutions. This measure also provides support to attract employees with experience in the field of the project to be developed. The employee has to have at least three years of experience in the field and at least Master's degree. The programme started in 2017 and so far only two companies have implemented projects that include attracting highly qualified employees in their mission. Low interest in this opportunity, as well as the small number of post-doctoral research projects implemented in private companies, indicates that either there is a lack of interest among businesses to attract highly qualified personnel or that the support measures and implementation modalities do not fit the needs of businesses.

The Law on Start-ups provides a fiscal plan where taxes of highly qualified employees are covered by the state and the employees receive full social benefits. The Law also provides support measure for co-financing highly qualified personnel. To date, these support measures have not made much of an impact due to heavy administrative requirements; only three start-ups have received the support. The Law and support measures that it provides are now under revision (Ministry of Economics, 2019).

4.3 Indirect Measures for Human Capital Development

Several research and innovation policy measures have a component of HR development even when these measures are not primarily targeting human resources. When EU Structural fund programmes for R&D investment are designed, some incentives related to human capital development are provided in the evaluation of project applications. For example, priority is given to projects with a higher level of young scientists involved full time.

The EU programme 'Practically oriented research grants' provides support to research institutions and enterprises for projects aiming to develop innovative solutions for practical socio-economic challenges. The projects, approved in the first call launched in 2017, have created 43 new R&D positions (FTE) and employs 146 Master's and PhD students. The second call, closed mid-2019, aims to create 67 new R&D positions. The EU-funded programme 'Support for development of

new products and technologies within competence centres' also provides support to individual and cooperative research projects. By the end of 2018, the programme had managed to support 191 research projects and created 492 jobs and involved 175 PhD students or new doctorates.

The EU programme 'Innovation grants for students' fosters the implementation of student innovation programmes, carried out by Latvian HEIs. These programmes aim to strengthen students' innovation skills and promote the development of enquiring and entrepreneurial minds, thus contributing to helping to create young leaders and human capital capable of innovating.

The EU investment programme 'To strengthen academic staff of higher education institutions in the areas of strategic specialisation' indirectly contributes to the renewal and development of R&D human resources as well. Investments are dedicated to support doctoral students at their early career development stage as academic staff in Latvian HEIs.

The EU programme 'Support for employee training to increase business competitiveness and innovation' provides training to employees to improve skills in enterprises, helping to promote the introduction of new or improved products or technologies, and to increase labour productivity.

The Ministry of Economics also implements measure to support highly qualified citizens of third countries to receive work permits easier and faster than before. The Cabinet of Ministers' Regulation determines the professions where labour gaps are predicted and foreign employees can be invited to fill those positions. The list of professions is based on data on labour market demand (survey of companies). If someone working in one of the listed professions wants to receive the EU Blue Card, the minimum salary for the person cannot be below the average salary in Latvia multiplied by 1.2.

The Ministry of Economics also offers start-up visas – temporary residence permits for non-EU start-up founders. By 2018, six start-up visas had been granted.

4.4 Cooperation with Science Diaspora

Engaging the science diaspora has potential to develop research in general and tackle the HR situation in research and development. Diaspora can be engaged either with a straight return option (by encouraging return to Latvia) or with diaspora/collaboration option (by promoting collaboration with members of science diaspora). The number of Latvia's diaspora scientists is unknown, but according to estimates and a survey of diaspora scientists it is somewhere around 807 (Bela et al, 2018).

Recently, the Ministry of Foreign Affairs and Ministry of Education and Science have been active in identifying and exploring Latvia's science diaspora and existing networks between Latvia's scientists and its diaspora scientists. Commissioned by these ministries, the University of Latvia's Diaspora and Migration Research Centre has performed two studies (a survey and in-depth interviews with science diaspora, and network analysis). In the latest survey in

2018, 234 diaspora scientists responded representing 29 countries. Most of them are based in the USA (26.5%), UK (15%), Sweden (11.1%), and Germany (8.5%). Most of the respondents are young scientists – 52.6% of the respondents are younger than 44. Most of them (74.5%) emigrated after Latvia joined the EU (Bela et al, 2018).

According to the survey of diaspora scientists, the main motivations for moving to a foreign country are to study (40%) and perform academic or scientific work (33%). In the past two years, 44% of the science diaspora have not been involved in scientific activity that is associated with Latvia or collaborated with scientists in Latvia (Mierina et al, 2017). As illustrated in Figure 43, most of science diaspora do not plan to return to Latvia or are undecided. This indicates that Latvia cannot rely on these human resources under the 'return option' and should rather consider the 'collaboration' option. However, the proportion of undecided diaspora scientists is quite high and leaves room for considering instruments that could facilitate their return.

Figure 43. Return plans of Latvia's science diaspora

	Natural sciences	Engineering	Life sciences and medicine	Social sciences	Humanities
Yes, in 6 months from now	0.0	0.0	0.0	5.1	0.0
In 1 year from now	2.0	4.9	0.0	3.4	0.0
In 2-3 years from now	1.0	9.8	0.0	3.4	6.7
In 4-5 years from now	6.1	7.3	3.1	3.4	3.3
In old age	10.2	9.8	15.6	16.9	10.0
Will not return in Latvia	31.6	34.1	25.0	23.7	23.3
Undecided	49.0	34.1	56.3	44.1	56.7

Source: Mierina et al, 2017

This recent research confirms that diaspora scientists are interested in collaboration and already have networks with scientists in Latvia. This is a potential that is not jet fully exploited. The report on scientist networks suggests that further effort in strengthening the ties between diaspora scientists and those in Latvia is needed. Networking options and contact- and matchmaking opportunities through events, projects and conferences can be considered (Bela et al, 2018).

In 2011, a distinct diaspora policy emerged in Latvia. The Ministry of Foreign Affairs appointed a special ambassador for diaspora issues. In 2013, the Government approved a 'Remigration Support Measure Plan 2013-2016' (Remigration Plan hereafter) aimed at providing support to Latvian nationals and their families living abroad in returning to Latvia, and to those diaspora members

who wish to establish a business in Latvia (European Commission, 2018 (c)). In November of 2018, Latvia's Parliament adopted the Law on Diaspora. The aim of the law is to strengthen the identity of the diaspora, ensure opportunities for collaboration with Latvia, and provide favourable circumstances for their return to Latvia (Parliament of Latvia 'Saeima', 2018). The Law foresees collaboration with science diaspora, but does not identify any specific measures.

5 BIBLIOGRAPHY

Arnold, E., Knee, P., Angelis, J., Giarraca, F., Griniece, E., Jávorka, Z., Reid, A. 2014. Latvia - Innovation System Review and Research Assessment Exercise: Final Report. Available here: http://izm.gov.lv/images/zinatne/ZISI/Latvia-systems-review_2014.pdf

Bela, B., Berzins, K., Krebs, V., Mierina, I., Vingre, A. 2018. Latvia's science diaspora: cooperation networks and opportunities. Available here: https://www.izm.gov.lv/images/statistika/petijumi/LU-SPPI-DMPC_Zinatnieku-diaspora-2018.pdf (in Latvian)

Central Statistical Bureau of Latvia. 2018. Science in Figures. Available here: https://www.csb.gov.lv/sites/default/files/publication/2018-06/Nr%2028%20Science%20in%20Figures%20%2818_00%29%20EN.pdf

Cross-Sectoral Coordination Centre. 2012. National Development Plan of Latvia for 2014-2020. Approved by a Decision of the Saeima on 20 December 2012.

European Commission. 2016. Study on the expected results of Cohesion policy in Estonia, Lithuania and Latvia within the programming period 2014-2020. Available here: https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/baltic_result_2014_20_en.pdf

European Commission. 2019. Country Report 2019: Latvia. Available here: https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-latvia_en.pdf

European Commission. 2018 (a). European Semester Country Report Latvia 2018. Brussels: European Commission.

European Commission. 2018 (b). Latvian Research Funding System Final Report. Horizon 2020 Policy Support Facility. Available here: https://rio.jrc.ec.europa.eu/en/policy-support-facility/specific-support-latvia

European Commission. 2018 (c). Labour Market Policy Thematic Review 2018: An in-depth analysis of immigration of skilled labour, Latvia.

European Commission. 2018 (d). European Innovation Scoreboard 2018, Latvia. Available here: https://ec.europa.eu/docsroom/documents/30689

European Commission. 2017 (a). Latvian Research Funding System Background Report. Horizon 2020 Policy Support Facility. Available here: https://rio.jrc.ec.europa.eu/en/policy-support-facility/specific-support-latvia

European Commission. 2017 (b). MORE3 study. Support data collection and analysis concerning mobility patterns and career paths of researchers.

Fidea, Technopolis Group. 2017. Izvertejuma zinojums. Available here: https://m.esfondi.lv/upload/Petijumi_un_izvertejumi/izvertejuma-zinojums_22122017.pdf (in Latvian)

Global Entrepreneurship Monitor (2018). Latvia Entrepreneurial Behaviour and Attitudes. Available here: https://www.gemconsortium.org/country-profile/80

Investment and Development Agency of Latvia. Foreign Trade Statistics. Available here: http://www.liaa.gov.lv/en/trade/foreign-trade-statistics

Mieriņa, I., Ulnicane, I., Vingre, A., Buzinska, L., van der Steina, A. 2017. Diasporas zinātnieku piesaiste un sadarbības veicināšana. (In Latvian).

Ministry of Economics. 2018 (a). The National Economy of Latvia: Macroeconomic Review. Available here: https://www.em.gov.lv/files/tautsaimniecibas_attistiba/leap/leap_2018-en.pdf

Ministry of Economics. 2018 (b). Information Report On medium- and long-term labour market forecasts.

Ministry of Economics, 2019. Assessment of Latvia's start-up ecosystem. Available here: https://em.gov.lv/files/attachments/2019-03-27_11_46_18_Jaunuznemumu_petijums.pdf (in Latvian)

Ministry of Education and Science. 2016. Smart Specialization Strategy. Available here: https://www.izm.gov.lv/en/Science/smart-specialisation-strategy

Ministry of Education and Science. 2017 (a). Priority Directions in Science. Available here: https://www.izm.gov.lv/en/science/priority-directions-in-science

Ministry of Education and Science. 2017 (b). Informative report, Doctorates in 2015. Available here: https://www.izm.gov.lv/images/zinatne/Doktori_Info_apskats_19102017.pdf (in Latvian)

Ministry of Education and Science. 2018 (a). Informative Report. Monitoring of Smart Specialization Strategy. Available here: https://www.izm.gov.lv/images/statistika/petijumi/RIS3_progress-report_LV_2018.pdf

Ministry of Education and Science. 2018 (b). Latvijas Viedās Specializācijas Stratēģija. Presentation at Parliament of Latvia Saeima. (In Latvian).

Ministry of Education and Science. 2018 (c). Overview of Higher Education in Latvia. Available here: https://www.izm.gov.lv/images/statistika/augst_izgl/AII_2017_parskats.pdf (in Latvian)

Ministry of Finance. 2019. FM: Ekonomikas izaugsme 2018.gadā sasniedz 4.8% - straujāko kāpumu septiņu gadu laikā.

Kulikovskis, G., Petraityte, D. and Stamenov, B. 2015. RIO Country Report 2015: Latvia. Available here: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101203/lv_cr2015.pdf

Kulikovskis, G., Petraityte, D. and Stamenov, B. 2018. RIO Country Report 2017: Latvia. Available here: https://rio.jrc.ec.europa.eu/en/country-analysis/Latvia/country-report

OECD. 2019. OECD Economic Surveys. Latvia. Available here: http://www.oecd.org/economy/surveys/Latvia-2019-OECD-economic-survey-overview.pdf

OECD. Latvia – Economic forecast summary (November 2018). Available here: http://www.oecd.org/eco/outlook/latvia-economic-forecast-summary.htm

Parliament of Latvia Saeima. 2007. Law on Scientific Activity. Available here: https://likumi.lv/doc.php?id=107337

Parliament of Latvia Saeima. 2018. Saeima supports new Law on Diaspora. Available here: http://www.saeima.lv/lv/aktualitates/saeimas-zinas/27362-saeima-atbalsta-jaunu-diasporas-likumu (In Latvian).

State Education Development Agency. 2019. Informative report on the progress of implementation of support measure "Support for post-doctoral research". Available here: http://tap.mk.gov.lv/lv/mk/tap/?pid=40471009&mode=mk&date=2019-04-02 (in Latvian).

State Education Development Agency. 2019. Postdoctoral research applications results. Available here: http://viaa.gov.lv/lat/pecdoktoranturas_atbalsts/postdoc_rezultati/ (in Latvian).

Sursock, A. 2016. Latvian doctoral studies and promotion system. Available here: https://www.izm.gov.lv/images/izglitiba_augst/Pasaules_Banka/Latvian_doctoral_studies_and_promotion_system.pdf

World Bank. 2018. World Bank Reimbursable Advisory Service on Higher Education in Latvia. Available here: https://izm.gov.lv/images/izglitiba_augst/Pasaules_Banka/LV-Careers-Recom-06April18-final_FINAL.pdf

World Economic Forum. 2018. Latvia Global Competitiveness Index. Available here: http://reports.weforum.org/pdf/gci4-2018/WEF_GCI4_2018_Profile_LVA.pdf

6 ABBREVIATIONS

BERD – Business expenditure on R&D

EC – European Commission

ERDF – European Regional Development Fund

EU – European Union

EU SF – European Union Structural Funds

FTE – Full-time equivalent

GDP – Gross Domestic Product

GERD – Gross domestic expenditure on research and development

HE – Higher education

HEI – Higher education institution

ICT – Information and communication technology

IMF – International Monetary Fund

IT – Information technologies

PhD – Doctor of Philosophy

RAE – Research assessment exercise

R&I – Research and innovation

R&D – Research and development

RDI – Research, development and innovation

RIS3 – Smart specialisation strategy

RTU – Riga Technical University

SME – Small and medium-sized enterprise

Appendix A Policy instruments targeting scientific competitiveness, capacity of innovation and increasing business competitiveness

Figure 44. Policy instruments supporting competitiveness of science

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
Science base funding National budget	23m (in 2019)	Ensure institutional stability and continuity of research activity	Formula based on input and output indicators Annual allocation	Allocated to scientific institutions with min. research staff 25 FTE, to other HEIs with 10 FTE, and to HEIs specialising in arts with 5 FTE Minimum RAE score 3 +10 % for RAE scores 4-5	Central planning by MoF Direct administration for calculation and allocation to performers by MoES	State-established scientific institutes and HEIs registered in the Register of Scientific Activity
State Research Programmes National budget	4-5m	High-impact, industry-relevant research in priority areas of national development	Open call and selection every 4 years Annual allocation per programme	Corresponds to national priorities Scientific and practical relevance	Central planning by MoF Selection and supervision by MoES and	State-established scientific institutes and HEIs

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
			14 programmes in 2014-2017	Scientific novelty	since 2018 by sectoral ministries	
Fundamental and applied research grants National budget	1m (2017)	Scientific and technological advances, solutions in topical research areas	Competitive, project-based Open call and selection every 4 years Annual allocation per project	Scientific potential and quality Impact and international competitiveness Scientific novelty	Central planning by MoF Appropriation by MoES Selection and supervision by LCS Administration by SRA	State-established scientific institutes, HEIs, individual scientists and groups of scientists
Practically oriented research grants ERDF	14.3m	Innovative solutions for practical socio-economic challenges, improving intersectoral collaboration and knowledge	Open call and selection every 1.5 years Max 600k, min 30k per project Public funding intensity for non-	Project scientific quality and correspondence with RIS3 goals Economic and social impact	Central planning by MoF Supervision by MoES Administration by CFCA	Scientific institutions and enterprises

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
		transfer in RIS3 areas, focus on high commercialisation potential	commercial entities – 92.5%, for commercial entities 25-85%	Quality and efficiency of implementation		
Grants for postdoctoral research ERDF	10.6m	Postdoc research projects in RIS3 areas, competence building, international mobility and networking, tech-transfer activities	Open call The max amount of the grant is EUR 133,806 for three years to perform research in Latvia	Project scientific quality and correspondence with RIS3 goals Economic and social impact Quality and efficiency of implementation	Central planning by MoF Supervision by MoES Administration by SEDA	Scientific institutions and enterprises employing PhD holders
Innovation grants for students ERDF	5.6m	Student research and innovation projects, particularly in STEM areas, life sciences and creative industries	Open call for implementation of innovation programmes for students	Correspondence with RIS3 goals Creation of innovation fund to finance student ideas Creation of students	Central planning by MoF Supervision by MoES Administration – CFCA	Higher education institutions

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
				motivation programme		
Support for international cooperation projects in R&I ERDF	5.4m	ERA bilateral and multilateral research cooperation project development, networking, strengthening capacity of H2020 national contact points. 1st selection round – national level measures for international research cooperation capacity building 2nd selection round – institutional level measures for international research	1st and 2nd round – one-off restricted call	The project application has been evaluated above threshold in Horizon 2020 programme	Central planning by MoF Supervision by MoES Administration by CFCA	1st round – MoES and SEDA 2nd and 3rd round – scientific institutions

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
		cooperation capacity building 3rd selection round – implementation of projects which have been evaluated above threshold in Horizon 2020 programme but have not been implemented due insufficient funding				
Development of research and innovation infrastructure and strengthening the institutional capacity of scientific institutions	Individual budget for each scientific institution (total 120m)	Increased institutional capacity of research institutions, concentration of resources by improving the governance and modernising the research	One-off restricted call for a targeted purpose	Allocated to 14 scientific institutions.	Central planning by MoF Supervised and administered by MoES Administration by CFCA	Scientific institutions and HEIs

Funding instrument and source	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
ERDF		infrastructure in RIS3 areas.				

Figure 45. Policy instruments targeting capacity for innovation

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
Tax allowances for R&D Horizontal measure, national budget	Cancelled in 2018	Promote new product and technology development in local enterprises and attracting FDI in research-intensive sectors	The applied value coefficient for eligible expenses is 3	The eligible costs include: • R&D personnel • Services from scientific institutions • Services of accredited certification	Budgetary oversight by MoF Operational oversight by MoE Administration by State Revenue Service	Enterprises that invest in R&D

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
				, testing and calibrating institutions		
Support to development of new products and technologies within competence centres ERDF	40m	Individual and cooperative research projects, including industrial research, experimental development, technical and economic feasibility studies for research projects	Funding allocated in four stages: 1st stage – MoES organises governance, monitoring and dissemination activities 2nd and 4th stage – calls for competence centre project implementation in RIS3 areas	Development of a competence centre in RIS3 sub-specialisation areas Competence centre must comprise at least five unrelated commercial entities in the sector	Central planning by MoF Supervision by MoE Administered by CFCA	Science and business cooperation platforms – competence centres

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
Technology-transfer system and innovation vouchers ERDF	6m	Establish a common technology-transfer centre to foster interest and develop cooperation between research institutions and potential IPR commercialisation entities, ensure the functions of research commercialisation and patenting fund, manage innovation voucher support to SMEs	Restricted call to a consortium of scientific institutions	Contribution of the common technology-transfer centre in reaching RIS3 goals	Central planning by MoF Supervision by MoE Administered by LIDA and CFCA	Investment and Development Agency of Latvia Consortiums of HEIs and scientific institutions

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
Innovation motivation programme ERDF	<1m	Informative and consultative support to students, business idea authors, potential start-ups on innovation-related issues to raise awareness and improve related business skills	Restricted call to LIDA	Experience and technical support Clear strategy for proposed activities Coherence with RIS3 goals	Central planning by MoF Supervision by MoE Administered by LIDA and CFCA	Latvian Investment and Development Agency Final beneficiary enterprises, start-ups, self-employed, NGOs, students
Support for employee training to increase business competitiveness and innovation ERDF	3m	Employee training to improve skills in enterprises to promote introduction of new or improved products or technology development	Open calls	Experience with implementation of similar projects Evaluation of skills needs in the sector has been performed	Central planning by MoF Supervision by MoE Administered by CFCA	Sectoral associations

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
		and increase in labour productivity		Training supply-and-demand analysis		
Support to technology-oriented start-ups ERDF	1m (total budget)	Support the creation and growth of technology-oriented start-ups through adjustments in social security payment rules, tax breaks and support for attracting highly qualified labour force	Continued application	Received venture capital investment; Registered no longer than 5 years; Revenue below EUR 200,000; Profit invested in development; Holds either intellectual property rights, at least 70% of personnel with MA or PhD degree or at least 50% of	Central planning by MoF Supervision by MoE Administered – LIDA	Technology- and innovation-oriented start-ups

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
				costs related to R&D.		
Support for training to improve ICT skills, capacities for non-technological innovation and attracting foreign investment ERDF	>1m	Employee training to improve ICT skills, capacities for non-technological innovation and attracting foreign investment	Restricted call to Latvian Information and Communication Technology Association, Chamber of Commerce and LIDA	Competence in ensuring training in ICT, non-technological innovation and attracting investment	Central planning by MoF Supervision by MoE Administered by LIDA and CFCA	LICT, Chamber of Commerce, LIDA Final beneficiary enterprises and self-employed
Support to introduction of new products into production ERDF	24-25m	Introduction of new products into production to increase business productivity and foster business R&D	Open calls	Alignment with RIS3 goals Experience with R&D projects and product development New R&D jobs created	Central planning by MoF Supervision by MoE Administered by CFCA	Enterprises that invest in R&D

Funding instrument	Average annual allocations (EUR)	Aim of the intervention	Funding allocation method and periodicity	Criteria and conditions	Operator(s)	Recipients
				Project sustainability		

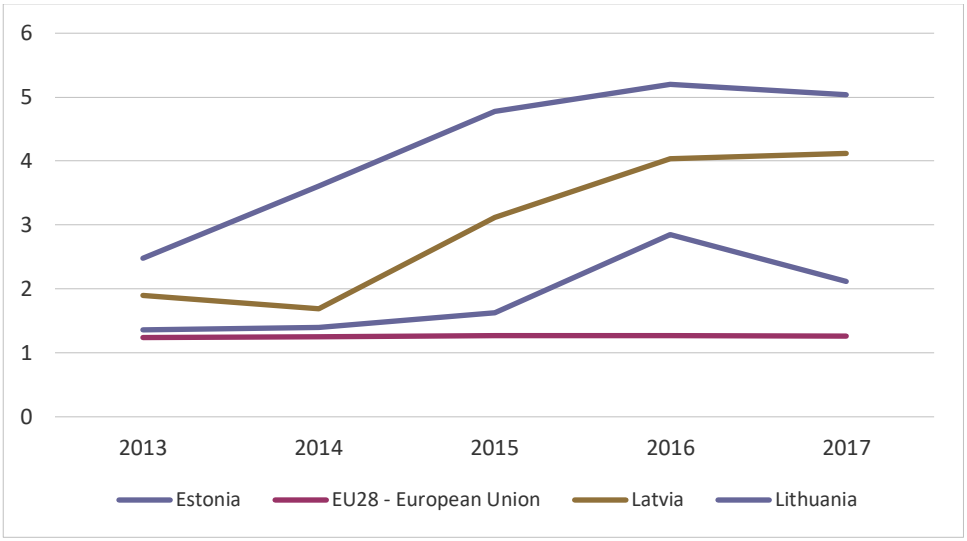
Figure 46. Policy instruments targeting overall business competitiveness

Funding instrument	Average annual allocations (EUR)	Operator(s)	Recipients	Funding instrument	Average annual allocations (EUR)	Operator(s)	Recipients
Support to improvement of production infrastructure and equipment ERDF	11-12m	Central planning by MoF Supervision by MoE Administered by CFCA	Enterprises, associations and port authorities	**Loan guarantees and mezzanine loans** ERDF	8m	Central planning by MoF Supervision by MoE Administered by ALTUM	All enterprises (SMEs for loan guarantees)
Business incubator support programme ERDF	4-5m	Central planning by MoF Supervision by MoE	LIDA Final beneficiary regional incubators and creative industry incubators	**Seed capital funds** ERDF	4-5m	Central planning by MoF Supervision by MoE Administered by ALTUM	Start-ups, micro enterprises and SMEs

		Administered by LIDA and CFCA					
Cluster programme ERDF	1m	Central planning by MoF Supervision by MoE Administered by CFCA	Consortiums, associations Final beneficiary enterprises	**Business angel co-investment** ERDF	1-2m	Central planning by MoF Supervision by MoE Administered by ALTUM	SMEs
Support to international competitiveness ERDF	8-9m	Central planning by MoF Supervision by MoE Administered by LIDA and CFCA	LIDA Final beneficiary enterprises	**Technology accelerator** ERDF	2-3m	Central planning by MoF Supervision by MoE Administered by ALTUM	SMEs, including start-ups

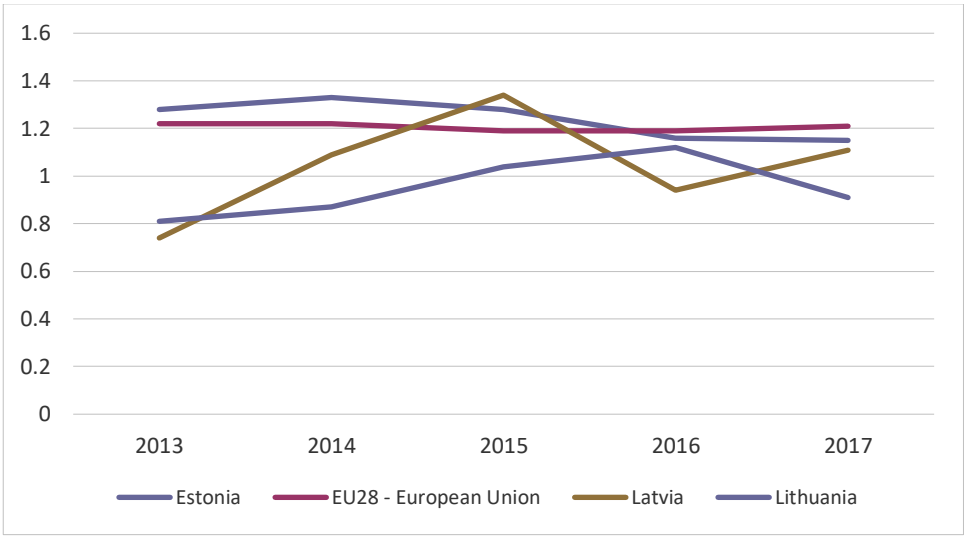
Appendix B FWCI of different science fields (Scopus, SciVal data)

Figure 47. FWCI medical sciences



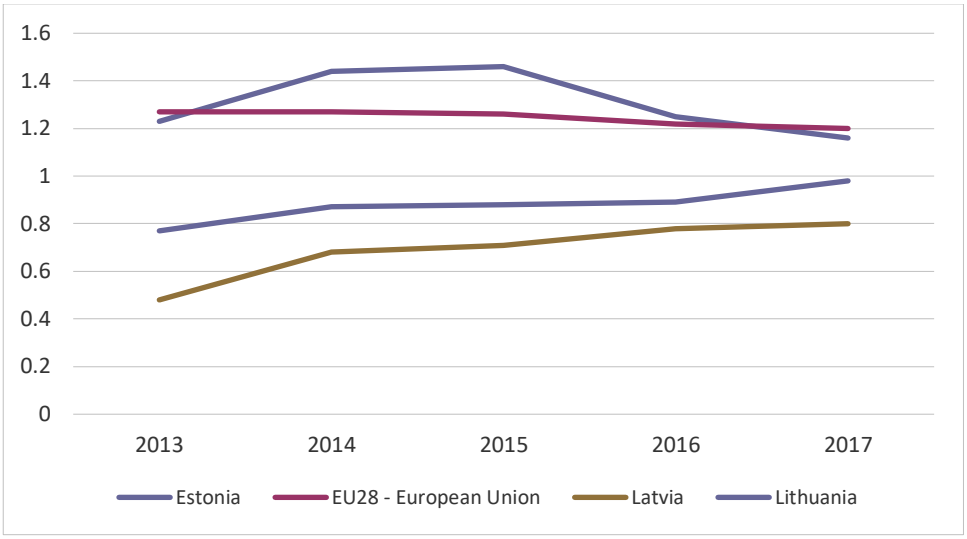
Source: SciVal

Figure 48. FWCI agricultural sciences



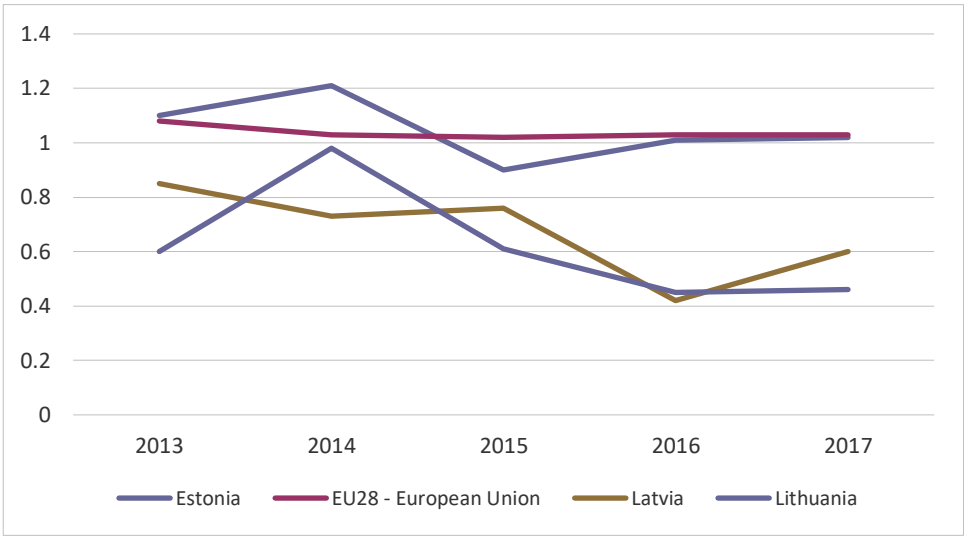
Source: SciVal

Figure 49. FWCI engineering and technologies



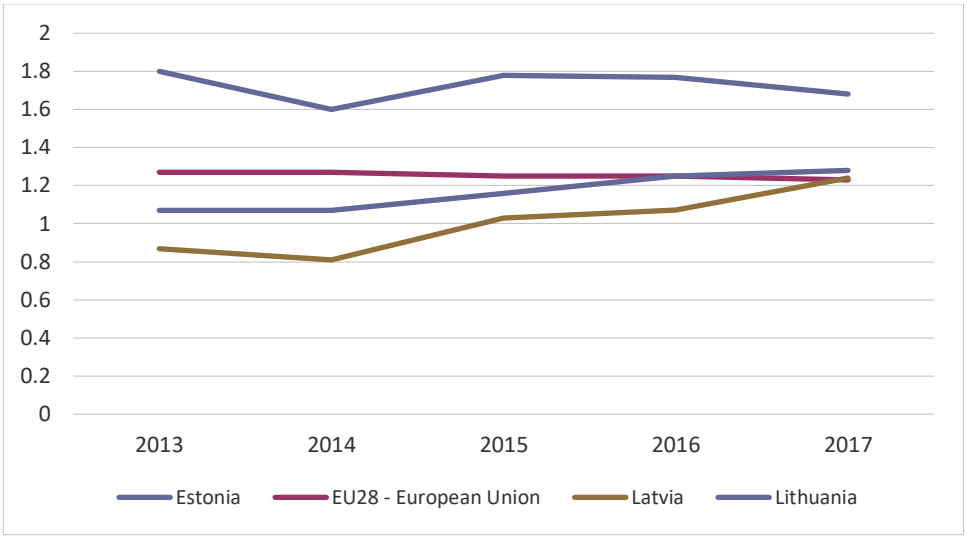
Source: SciVal

Figure 50. FWCI humanities



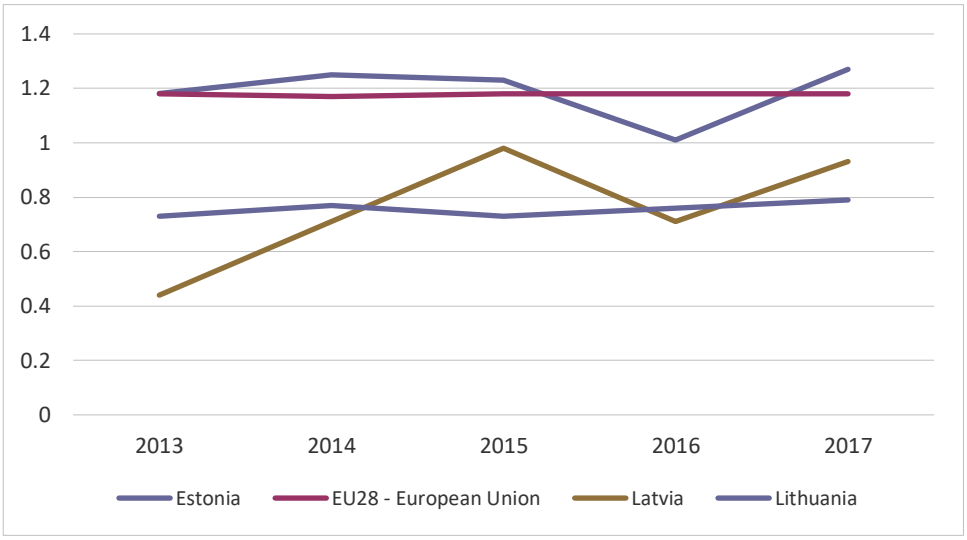
Source: SciVal

Figure 51. FWCI natural sciences



Source: SciVal

Figure 52. FWCI social sciences



Source: SciVal

IN PERSON

All over the European Union there are hundreds of Europe Direct Information Centres.
You can find the address of the centre nearest you at: http://europa.eu/contact

ON THE PHONE OR BY E-MAIL

Europe Direct is a service that answers your questions about the European Union.
You can contact this service
– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
– at the following standard number: +32 22999696 or
– by electronic mail via: http://europa.eu/contact

ONLINE

Information about the European Union in all the official languages of the EU is available on the Europa website at: http://europa.eu

EU PUBLICATIONS

You can download or order free and priced EU publications from EU Bookshop at: http://bookshop.europa.eu. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see http://europa.eu/contact)

EU LAW AND RELATED DOCUMENTS

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

OPEN DATA FROM THE EU

The EU Open Data Portal (http://data.europa.eu/euodp/en/data) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

KI-AX-19-008-EN-N

The Horizon 2020 Policy Support Facility (PSF) has been set up by the Directorate-General for Research and Innovation (DG RTD) of the European Commission under the EU Framework Programme for Research and Innovation 'Horizon 2020'. It supports Member States and countries associated to Horizon 2020 in reforming their national science, technology and innovation systems.

This report provides background information on the Latvian research and innovation system with specific focus on human capital for research and innovation. It includes a concise overview of Latvia's current performance in research and innovation, and the defined national priorities and targets for research and innovation system development, as well as recent achievements in fulfilling the set objectives. The report summarises information on the governance of the Latvian research and innovation system and the landscape of research performers. It also includes a section on bibliometric analysis. Details on the most relevant R&D and human resource statistics are provided by outlining the key indicators. Current initiatives and measures targeting human resources development in research and innovation are described.

Studies and reports

Publications Office

doi:10.2777/264675
ISBN: 978-92-76-08994-0