R&I and Infrastructure Report

Research and Innovation Policy

Sustainable Governance Indicators 2022

SGI Sustainable Governance Indicators

BertelsmannStiftung

Indicator

R&I Policy

Question

To what extent does research and innovation policy support technological innovations that foster the creation and introduction of new products?

41 OECD and EU countries are sorted according to their performance on a scale from 10 (best) to 1 (lowest). This scale is tied to four qualitative evaluation levels.

10-9 = Research and innovation policy effectively supports innovations that foster the creation of new products and enhance productivity.
8-6 = Research and innovation policy largely supports innovations that foster the creation of new products and enhance productivity.
5-3 = Research and innovation policy partly supports innovations that foster the creation of new products and enhance productivity.
2-1 = Research and innovation policy has largely failed to support innovations that foster the creation of new products and enhance productivity.

Sweden

Score 10

Sweden has ranked among the top five advanced industrialized democracies on all aspects of research and development (R&D): spending (public and private) per capita; number of researchers; number of patent applications and intellectual ownership licenses. This high level of investment in R&D has existed for considerable time. As an economy with high labor costs, Sweden's competitive edge lies not in large-scale manufacturing but in knowledge-intensive sectors. R&D spending thus directly sustains that competitive edge.

Governments – center-right as well as Social Democratic-Green – rarely miss an opportunity to reinforce the argument that public spending on higher education, research institutions and research and development in general is integral to future prosperity and wealth. There is nothing suggesting that the commitment among all major political players to R&D spending is about to change.

However, the portion of the population self-reporting that they have entrepreneurial skills is low. This is the case despite a reform that drastically reduced the regulatory burden on new startups to the point that it is very low compared to the average among EU member states. Additionally, recent public policy efforts to increase innovation and entrepreneurship included the provision of better communication through a consolidated portal (www.verksamt.se), and the digital streamlining of communication between municipalities and firms (OECD, 2020).

Vinnova, the Swedish public agency for innovation, has expressed concern for the immediate future of innovation policies caused by the uncertainty and concomitant budget cuts associated with the pandemic. The agency stresses that its current focus

is placed on innovation systems. It also provides financing for start-ups, and backs increased collaboration with the European Union (Vinnova, 2021).

Finally, the pandemic notwithstanding, there are signs that R&D public policies are bearing fruit in Sweden, as the country was ranked second in the world in the Global Innovation Index (GII) 2021 (Dutta et al., 2021).

Citation:
Dutta, Sumitra, Bruno Lanvin, Loreta Rivera León, and Sacha Wunsch-Vincent. (eds.). 2021. "Global Innovation Index 2021: Tracking Innovation Through the COVID-19 Crisis." World Intellectual Property Organization. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf

OECD. 2020. "Inclusive Entrepreneurship Policies, Country Assessment Notes. Sweden, 2020." https://www.oecd.org/cfe/smes/Sweden-IE-2020.pdf

Vinnova. 2021. "Årsredovisning 2020." https://www.vinnova.se/contentassets/218b4a9789844354a1f56e2629c9dc7f/vinnova_ar2020.pdf?cb=20210331142235

Germany

Score 9

Germany's performance in the area of research and development (R&D) remains good, but the country is losing ground in international rankings. According to the World Economic Forum (2019), Germany's capacity for innovation was ranked best among the world's top performers. In the Global Competitiveness Report 2019 (which is still the most recent regular report), Germany retained its top rank. Furthermore, Germany ranked fifth out of 141 countries with regard to patent applications per inhabitant. The quality of scientific research institutions was ranked at fourth place, a strong improvement relative to 2017, when Germany was ranked only 11th out of 140 countries (World Economic Forum 2019, p. 241). The leading role of German companies in the development of innovative vaccines against COVID-19 has demonstrated the country's strength in biopharmaceutical research in a spectacular way.

However, in a more recent special report by the World Economic Forum with a focus on coronavirus-induced transformation challenges from 2020, Germany is ranked only 10th out of 37 countries with respect to its incentives for investments in research, innovation and invention "that can create the markets of tomorrow" (World Economic Forum 2020). In general, many have criticized in recent years that, in spite of Germany's first-class research output, very few developments from research institutions have been successfully commercialized. In addition, many criticize the fact that while the German innovation system achieves incremental progress, no disruptive innovations result (Harhoff/Kagermann/Stratmann 2018; EFI 2018: p. 62). However, the Federal Agency for Disruptive Innovation, established in 2019 following the example of DARPA in the United States, does not seem to enjoy enough freedom to fulfill its mission (Bernau 2021).

Regarding funding, the German government has continuously increased R&D over recent years with spending levels above the European average. The total spending on

R&D was at 3.17% of GDP in 2019 and slightly fell to 3.14% in 2020 due to the crisis-induced decline of spending in the private sector, whereas funding in the public sector was stable (Stifterverband 2022). The new coalition government has confirmed the past government's commitment to increasing the ratio of R&D spending to GDP to 3.5% by 2025 (Koalitionsvertrag 2021, p. 19).

In 2020, Germany introduced an R&D tax incentive that involves providing entities a 25% tax credit for spending on R&D staff that will be paid out if the entity makes a loss. The tax subsidy is currently capped at €1 million per company per year.

In recent years, as Germany has increased its research and education budget and pursued its excellence initiative within the tertiary education sector, the quality of its scientific research institutions has improved slightly. In the World Economic Forum's Global Competitiveness Report 2019, Germany performs well in the areas of higher education and training. However, the country was at only 21st place with regard to digital skills among the population (World Economic Forum 2019, p. 240).

Citation:
Bernau, Patrick, 2021: "Deutschland scheitert in kleinen Schritten." https://zeitung.faz.net/fas/wirtschaft/2021-05-30/fe89e2d58aeac7fb63fbf74704468576/ (accessed: 6 February 2022)

EFI (Expertenkommission Forschung und Innovation), 2018: Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands, Berlin. https://www.e-fi.de/fileadmin/Assets/Gutachten/2018/EFI_Gutachten_2018.pdf (accessed: 6 February 2022)

Harhoff, Dietmar, Henning Kagermann, and Martin Stratmann (eds): Impulse für Sprunginnovationen in Deutschland. acatech DISKUSSION, https://www.acatech.de/publikation/impulse-fuer-sprunginnovationen-in-deutschland/download-pdf?lang=de (accessed: 6 February 2022)

Koalitionsvertrag (2021): Mehr Fortschritt wagen, Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit, Koalitionsvertrag zwischen SPD, Bündnis 90/Die Grünen und FDP.

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World Economic Forum (2019): The Global Competitiveness Report 2019. World Economic Forum.

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Israel

Score 9

Israel's research and development (R&D) sector is based on three pillars: scientific research performed primarily in academia, research conducted in government institutes, and research conducted by civil-industrial partnerships overseen the by Ministry of Finance. For many years, Israel has led the world in research and development (R&D) investment, spending more on R&D as a share of GDP than any other developed country.

A large portion of Israel's R&D policy is directed toward international cooperation. In 2019, Israel was engaged in around 70 different international cooperative research

ventures with a variety of European countries and organizations. Overall, 90 Israeli companies have received grants or another financing to conduct R&D activities with companies from other countries. Israel has also signed 29 bilateral R&D agreements, which fund around 100 new projects each year, and is a partner in five EU programs, including Eureka, Eurostars, the Competitive and Innovation Program – Enterprise Europe Network (CIP-EEN), Galileo, and Sesar. In terms of R&D policy and budgets, the most significant international involvement is through framework programs, such as Horizon 2020, which are managed by the Israel-Europe R&D Directorate.

Despite Israel's strong R&D position at the beginning of the coronavirus crisis, the rate of the government's support for research in the fields of health, environment and infrastructure development was very low compared to other OECD countries. Only 0.5% of government investments in R&D were in the field of health (Buchnik, Klein & Getz, 2020). This long-term trend must be reversed if Israel is to maintain its position as a global leader in the field of innovation.

Despite the maturation and prosperity of Israel's high-tech industry, the market failures that characterize the industry are becoming more complex, and there is a greater need for private market participation in the risks inherent in seed and early-stage investments, especially against the background of increased later stage investment (Israel Innovation Authority 2021). Moreover, The Israeli high-tech industry is undergoing a transformation. More Israeli companies are preserving their independence rather than becoming R&D centers for multinational corporations as was customary in the past. A crucial question is whether this will lead to more diversified local manufacturing jobs and a change the current situation in which the fruits of R&D investment are mainly enjoyed by a small share of Israelis.

Citation:
Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO), The Global Innovation Index 2019: Creating Healthy Lives – The Future of Medical Innovation, Genf 2019, https://www.globalinnovationindex.org/gii-2019-report

Innovation in Israel overview 2018-2019, Israel Innovation Authority, 2019 (Hebrew)
https://innovationisrael.org.il/en/sites/default/files/2018-19_Innovation_Report.pdf

Dutta, Soumitra, Bruno Lanvin, and Sacha Wunsch-Vincent (Editors), "The Global Innovation Index 2017. Innovation Feeding the World," https://www.globalinnovationindex.org/gii-2017-report

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Buchnik Tzipi, Klein Rinat, Getz Dafna. Medical research in Israel – the government must wake up before the next crisis Haifa, Israel, Shmuel Ne'eman Institute, November 2020, retrieved from https://www.neaman.org.il/Medical-research-in-Israel-a-wake-up-call-for-the-government-before-the-next-crisis

Israel Ministry of Foreign Affairs, Science, Science, and Technology: Research and Development, n.d, accessed on January 10, 2020, retrieved from https://mfa.gov.il/mfa/aboutisrael/science/pages/science%20and%20technology-%20research%20and%20development.aspx

Netherlands

Score 9

Regarding knowledge infrastructure as whole – that is, pre-university education, technical and vocational education and training, higher education, research, development and innovation (RDI), information and communications technology (ICT), and economy, in addition to the general enabling environment – Netherlands is a leading performer. It ranks fifth out of 138 countries in the Global Knowledge Index 2020 and fifth out of the 56 countries with very high human development. As strengths, the Global Knowledge Index mentions: expenditure on non-tertiary vocational education, secure internet servers, the availability of research and training services, and the impact of ICT on new services and products.

Regarding R&I in the narrow sense of the word, the 2021 EU Innovation Scoreboard mentions Sweden as a leader of innovation in the EU, followed by France, Denmark and Belgium. The Netherlands is identified as a "strong innovator" whose performance improved 10%-15% compared to 2019-20. In the 2021 World Economic Forum's Global Competitiveness Index, the Netherlands ranks fifth, ex aequo with Singapore, after Switzerland, Sweden and Denmark.

R&D expenditures (aggregated for both public and private) in the Netherlands have increased from half a billion euros in 1964 to €17.8 billion in 2019. As a percentage of GDP, R&D expenditures over the last 50 years have moved in a band between 1.64% and 2.18%. The government has determined that 2.5% is its policy goal. Public R&D expenditure is stable at approximately 62%-64% of total expenditures. Since 2017 it has increased, but not proportionally to the growth in GDP. Private expenditures are not likely to increase either. Private business expenditure on R&D is similar to the EU-27 average, but below the OECD average. Some economic sectors are clearly R&D-intensive, like ICT/software, high-tech, automotive and particularly pharmaceuticals. But the Dutch economic structure is traditionally more dominated by R&D-extensive sectors like oil and gas, trade, hospitality and building. A number of studies demonstrates how this mix of economic activities and sectors strongly determines the level of private investment in R&D.

The leap from an R&D expenditure of 2.18% to 2.5% of GDP cannot be achieved by incremental increases of several hundreds of million euros. It means a full-scale

transition to a different economic structure in which the government pursues a mission-driven innovation strategy focusing on great societal challenges: an energy transition, strong efforts to mitigate climate change, innovations in agro-food, water management, and physical and cybersecurity. Green industrial policy may offer the proper double-edged instrument that, on the one hand, stimulates industry to use technologies befitting a sustainable and circular economy, and on the other uses levies on CO2 emissions.

Citation:
Rathenau Instituut, Voorpublicatie Totale Investeringen in Wetenschap en Innovatie (TWIN) 2017-2023, (rathenau.nl)

European Commission, Innovation Union Scoreboard 2021 (ec.europa.eu)

World Economic Forum, The Global Competitiveness Report 2021 (reports.weforum.org))

Rathenau Instituut, 9 November 2021, Twee en een half procent

Haveman, E. Donselaar, P. Innovatieplatform Analysis of the Netherlands' private R&D position 2008

NRC.next, Stellinga, 11 September 2021 Groene Industriepolitiek, is dat een goed idee?

South Korea

Score 9

The South Korean government invests heavily in research and development (R&D), particularly in fields which can be directly commercialized. Korea's R&D spending-to-GDP ratio, which is the second-highest in the OECD, seems to be paying off. Korea has led Bloomberg's Innovation Index for seven of the nine years that the index has been published, including in 2021. Korea's internet broadband and mobile-phone infrastructures are among the world's best, and it was one of the first worldwide to establish a comprehensive 5G infrastructure. More recently, in response to COVID-19, Korea demonstrated its leadership and innovation capacity in health technology (e.g., contact-tracing, testing, vaccine manufacture). The country has an excellent research infrastructure, with many world-class universities and research institutes that produce internationally competitive research and patents.

One major impediment to innovation is the Korean market's oligopolistic structure and bureaucratic regulations, which make it difficult for SMEs and new entrepreneurs to succeed. SMEs are constrained by a lack of skilled workers in digital fields, limited access to ICT training, and insufficient capacity to translate digital technologies into productivity increases.

The Moon administration aimed for more inclusive and income-led growth, facilitating this via regulatory sandboxes and bottom-up R&D projects that benefit SMEs, academics and other non-chaebol actors. There is increasing interest in and funding for research in areas that address domestic societal needs, such as pollution and aging, rather than just large-scale, top-down R&D to expand national economic output and exports. Basic research grants provided by Korea's National Research Foundation are set to double by 2022.

Citation:
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Denmark

Score 8

Among OECD countries, Denmark has the fourth highest ratio of public R&D spending to GDP and the seventh highest submission rate of patent applications. The target of 3% of GDP investment in R&D remains the same.

The World Economic Forum ranked Denmark third (out of 141 countries) in terms of competitiveness on its 2021 Global Competitiveness Report. Denmark stands out in terms of modern skills, a robust labor market and widespread ICT adoption, but has reduced its investment in R&D. The report also noted that relaxing the country’s barriers to hiring foreign labor could help improve its labor market efficiency.

Noting the country’s strong and widespread IT skills among its labor force, the 2020 report named Denmark as one of the most prepared countries with regard to digital transformation. The government’s digital policies have also enhanced productivity by minimizing transaction costs in relation to the public sector and by creating markets for digital solutions more broadly.

Citation:
World Economic Forum, The Global Competitivenes Report 2020. (accessed 13 December 2020). https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2020.pdf

World Economic Forum, The Global Competitivenes Report 2021. (accessed 20February 2022).https://www.imd.org/centers/world-competitiveness-center/rankings/world-competitiveness/

France

Score 8

Having improved since 2007, France performs well in research and development policy. According to the EU Innovation Scoreboard 2021, France was ranked 14th out of 38 European states with respect to innovation capacity. In the report’s global innovation index, France performs slightly above the EU average and is ranked in the group of “strong innovators,” behind the group of “innovation leaders.” Although the absolute level of innovation performance remains strong, the French position relative to the EU has slightly declined in the last years. Overall spending on research and development constitutes 2.2% of GDP (2019), which means a marginal increase compared to 2000 and a slight decline since 2015. R&I spending is still below the OECD average, and far from the EU target of 3%. Whereas public

spending is comparable to the best-performing countries, private spending remains less strong. France's main relative weaknesses are its low levels of private investment and the transfer of innovation into the industrial sector. A new law (Loi PACTE) was passed in May 2019 with the aim of supporting innovation and improving company performance, particularly for small and medium size enterprises.

On the positive side, the measures initiated by the Hollande administration have encouraged the creation of new technology-based startup firms. President Macron declared that he would "make France a startup nation," and his government has adopted further legal and fiscal policy measures intended to facilitate the creation and growth of startups. For example, he created a €5 billion development fund earmarked for startups that had passed through initial stages of growth. The government's objective is to boost the capitalization of these new companies, thus avoiding the twin risks of expatriation or absorption by more powerful foreign companies. The government has also resisted the suggestion of reducing the tax exemption offered to companies that improve their research capacities in spite of its increasingly high costs to the state budget. The recovery programs aimed at overcoming the pandemic crisis contain important measures favorable to startups and to innovation in general. Presently, France has become Europe's second-largest tech market by dollar funding, outpacing Germany and falling just behind the United Kingdom. Over the past year, steady progress has been made, and France has moved up to the 11th position (out of 51 high-income economies) in 2020 from 16th (2019) in the rankings of the World Intellectual Property Organization (WIPO) Global Innovation Index.

However, barriers to innovation still exist. Cooperation between academic institutions and businesses is still restricted by cultural traditions, such as a lack of investment by small and medium-sized companies and the reluctance of researchers to invest in policy-relevant or applied research. Productivity levels and public research could also be improved. However, the development of public-private initiatives as well as the launching of incubators by private investors are improving the quantity and quality of initiatives and investments, in particular in new technologies.

Citation:
European Innovation Scoreboard 2021
https://ec.europa.eu/info/research-and-innovation/statistics/performance-indicators/european-innovation-scoreboard_en
World Intellectual Property Organization (WIPO): Global Innovation Index 2021
https://www.wipo.int/global_innovation_index/en/2021/

Luxembourg

Score 8

Luxembourg has made research, development and higher education one of the cornerstones of the nation's vision for the future. In February 2020, the government adopted its National Research and Innovation Strategy, with the objective of building a diverse and sustainable knowledge society by 2030, with a strong digital pillar.

Luxembourg expects to allocate about 1% of GDP to research and development (R&D) investments by 2023, by providing financing to both the public and private sectors. Public sector spending is expected to reach 0.8% of GDP. According to EUROSTAT, the Grand Duchy ranked first in the EU in 2020 with €648 per capita invested in R&D (followed by Denmark, Germany and Finland), while the EU average stood at €225 per capita. The IMD World Competitiveness Ranking 2021 classified Luxembourg as the 12th most innovative country worldwide, and the European Innovation Scoreboard 2021 assessed it as a "strong innovator country" due to its research systems, human resources and intellectual assets.

The main funder is the National Research Fund (FNR), which oversees a large number of research and aid programs (focused on areas such as materials science, health, ICT, data science, fintech, space industry, automation and robotics), and promotes activities to strengthen the link between science and society. From 2000 to 2020, the FNR devoted €813 million to 4,170 projects, and in 2021 disbursed €97.06 million to 299 projects. In the 2022 state budget, the FNR will receive €132 million. About 2,709 persons currently work on R&D functions in the public sector. The private sector contributes to the R&D activities with an annual budget of €382 million. (0.6% of GDP), and with more than 3,000 specialized staff (2019). The government encourages the development of public-private partnerships, supported by Luxinnovation, which is in turn supported by the Ministry of the Economy, the Ministry for Higher Education and Research, the Luxembourg Chamber of Commerce, the Luxembourg Chamber of Skilled Crafts, and the Association of Luxembourg's Industry (FEDIL).

In the World University Rankings 2022, the University of Luxembourg (founded in 2003) ranked among the top 300 universities in the world (total of 1662 participants) and third worldwide for its international outlook. It conducts research across multiple fields in its three faculties and three interdisciplinary research centers, as well as in the Luxembourg Learning Center (LLC). It boasts 1,688 academic staff from 94 different countries, 6,783 students originating from 130 various countries and 950 doctoral candidates.

The 2022 state budget allotted €234.9 million for the University of Luxembourg, or an annual increase of only 2% through 2025. Between 2014 and 2017, the government's contribution to the university increased by 7.6% per year. The Idea Foundation think tank expressed its surprise over this lower level of investment, declaring that "this goes against the stated ambition to focus on the knowledge economy and diversification, particularly in favor of a health ecosystem."

Citation:
"Creating value for society: The FNR's strategy and action plan 2022-2025." FNR (14 January 2022). https://www.fnr.lu/creating-value-for-society-the-fnrs-strategy-and-action-plan-2022-2025/. Accessed 15 January 2022.

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United States

Score 8

The United States has traditionally invested heavily in research and development, but the effects of the Great Recession and the country's problematic budget politics have compromised this support. Certain public institutions stand out, particularly the National Science Foundation, the National Institute of Health, the country's federal laboratories and various research institutions that are attached to federal agencies. In addition, there is a vast array of federally supported military research, which often has spillover benefits.

The Trump administration afforded research and innovation, apart from defense, a low priority. It cut federal R&D spending, except for Department of Defense R&D, which was projected to increase by 15%. Trump cut scientific and engineering personnel in environmental and resource-related agencies and withdrew support for alternative energy development. In part to compensate for this situation, the Biden administration has proposed major increases in non-defense R&D spending, coupled with small cuts in defense R&D.

Citation:
Joel Achenbach et.al., Trumps budget seeks cuts in science funding, Washington Post, March 11. 2019.

Austria

Score 7

Public research in Austria is largely centered on universities. However, this is a challenging environment, as universities in some areas are struggling with too many students, while researchers are often overwhelmed by teaching obligations. The Austrian Science Fund (Fonds zur Förderung der Wissenschaftlichen Forschung) is tasked with coordinating academic research, but has achieved only partial success in performing this task. Research funded by private corporations has little tradition in Austria and things are unlikely to change fundamentally anytime soon. Thus, the deficiencies in public-funded research cannot be counterbalanced by privately funded operations.

Links between industry and science are sound, and a large share of public research is funded by industry. In contrast to basic research, industry-sponsored research is mostly aimed at the applied sciences and does not necessarily affect universities. Integration within international networks is strong, and a high share of the labor force is occupied in science and technology-related occupations. Business R&D is particularly strong in niche markets, often performed by specialized small and medium-sized enterprises (SMEs). Other pillars of Austrian business research include large companies, affiliates of foreign corporations and the manufacturing sector.

Because of the coronavirus pandemic, no reliable/strictly comparable figures are available for 2020 and 2021. However, estimates of the research quota (Forschungsquote) show an increase from 3.18% in 2019 to 3.23% in 2020. However, this rise reflected to a considerable extent the pandemic-induced economic downturn. Of the total spending on research in 2020 (about €12.1 billion), 42% (i.e., about €5 billion) came from Austrian companies; slightly more than 8% accounted for the indirect research and experimental development (R&D) support (Forschungsprämie).

The government's new research, technology and innovation (RTI) strategy, which was adopted late in 2020, marked a clear commitment on the part of the federal government to enhancing Austria's innovative capacity through science and research. The planned actions identify different ways to further increase the efficiency and output of research investments, and encompass all areas and stakeholders of Austria's innovation system. Digitalization is catching up, but is still fairly deficient in the public sector. The coronavirus crisis has highlighted serious deficits in the government's data and digitalization policies as important information about coronavirus-related problems was not available.

Citation:
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Canada

Score 7

Canada's economic and policy environment is conducive to innovation and investment in productivity growth. Moreover, the country benefits from a large talent pool; its population has the OECD's highest level of educational attainment with regard to the proportion of the population with a post-secondary education. The number of researchers per capita in Canada is on a par with that of other developed countries.

Despite this, a 2015 report from the federal government's Science, Technology and Innovation Council found that the country continues to lag behind other countries when it comes to key innovation measures such as patent filings and corporate R&D spending. Similarly, a recent report from the Council of Canadian academics warns that although Canada remains a leading global contributor to research, its standing is at risk due to a sustained slide in private and public R&D investment. Indeed, as a share of gross domestic product, R&D expenditures have steadily declined in Canada since 2001, with the ratio now standing at 1.7%, well below the OECD average. The same report indicated that there are significant barriers between innovation and wealth creation in Canada, resulting in a deficit of technology startups growing to scale in Canada and a consequent loss of economic benefits. However, with respect to Higher Education R&D expenditures as a percentage of GDP, Canada has in the past ranked – and continues to rank – above the OECD average.

In 2017, the government announced an innovation and skills agenda, providing CAD 950 million funding in support for "innovation superclusters," with the goal of encouraging innovation, R&D and economic growth. In addition, a Strategic Innovation Fund with a budget of CAD 1.26 billion over five years was created, with the funding to be allocated to firms across Canada's industrial and technological sectors. This was followed in Budget 2021 with an additional CAD 7.2 billion over seven years to support innovation in strategic economic sectors and particularly in life sciences and bio-manufacturing given the country's lack of domestic vaccine supply. Nonetheless, the question of how effective government policy is in encouraging R&D investment and productivity gains remains a contentious one, particularly in light of the pandemic and scaling of Canadian firms to global scale remains a challenge.

Citation:
Council of Canadian Academies, Expert Panel on the State of Science and Technology and Industrial Research and Development in Canada, Competing in a Global Innovation Economy: The Current State of R&D in Canada, 2018, Ottawa (ON), http://new-report.
scienceadvice.ca/assets/report/Competing_in_a_Global_Innovation_Economy_FullReport_EN.pdf.

Government of Canada, Budget 2021: A Recovery Plan for Jobs, Growth, and Resilience, 2021, https://www.budget.gc.ca/2021/home-accueil-en.html

Greenspon, Jacob and Erika Rodriques (2017) "Are Trends in Patenting Reflective of Innovative Activity in Canada?" CSLS Research Report 2017-01, January http://www.csls.ca/reports/csls2017-01.pdf.

Science, Technology and Innovation Council, Canada's Innovation Challenges and Opportunities, State of the Nation: 2014, 2015, http://www.stic-csti.ca/eic/site/stic-csti.nsf/vwapj/STIC_1500_SON_Report_e_proof4.pdf/$FILE/STIC_1500_SON_Report_e_proof4.pdf.

Estonia

Score 7

Research, development and innovation (RDI) are frequently stressed as national development priorities, reflected in the National Development Plan of Research, Innovation and Entrepreneurship 2021–2035 (TAIE). The new strategy should bring research closer to the economy, where outcomes, so far, have been modest. The Estonian Research Council (ETAG) has stated that national strategies "have not triggered any significant changes in the R&D structures and strategies of universities or companies."

Public and private R&D expenditures have remained stagnant or even decreased; the shortage of funds remains one of the main obstacles to promoting RDI. The promise to increase public RDI expenditure to 1% of GDP over the next three years has not been fulfilled and RDI expenditures stagnated at 0.71% of GDP for 2019–2021.

Estonia is one of the few countries worldwide that does not have tax exemptions for enterprise-led R&D activities, nor is there any R&D-related risk-sharing between the public and private sectors. High costs and high risks undermine private sector motivation for investing in R&D. The government policy toward this problem has been to encourage innovation and the transfer of scientific knowledge to enterprises via special grant schemes (NUTIKAS, ResTA, SekMO) by supporting collaboration between R&D institutions and companies. As a result of these efforts, private sector R&D expenditure exceeds that of the public sector.

R&D policy measures have been much more successful in developing scientific research, as indicated by an increased number of highly ranked international publications and the improved international rankings of main Estonian universities. Advances in the development of patents, high-tech products and services are noticeable but less prominent. In recent years, the number of R&D personnel in the private sector has increased by 45% in contrast to a decrease (-3%) in the public sector.

Citation:
ETAG (2021). TA statistika rahvusvahelises võrdluses.https://www.etag.ee/wp-content/uploads/2022/01/TA-statistika-rahvusvaheline-vordlus_jaanuar-2022_07012022.pdf (accessed 07.01.2022)

Finland

Score 7

In general, research and innovation policy in Finland focuses on basic and applied research in research institutions, supporting startups that convert scientific output into products, and seeking to fostering productivity as well as social innovations.

The Finnish higher education system is centralized. It consists of 13 universities and 22 universities of applied sciences (UAS) that operate under aegis of the Ministry of Education, Science and Culture. As for institutions promoting and coordinating the development of (social) innovations, 12 public research institutes work under related ministries. The key agency for developing technological research is the Technical Research Centre of Finland (VTT), which operates under the Ministry of Economic Affairs and Employment. It is a cooperation partner for companies, research institutes, higher education institutions and policymakers both nationally and internationally. In terms of R&D activities, other public research institutes are more mission-oriented, with a broad range of research objectives. Their mandate can vary from research (both basic and applied) to additional responsibilities, such as monitoring, data collection and management, and certification and inspection (Schienstock and Hämäläinen 2001).

The recognition of companies as key partners for research institutions is reflected in increased private sector cooperation in the research sector in Finland. However, successful startup companies tend to be acquired by technology giants (GAFAM), thereby eliminating the benefits of innovations at the local and national level.

Finland was previously among the forerunners in research and development (R&D) spending, as well as in the number of researchers and patent applications. Indeed, in 2014, Finland had the European Union's highest R&D intensity, followed by Sweden and Denmark. However, this lead position subsequently declined in the wake of weakening economic prospects.

The innovation system's low level of internationalization is a particular weakness. Moreover, the focus of R&D has been on applied research, with basic research at universities and other institutes benefiting little. In the long run, given the obvious dependence of applied research on basic-research developments, the heavy bias in favor of applied research and the continuing neglect of the financial needs of schools and higher learning institutions will carry negative consequences for product development and productivity. Furthermore, the system of technology transfer from universities to the private sector is comparatively weak, and academic entrepreneurship is not well developed.

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"Research and Innovation Policy Guidelines for 2010-2015." The Research and Innovation Council of Finland, 2010. http://www.minedu.fi/export/sites/default/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/julkaisut/liitteet/Review2011-2015.pdf

Schienstock, Gerd and Hämäläinen, Timo. 2001. Transformation of the Finnish Innovation System: A Network Approach. Sitra Series 7. Accessed 7.1. 2021. https://media.sitra.fi/2017/02/28142146/raportti7.pdfet"Statistics Finland – Science, Technology and Information Society – Research and Development," www.stat.fi

Data on R&D expenditure; http://ec.europa.eu/eurostat/

http://www.stat.fi/til/tkker/2019/tkker_2019_2019-02-21_tie_001_en.html

https://yle.fi/uutiset/osasto/news/education_wage_subsidies_key_in_next_years_budget/10978952

Iceland

Score 7

Public and private research and development (R&D) expenditure in Iceland totaled 3% of GDP in 2006, one of the highest levels among OECD members. About 40% of this expenditure was provided by the government. This high level of R&D investment reflects the ongoing transformation from an economic focus on agriculture and fisheries toward manufacturing and services. In particular, this has led to the creation of new private firms focused on biotechnology, pharmaceuticals and high-tech manufacturing. Such export-oriented firms were helped by the depreciation of the króna, which lost a third of its value in real terms following the 2008 crash, but they were then hurt by the króna's gradual recovery. The economic collapse in 2008 led to a cut in R&D expenditure to 1.8% of GDP in 2013. Since then, R&D expenditure has recovered to 2.5% of GDP (Statistics Iceland). In 2017, Iceland had 6,100 researchers per million people in R&D compared with 4,100 for the OECD region as a whole and 4,000 for the European Union (World Bank). The number of small high-tech startup companies has risen in recent years, supported by vigorous research in life sciences and energy, as well as by favorable investment incentives.

Citation:

Statistics Iceland, https://px.hagstofa.is/pxis/pxweb/is/Atvinnuvegir/Atvinnuvegir__visinditaekni__rannsoknthroun/FYR05101.px/table/tableViewLayout1/?rxid=70f04369-335f-4fab-b1a4-5d7d4232d9fb. Accessed 1 February 2022.

Rannis (The Icelandic Centre for Research), Annual Report 2020, https://www.rannis.is/media/arsskyrslur/Arsskyrsla-Rannis-2020-web.pdf. Accessed 1 February 2022.

World Bank, World Development Indicators, 2022, https://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6. Accessed 1 February 2022.

Ireland

Score 7

While government policy is supportive of research and innovation by indigenous firms, the most striking success of Irish industrial policy has been in attracting foreign-owned firms in high-tech sectors to Ireland. This trend continued during the economic crisis and throughout the pandemic. Indeed, the inflow of FDI in the IT and pharmaceutical sectors contributed significantly to the economy's strong recovery. The location of these firms in Ireland has created opportunities for innovative small Irish firms to develop technological inputs to supply them.

Ireland's overall information and communication technology readiness continues to lag behind most other northern and western European countries, as well as Israel. Nonetheless, the World Economic Forum's Global Competitiveness Report for 2019 ranked Ireland 24 out of 141 countries in terms of global competitiveness (up from 28 in 2014). Ireland was ranked sixth in terms of its labor market competitiveness

and 10th in terms of business dynamics.

The so-called double Irish tax facility, which provided significant tax incentives for multinational corporations to attribute intellectual property income (wherever its origin) to their Irish subsidiaries, was abolished in the 2015 budget in order to avert EU penalties over illegal state aid to industry. In the 2016 budget, the minister for finance announced some details of a new "knowledge box" scheme to partially replace this facility. This provides for a 6.25% corporate tax rate on profits arising from "certain patents and copyrighted software which are the result of qualifying R&D carried out in Ireland." The Irish government intends to remain a world leader in attracting R&D-intensive investment, irrespective of whether or not the OECD agreement on corporate tax is implemented.

Citation:
World Economic Forum Global Competitiveness Report 2019

Japan

Score 7

Science, technology and innovation (STI) receive considerable government attention and funding. Building on the 5th Science and Technology Basic Plan (2016-2020), in which the government aimed to spend 1% of GDP on R&D to achieve a combined public-private R&D investment of 4% GDP, the government announced its 6th Science and Technology Basic Plan (2021-2025) in 2021 with a goal to invest ¥30 trillion/1 billion between 2021 and 2025 in public R&D, cumulating to ¥120 trillion /.04 trillion in combined public-private investment. In addition to the expected investment of ¥90 trillion to industry, a new university fund of ¥10 trillion has been created to raise Japanese universities' global competition and performance. There is some suggestion of the 6th Plan aiming to incorporate humanities and social sciences in the National STI policy.

The government and outside observers, pointing to various indicators, realize that Japan's strong position among the world's top technology nations is on the decline. As a recent government report pointed out, Japan's international strength in quality and quantity of scientific output has weakened over the last 20 years. The lack of progress in university reforms and government's stalled public investments in R&D are blamed for the country's anemic industry-academia partnership development.

Citation:
Council for Science, Technology and Innovation/Cabinet Office, Report on the 5th Science and Technology Basic Plan, 18 December 2015

Takahiro Ueyama, Japan's 6th Science, Technology and Innovation Basic Plan, Open Access Government, September 21, 2021. https://www.openaccessgovernment.org/japans-6th-science-technology-and-innovation-basic-plan/120486/

Outline of the Fifth Science and Technology Basic Plan, http://www.dst.tokyo/docs/5th-STBP.pdf

Smriti Mallapaty, Japan prepares 'moonshot' project to solve global problems, Nature, 09 April 2019, https://www.nature.com/articles/d41586-019-01094-w

Norway

Score 7

Norway is steadily increasing its spending on research and development (R&D), with 4% of GDP as a target. Innovation is limited by the fact that Norwegian industry and businesses spend less on research than their counterparts in other countries. Research policy is non-pluralistic, government-led and has historically not been strongly oriented toward enterprises or innovation in the market. The country's strength lies in applied economic and social research rather than in basic and hard science research. However, there are some excellent research groups and networks. Research funding is predominantly public, and funds are distributed through a single national research council. New priorities have been given to research on marine issues and to green industries. Also, priority has been given to research and innovation that may contribute to improving efficiency and service quality in the public welfare services, including health services.

By international comparison, the country's private sector provides little in the way of research funding. This low aggregate investment level is reflected in the relatively low number of patents that are granted. It is also relevant to note that the share of university degrees granted in science and technology is low, and that Norwegian children have fared especially poorly in scientific knowledge, at least in relative terms, in the OECD's Program for International Student Assessment (PISA) study. However, the international rankings of some of the country's most important universities have improved in recent years. The country would certainly benefit from a higher absolute level of investment in R&D. However, the research council's centralized allocation of funds and state subsidies, with only limited participation by private donors, has also been criticized as a model. The council's selection of priorities has often been too narrow. There is thus ample scope for increasing investment in academic and basic research, as well for promoting more involvement by private- and public sector actors.

Portugal

Score 7

The European Union's 2020 Innovation Scoreboard classified Portugal as a "strong innovator," the second-highest category (out of four) and an improvement vis-à-vis the 2019 Innovation Scoreboard, in which Portugal was deemed a "moderate innovator."

However, there was a significant deterioration in the 2021 Innovation Scoreboard, with Portugal being downgraded to a "moderate innovator," dropping from 12th to 19th place in the EU. Nevertheless, this reduction may be due to data collection issues, with the 2021 Innovation Scoreboard noting that the country's "recent decline in innovation performance is due to reduced performance on the indicators using

innovation survey data, hiding strong performance increases on tertiary education, government support for business R&D, ICT specialists, job-to-job mobility of human resources in science and technology (HRST) and environment-related technologies."

The 2021 Innovation Scoreboard report noted that Portugal's strengths include attractive research systems, digitalization and the use of information technologies. Conversely, its weaknesses are with regard to In-house business process innovators; Innovators that do not develop innovations themselves; and Climate change related indicators.

In previous SGI reports we noted that the government places a great deal of emphasis on research and innovation, with a particular interest in developing the tech sector, signing a €110 million deal to host the Web Summit in Lisbon until 2028. A reflection of this commitment is the Portuguese government's leadership in setting up the European Startup Nations Alliance (ESNA) in November 2021, which will have its permanent seat in Lisbon. Moreover, innovation is a key plank of the country's Recovery and Resilience Plan.

While this is beginning to have some impact, it should be noted that Portugal is developing from a very low position, a pattern that is reflected in the results that fall below the EU average in terms of the tech sector as highlighted in the State of European Tech 2021 report.

Citation:
Atomico & Slush (2021), "The State of European Tech 2018," available online at: https://2021.stateofeuropeantech.com/chapter/executive-summary/

"European Innovation Scoreboard 2020 – Portugal." Available online at: https://eurocid.mne.gov.pt/sites/default/files/repository/paragraph/documents/9961/000084557.pdf

"European Innovation Scoreboard 2021 – Portugal." Available online at: https://www.kowi.de/Portaldata/2/Resources/fp/EIS-2021-Report.pdf

"Portuguese Roadmap of Research Infrastructures. 2020 Update" at https://www.fct.pt/media/docs/Portuguese_Roadmap_Infrastructures2020.pdf

Spain

Score 7

Research and technology policy is traditionally a weak point, as evidenced by the low number of patents registered, the relatively poor international ranking of universities and the low level of spending on R&D.

According to the European Commission's 2021 Innovation Scoreboard, Spain's innovation performance has notably improved relative to 2010, with human resources the strongest-performing innovation dimension. Moreover, Spain performs above the EU average with regard to innovation-friendly environment and employment impacts. Spain also scores high with respect to new doctorate graduates, sales of new-to-market and new-to-firm product innovations, broadband penetration,

and the share of the population with tertiary education.
In 2020, the government approved the new Science, Technology and Innovation Strategy for 2021 – 2027, with the aim of doubling the amount of public and private investment in R&D to 2.12% of GDP by 2027. The strategy was elaborated together with regional governments, economic and social stakeholders, universities, research organizations, and scientific bodies.

In July 2020, the government approved the Action Plan for Science and Innovation. After a decade of cuts and a lack of reforms, the plan includes 17 measures based on three cornerstones: research and innovation in health, the transformation of the science system and attracting talent, and driving business R&D and the science industry. Although the plan focuses on short-term measures, it takes into account the long-term recovery of the science and innovation system.

In fact, in 2021, the budget of the Ministry of Science and Innovation was increased by 59.4% as compared to 2020. However, a large part of these funds came from the NextGenerationEU program. The Science and Innovation Ministry will also receive a historically high amount of €3.8 billion in 2022.

In addition, regional governments contribute with their own research and innovation policy to technological innovations. The autonomous communities increased their R&D budgets in 2021. The 2021 Regional Innovation Scoreboard (RIS) indicated substantial variation in regional performance, with the best performing regions, the Basque Country and Madrid, performing three times as well as the lowest performing region, Ciudad Autónoma de Ceuta.

Citation:
EC(2021), European Innovation Scoreboard
https://euraxess.ec.europa.eu/worldwide/asean/european-innovation-scoreboard-2021-published

Spanish government (2020) Plan de choque para la ciencia y la innovación
https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/ciencia-e-innovacion/Documents/2020/09072020_PChoqueCiencia.pdf

Switzerland

Score 7

Switzerland’s achievement in terms of innovation is considerable. It spends 3.2% of GDP (2019) on research and development, as compared to the EU average of 2.1% (2019; OECD 2022; BfS 2021). In the period between 2000 and 2017, the growth rate of expenditures on R&D exceeded the growth rate of GDP. Standardized by the number of inhabitants, Switzerland is an international leader in patent applications, with strengths in health technologies and biotechnology. 68% of research spending is corporate spending with the direct aim of economic innovation, an important factor in the country’s strong overall competitiveness. With a share of about 29%, public research funding plays a lesser role than in other European countries, but public spending on research is increasing. It depends on five main actors: the cantonal universities, the two federal institutes of technology, the National Science

Foundation, the Federal Commission for Technology and Innovation, and the academies of sciences. These actors are independent of each other but cooperate based on complementarity and (limited) competition. The various institutions are highly autonomous, and research policies and processes are driven by bottom-up operations. Thus, Swiss research policy is not centralized, but rather relies on a concept of decentralized innovation with periodic intervention by the federal government. The output of the research system is impressive. The Federal Institutes of Technology Zürich and Lausanne belong to the top-ranked universities in the world, and the universities of Basel, Bern, Geneva and Zürich regularly appear on the list of the 150 best universities worldwide.

In the recent tender for European Research Council grants, Switzerland was the fifth most successful nation along with Italy, winning 28 grants, behind Germany (72), France (53), the United Kingdom (46) and the Netherlands (44).
However, Switzerland was excluded from the European research agreement due to its rejection of a new framework agreement governing the updating of bilateral treaties. As such, successful Swiss researchers will not receive their grant from the European Union, although this will be compensated by Swiss sources (NZZ 12 January 2022). This decision, which was taken in 2021 to exclude Switzerland from the European research program Horizon Europe, represents a major blow to the Swiss research community, which fears not only the lack of funding but also the inability to access European networks (RTS Info, 26 January 2022). This isolation from the European research community represents a major challenge for Switzerland, which must remain competitive and attractive in terms of research and development in order to continue to attract the international talent on which its universities, federal institutes and industries depend.

A number of other deficits persist, such as coordination among universities and the new universities of applied sciences as well as the weakness in social science and humanities research relative to that conducted in the natural sciences and technologically.

In 2016, the federal government defined its research and innovation goals for the coming four years: increased support for (1) continuing education in vocational training, (2) young academics, (3) training in medicine and (4) innovation. Resources for education, research and innovation should grow by 2% annually.

Citation:
Bundesamt für Statistik 2019: Forschung und Entwicklung in der Schweiz 2017 Finanzen und Personal, Neuchatel: Bundesamt für Statistik

Bundesamt für Statistik 2021: Forschung und Entwicklung in der Schweiz. https://www.bfs.admin.ch/bfs/de/home/statistiken/volkswirtschaft/forschung-entwicklung.assetdetail.17164247.html, see also: https://www.bfs.admin.ch/bfs/de/home/statistiken/bildung-wissenschaft/technologie.html

OECD 2022: Main Science and Technology Indicators, Paris:OECD

RTS Info: Horizon Europe “Nous vivons les premiers revers,” alerte la recherche. https://www.rts.ch/info/suisse/12817546-horizon-europe-nous-vivons-les-premiers-revers-alerte-la-recherche.html

United Kingdom

Score 7

The United Kingdom's tradition of being an active player in research and innovation dates back to the Industrial Revolution. The country's clusters of pre-eminent universities have for a long time played an important role in linking cutting-edge academic research with industries such as biotechnology, and information and communications technology (ICT). Performance has been weaker in terms of overall R&D spending – around 1.74% of GDP in the years prior to the pandemic, well short of the norm set for EU member states – as well as in the conversion of innovation into sustainable, large-scale production, which holds the potential for long-term profitability. However, it is important to emphasize that manufacturing contributes to a smaller share of UK GDP than in most OECD countries, and other indicators, such as ICT spending (which matters more for service industries), have to be taken into account to understand trends in innovation in the United Kingdom.

Over recent decades, successive governments have attempted to improve this situation, for example, by targeting weaknesses in technical education at various levels. Recent government initiatives have focused on extending tax credits for R&D, setting up regional technology and innovation centers, investing in digital infrastructure and new university research facilities, as well as establishing Innovate UK to promote economic growth through science and technology.

After leaving the European Union, the UK government must address the challenge of maintaining its research and innovation effort. The government chose to end UK participation in the European Union's Erasmus program, replacing it with the somewhat less ambitious Turing scheme, but is expected to continue to participate in the European Union's Horizon program after projects currently in progress end. However, although the Trade and Cooperation Agreement (TCA) between the European Union and the United Kingdom provides for the United Kingdom to be associated with Horizon, the precise terms are yet to be confirmed and there has been friction between the United Kingdom and European Union over this matter, as with other aspects of implementing the TCA.

The United Kingdom has significantly increased its own science budget. However, for reasons of fiscal prudence, a decision in the November 2021 budget about reaching the target level of £22 billion per annum means it will take longer than previously expected, as explained in a BBC report. Nevertheless, many of the fears of UK universities and the country's corporate sector about the impact of Brexit have been allayed. In life sciences and pharmaceuticals where the United Kingdom maintains a prominent research role (as witnessed by the rapid development of the Oxford-AstraZeneca COVID-19 vaccine), UK research efforts remain especially strong. The revenue of some universities may, however, be affected by a sharp decline in applications by EU students since Brexit. This is partly because all EU

students will, in future, have to pay the higher foreign student fees instead of the domestic rates they were entitled while the United Kingdom was an EU member state.

Citation:
https://ifs.org.uk/uploads/publications/bns/BN283-Drop-in-international-students-would-imperil-university-finances.pdf
https://www.politico.eu/article/eu-applications-uk-university-ucas-brexit-tuition-fees/
https://www.thetimes.co.uk/article/universities-hire-planes-to-fly-in-china-students-gfq2cc9j0
https://www.bbc.co.uk/news/science-environment-59068487

Australia

Score 6

In November 2017, a report was released laying out a strategic plan to 2030 for optimizing investment in Australian innovation. The Australian government, in its May 2018 response to the report, expressed support in principle for most of the recommendations, but there has been little evidence of substantive policy change since then. The comparatively low quality of the infrastructure is the result of limited spending on its modernization. This reflects the preference of Australian society for moderate levels of taxation.

In the 2020-21 budget, the Morrison government introduced a new R&D tax incentive scheme effective 1 July 2021 that provides up to a 43.5% tax offset (reduction) on company R&D expenditures. It remains to be seen whether this leads to an increase in private sector R&D investment. The 2020-21 budget also provided for a AUD 1.5 billion Modern Manufacturing Strategy, the centerpiece of which is AUD 1.3 billion allocated to local manufacturers to help them “collaborate and build scale, commercialize their ideas and connect to global supply chains.”

Australia’s support for local manufacturing in six areas – resources and critical minerals, food and beverage, medical products, recycling and clean energy, defense, and space – is similar to the subsidy programs that other OECD countries have embraced.

Citation:
Innovation and Science Australia 2017, Australia 2030: prosperity through innovation, Australian Government, Canberra: https://www.industry.gov.au/sites/g/files/net3906/f/May%202018/document/pdf/australia-2030-prosperity-through-innovation-full-report.pdf

Australia’s Economic Accelerator To Propel Economy, https://www.pm.gov.au/media/australias-economic-accelerator-propel-economy

Belgium

Score 6

R&D policy is shared between the federal government, which can offer tax incentives, and the subnational (regional and community) governments, which are responsible for managing the bulk of European subsidies and supporting university R&D and related projects. This increases subnational accountability but hurts

coordination and limits economies of scale. According to KPMG, a consultancy, Belgium has "increased its attractiveness as a prime location for companies involved in research and development activities and in the exploitation of patents." The country's location, transportation facilities and infrastructure offer considerable advantages to potential investors, KPMG says.

General investment levels have declined across the OECD since the onset of the financial crisis in 2007. Belgium withstood that negative trend comparatively well, with investment as a share of GDP hovering around 23% (comparable to France and Austria, and three points above Germany or the Netherlands, according to IMF data). Specific R&D investment stands at 2.5% of GDP, which is lower than in Germany, Denmark and Austria, but ahead of France, the Netherlands or the EU average (Eurostat data).

In spite of this, Belgium still suffers from a chronic shortage of new and innovative enterprises. Dumont and Kegels (2016) write that "Belgium performed rather well in terms of net job creation over the period 2000 – 2014, in comparison with […] neighboring countries. […] However, our results underline the importance of the decrease in industry-level productivity growth as the main explanation of the aggregate productivity-growth slowdown. […] Belgium stands out unfavorably from other OECD countries, in its low entry of new firms. […] The specific tax benefit for young innovative companies, introduced by the Belgian federal government in 2006, and the Startup Plan that was initiated in 2015, seem to be good practice in targeting tax incentives on young firms [… It] seems that access to finance is the major barrier for entrants and young firms in Belgium. […] Despite improved fiscal incentives, Belgium remains technologically considerably behind other European countries of a similar size such as Denmark and the Netherlands. While some indicators such as patent registration and monetary returns may be improving, the technological content of the country's exports is progressively eroding. Universities are chronically underfunded […]. This should not overshadow important exceptions; a highly skilled work force is present, and fiscal incentives have attracted some research-intensive firms in the chemical, pharmaceutical, and more recently computer-science sectors (such as Google, in the latter category)."

As a silver lining, the COVID-19 crisis displayed the dynamism of the Belgium-based pharmaceuticals industry, with vaccine production and new upcoming technologies well represented in the country.

Citation:
Dumont and Kegels (2016): http://www.plan.be/admin/uploaded/201606240814370.WP_1606.pdf

Eurostat on R&D expenditures:
http://ec.europa.eu/eurostat/tgm/graph.do?tab=graph&plugin=1&pcode=tsc00001&language=en&toolbox=data

IMF for total investment:
http://www.imf.org/external/pubs/ft/weo/2017/02/weodata/weorept.aspx?pr.x=20&pr.y=14&sy=1998&ey=2022&scsm=1&ssd=1&sort=country&ds=.&br=1&c=122%2C124%2C138%2C132%2C134&s=NID_NGDP&grp=0&a

Italy

Score 6

In recent years, Italian governments' research and innovation policies have been weak, underfunded and not strategically coordinated. The policy of linking university funding to the quality of research outputs has been continued and slightly strengthened over recent years. This policy is intended to incentivize universities to generate more quality research. Fiscal policies to promote investment in technological innovation in industry, introduced in 2016, gained momentum in 2017. The "Piano Nazionale Industria 4.0" program running from 2017 to 2020 was a very successful attempt to catch up with the rate of economic innovation in other OECD countries.

During the height of the pandemic crisis, the second Conte government was not in a position to strengthen research and innovation policies. In 2021, under the Draghi government, the Ministry of University and Research (MUR) was able to allocate to the field of research a significant amount of the Italian Recovery and Resilience Plan (PNRR) Next Generation EU funds. More specifically, the plan aims to invest around €6.9 billion in applied research, which will connect universities, public research institutions and private firms, and push them to work together toward innovation.

Citation:
https://www.mur.gov.it/it/news/mercoledi-29122021/pnrr-pubblicati-i-bandi-le-infrastrutture-di-ricerca-e-le-infrastrutture

Latvia

Score 6

Even though Latvia's productivity growth has been solid, innovation performance remains average, with the total government budget allocation for R&D amounting to 0.7% of the GDP in 2020. The 2021 European Innovation Scoreboard noted that Latvia's performance had increased strongly relative to the overall EU trend up until 2020, but then decreased in 2021, reaching a performance level 70% below the EU average. Latvia was thus ranked 25th out of 27 EU members in the 2021 scoreboard. The share of high-tech companies in the Latvian economy remains small, as is the private sector's demand for R&D activities. In budgetary debates, innovation remains a low priority.

The OECD recognized Latvia for improving its research and development in 2017 and commended its innovation framework, the consolidation of research institutions, the introduction of quality-based financing models and the provision of incentives to boost research. However, in 2019 the OECD described innovation performance in Latvia as weak, especially in the business sector. At 0.14% of GDP, the rate of business-based research and development (R&D) expenditure is among the lowest in the OECD.

In Latvia, a high proportion of the population has completed tertiary education, which – paired with favorable business conditions – creates an advantageous climate for innovation-driven growth. As noted by the European Commission and the OECD, these conditions have not been sufficiently utilized, and business-sector collaboration with science remains insufficient despite the fact that so-called competence centers and clusters have successfully strengthened collaborations between research institutions and companies in some sectors.

In the coming years, the quality of public R&D has to increase. Links between academia and business need to be strengthened, more Ph.D. students should be attracted, and innovation capacity in the private sector should be further increased. Policies currently in place address some of these challenges, but most of the interventions rely on European Structural and Investment Funds (ESIF) that provide no more than short-term financial support.

Citation:
1. Eurostat (2021) Government Budget Allocations for R&D, Available at:https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20211129-2, Last accessed: 10.01.2022.

2. European Comission (2021), European innovation scoreboard, Available at: https://ec.europa.eu/commission/presscorner/detail/en/QANDA_21_3050, Last accessed: 07.01.2022.

3. Ministry of Economics (2018) Competency Centers Continue to Develop New Products and Technologies, (In Latvian) AvaibleAvailable at: https://mk.gov.lv/lv/aktualitates/kompetences-centri-turpina-attistit-jaunus-produktus-un-tehnologijas, Last accessed: 05.01.2022.

4. OECD (2017) Going for Growth-Latvia 2017. http://www.oecd.org/eco/growth/Going-for-Growth-Latvia-2017.pdf. Last accessed 05.01.2022.

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6. European Commission (2020) Development of the Human Capital for Research and Innovation in Latvia (Specific Support), Available at:https://ec.europa.eu/research-and-innovation/sites/default/files/rio/report/SS%2520Latvia_Final%2520Report.pdf, Last accessed: 10.01.2022.

Lithuania

Score 6

Lithuania’s economy is characterized by the exploitation of cheap factors of production rather than innovation-led growth. According to the EU Innovation Scorecard, the country performs below the EU average, falling into the “moderate innovators” group. At the same time, Lithuania has made very substantial progress over the years; for example, its innovation index score jumped from 61.2% of the EU average in 2014 to 92.1% in 2021. Moreover, the share of this sum spent by the business sector is low (totaling just 0.56% of GDP in 2020), as research and innovation policy is dominated by the public sector and highly dependent on EU funds. Within the country’s innovation system, research is oriented only weakly to the market, research products are not supported with sufficient marketing or

commercialization efforts, investment is fragmented, funding levels are not competitive with other European states. Although some sectors of the Lithuanian economy are export-oriented and have strong potential for growth, Lithuanian industry is in general dominated by low- and medium-low-level manufacturing sectors.

Lithuanian authorities have used EU structural funds to improve the country's R&D infrastructure. So-called science valleys have been developed, integrating higher-education institutions, research centers and businesses areas that work within specific scientific or technological areas. However, using this new research infrastructure efficiently remains a major challenge, and cooperation between industry and research organizations remains rather weak. The government has also supported the sector through financial incentives (in particular, an R&D tax credit for enterprises) and regulatory measures. Demand-side measures encouraging innovation are less developed. Excessively bureaucratic procedures are still an obstacle to research and innovation, while the existing system of innovation governance is rather complex, with limited synergies between the several implementing agencies and support schemes. Due to the lack of funding and the rules for calculating the salaries of scholars participating in EU-funded programs such as Horizon 2020, incentives to apply to such programs are weak.

The 2012 – 2016 government developed a new smart-specialization strategy intended to focus resources in science and technology areas in which Lithuania can be internationally competitive, although it has been criticized for investing too heavily in the construction of new buildings and renovation of low-ranking universities' campuses. In 2016, the parliament approved new science and innovation policy guidelines, which were proposed by the president. The guidelines proposed restructuring the research and higher-education systems, supporting innovation development, improving coordination of science and innovation policy, and monitoring science and innovation policy implementation. In June 2017, the parliament approved a resolution to optimize Lithuania's state universities. The plan proposed merging the existing state universities into two comprehensive universities in Vilnius and Kaunas, and regional science centers (branches of other Lithuanian universities) in Klaipėda and Šiauliai. However, after intense lobbying by representatives of the existing universities, the initial plan was amended, and the government's ambitions of reducing the overall number of higher-education institutions were scaled back and delayed. By the end of 2019, the implementation of the optimization plan had produced results only in the city of Kaunas.

In its 2019 staff working document, the European Commission recommended the development of a coherent policy framework supporting science-business cooperation, and the consolidation of the various agencies that oversee research and innovation policies in Lithuania. In line with this, the Šimonytė government aims to implement an innovation-sector structural reform by consolidating several institutions into one agency responsible for innovation.

Whereas salaries and stipends for researchers at universities are relatively low (in both international context and compared to average compensation in the country), one positive development has been the fact that both the Skvernelis and Šimonytė governments have been increasing funding, which has resulted in rather robust wage growth in the sector. Furthermore, although they still comprise a relatively low share in the total economy, Lithuania has seen very rapid growth in several high value-added sectors, such as biotechnology, lasers, and financial services and technologies. For instance, the biotech industry grew by more than 90% in 2020. Lithuania has also become one of the leaders in the EU in creating a fintech ecosystem.

Citation:
The EU Innovation Scoreboard 2021 is available at https://ec.europa.eu/info/research-and-innovation/statistics/performance-indicators/european-innovation-scoreboard_en
COMMISSION STAFF WORKING DOCUMENT, country report Lithuania 2019: https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-lithuania_en.pdf

Malta

Score 6

Given Malta's very limited access to natural resources, the country's business R&D sector continues to hold considerable potential. However, Malta has traditionally been one of the EU member states with one of the lowest investment levels in this area. In 2019, Malta was last in the EU in terms of government R&D spending. Data published by Eurostat in 2021 highlighted the fact that, at 0.7% of GDP, Malta had one of the lowest R&D expenditures in Europe when compared to the EU average of 2.3%. Figures published by the European Commission in 2021 indicate that there were 478 female researchers and 1,068 male researchers working in Malta during 2017.

As of 2021, the European Union has made €95 billion in funds for R&I available throughout the European Union through Horizon Europe. This constitutes the largest funding scheme for R&I endeavors to date. The program was officially launched in Malta in February 2021 and should provide much needed funding for local R&I projects.

The European Innovation Scoreboard 2021 identifies Malta as a moderate innovator and highlights the fact that the country's performance relative to the European Union has increased over the years, though it remains below the EU average. The country's R&I strategy for the period 2020–2027 highlights smart specialization as the key to harness innovation. The sectors that have been identified as having potential for growth are health and well-being, sustainable use of resources for climate change mitigation and adaptation, smart manufacturing, marine and maritime technologies, aviation and aerospace, and digital technologies. With 10%, Malta has the sixth highest share in the European Union for green innovations in energy-intensive industries.

Other significant actions include the FUSION program, which focuses on the analyses of companies' or researchers' ideas for commercial viability purposes, the introduction of research clusters, and the applied research framework. The applied research framework is administered by the Malta College of Arts, Science and Technology (MCAST), the research trust, the Center for Entrepreneurship and Business Incubation (CEBI) within the University of Malta, the Malta Information Technology Agency (MITA) Innovation Hub, and the Malta Life Sciences Park, which provides high-end facilities for the chemistry, biology and digital-imaging sectors. The Malta Digital Innovation Authority has also been active since 2018 and is tasked with promoting digital innovation activities. Furthermore, Esplora, Malta's Interactive Science Center, is intended to instill a broader interest in science and innovation within the general public.

Despite limited funding, Malta still contributes to cutting-edge R&D. For instance, researchers at the University of Malta have developed state-of-the-art diving safety equipment, while Malta's first space mission, Project MALETH, aims to advance medical research in the area of diabetes.

Citation:
Times of Malta 01/12/17 "Very little being spent on research despite surplus"
Malta Independent 02/12/17 Malta holds position as one of lowest spenders on R&D in the EU
Eurostat News Release 5/2019
https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20211129-2
SHE Figures 2021 p.134
Times of Malta 27/10/2021 €95.5 Billion Available for R&I
Times of Malta 17/02/2021 Horizon Europe Launched in Malta
European Innovation Scoreboard 2021 p. 57
Malta's Smart Specialisation Strategy 2020-2027 p.5
http://mcst.gov.mt/ri-programmes/fusion/
https://www.mcast.edu.mt/applied-research/
https://www.um.edu.mt/cebi/ourresearch
https://mih.mt/
https://www.maltaenterprise.com/industries/life-sciences
http://esplora.org.mt/
The Malta Independent 06/12/2021 University Researchers Develop State-Of-The-Art Diving Safety Equipment
https://zaar.com.mt/projects/maleth-maltas-space-mission/
European Commission THE 2021 EU INDUSTRIAL R&D INVESTMENT SCOREBOARD

New Zealand

Score 6

New Zealand's lack of commitment to technological innovation has been visible for a long time (OECD 2007). In 2021, New Zealand ranked 25th in the Bloomberg Innovation Index, which scores countries using seven criteria including R&I spending and concentration of high-tech public companies. This came off the back of a four-place drop in 2018, which saw New Zealand slip out of the top 20 with a fall from 19th to 23rd place, and a drop to 24th place in the subsequent Bloomberg Innovation Index (Jamrisko et al. 2021).

The 2020 COVID-19 budget pledged more than $401 million for research and innovation, including $196 million for Crown Research Institutes, $150 million for

an R&I loan scheme, and $33 million for Māori research and development opportunities. However, the 2021 budget is considered a "disappointing" step back by many stakeholders: while the $300 million top-up for Green Investment Finance to accelerate investment in low-carbon technologies has been welcome, critics have pointed out that the latest budget flat-lines and even cuts research funds, including the Endeavour Fund and the Health Research Fund (Science Media Centre 2021). In 2021 the government released its Future Pathways Green Paper on Research, Science and Innovation (MBIE, 2021), which is likely to make significant changes to the way hundreds of millions of dollars of scientific research funding is allocated in New Zealand. The government argued change was necessary to address environmental challenges, include Treaty-led research, and increase productivity and other measures of economic well-being.

Citation:
Jamrisko et al. (2021) "South Korea Leads World in Innovation as U.S. Exits Top Ten." Bloomberg. https://www.bloomberg.com/news/articles/2021-02-03/south-korea-leads-world-in-innovation-u-s-drops-out-of-top-10

Junn, (2019) "The frustrating complexity of the new R&D tax scheme." The Spinoff. https://bit.ly/3eFUkal

MBIE, (2021), Future Pathways Green Paper, https://www.mbie.govt.nz/dmsdocument/17637-future-pathways-green-paper

New Zealand Government (2018) Budget 2018: Foundations for the Future. https://bit.ly/2Kg9192

OECD (2007) OECD Reviews of Innovation Policy: New Zealand. https://www.oecd.org/newzealand/oecdreviewsofinnovationpolicynewzealand.htm

Pullar-Strecker (2018) "Tax break for R&D upped to 15pc, with stop gap help for startups." Stuff. https://bit.ly/35DfdA9

Science Media Centre (2021) Budget 2021: Expert Reaction. https://www.sciencemediacentre.co.nz/2021/05/20/budget-2021-expert-reaction/

Poland

Score 6

The PiS government has continued the restructuring of Polish R&I, which had begun under the previous government in 2010 (Fabijańska 2021; Stasik et al. 2020; Fabijańska 2021). Jarosław Gowin, the minister of science and higher education from 2015 to 2020, sought to strengthen university-led research through his "constitution for science" and an initiative to promote research-oriented universities. Ten universities were selected and awarded a 10% increase in funding for 2020–2026. The Łukasiewicz Research Network has bundled 39 institutes that lead research in applied industrial development and commercialization. Under the PiS government, the increase in public R&I spending has continued (Fabijańska 2021: 4). The PiS government has also expanded tax incentives for R&D and startups, and simplified patent procedures. The amount of tax-deductible R&D spending has increased to 30–50%, depending on the size of the company. In addition, the period in which companies may deduct these costs has been expanded from three to six years.

The COVID-19 pandemic has further underlined the importance of R&I. The government's direct measures to tackle the pandemic in 2020 focused on the promotion of telemedicine and the development of two apps, one for contact-tracing (ProteGO Safe), one for checking quarantine behavior (Kwarantanna Domowa). The government has also sought to accelerate the digitalization of the country. In July 2021, Przemysław Czarnek, the minister for science and education since October 2020, launched the program "science for society," which aims to promote the collaboration of universities and research institutes. It provides funding for projects between PLN 100,000 and PLN 2 million for a duration of two years.

Despite these measures and some improvements, the innovation capacity of the Polish economy has remained relatively low. In the European Commission's European Innovation Scoreboard, Poland still ranks in the lowest category ("emerging innovator") and continues to trail most other EU member states, including regional peers such as Czechia, Hungary, Lithuania and Slovakia (European Commission 2021).

Citation:
European Commission (2021): European Innovation Scoreboard: Innovation performance keeps improving in EU Member States and regions, Brussels, June 21 (https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3048).

Fabijańska, A. (2021): Organization of R&I and Higher Education in Poland. Paris (https://www.euro-case.org/wp-content/uploads/Eurocase/PDF/platform_poscovid/platform-post-covid_100921_AFabijanska.pdf).

Stasik, A., A. Dańkowska, N. Kobza (2020): Responsible Research & Innovation in Poland. dia-e-logos, Discussion Paper 03/2020. Barcelona (http://dia-e-logos.eu/Papeles/RRIL-IO-1%20Report_RRI%20in%20Poland.pdf).

Chile

Score 5

Research and development (R&D) expenditure as a share of GDP is very low in Chile compared to other OECD countries, and most of this expenditure is undertaken by the government rather than the private sector. But Chile has shown that it is aware of shortcomings in the area of technological innovation, with potentially deleterious impact on the country's future economic and social development. Significant reforms have been put in place to raise R&D funding, including earmarked taxation (a royalty tax on mining), higher government expenditure, the improvement of tax incentives for private R&D, and the creation of the Ministry of Science, Technology, Knowledge and Innovation (Minciencia) in 2018. Although results have to date been disappointing – in large part because of bureaucratic hurdles to the approval of private and public projects – Chilean institutions show good results at least in the area of basic research. But the steps required to transform this strong basic research into applied research are almost never taken. Universities are often not prepared to support research that operates at the interface between basic research and industrial development. This is reflected in the comparatively low number of patents registered per year on a per capita basis, whereas the number of scientific publications is

relatively high. In general, access to the limited public funds available for research tends to be quite difficult due to high bureaucratic barriers (red tape). Despite these facts and considering the development of the last decade, clear improvements regarding innovation policy and scientific cooperation can be observed. Chile is ranked 53rd out of 132 countries in the latest edition of the Global Innovation Index (2021). Given its previous-year rankings, the country's innovation performance appears to be stable.

Citation:
Global Innovation Index (2021), https://www.globalinnovationindex.org/Home, last accessed: 13 January 2022.

Ministry of Finance (Ministerio de Hacienda), November 2021, https://www.hacienda.cl/noticias-y-eventos/noticias/ministerio-de-hacienda-y-dipres-valoran-despacho-del-presupuesto-2022-del, last accessed: 13 January 2022.

Czechia

Score 5

The Babiš government continued the previous government's verbal commitment to aim for the EU target of an R&D spending level equivalent to 2.5% of GDP. Despite the substantial EU co-financing, however, R&D spending has stagnated at about 2% of GDP and even slightly declined in 2020. Five foreign-owned companies and the automotive sector continue to account for 50% of total research in the business sector. Foreign and domestic businesses benefit from indirect subsidization, as 100% of R&D expenditure is exempt from taxation. However, many smaller enterprises complain that this exemption has not been honored in practice. Various reports have highlighted R&D weaknesses, suggesting a low effectiveness rate for much of what has been spent. Problems include the failure to attract and retain young, qualified researchers, who take advantage of the European Union's free movement of people to find better-paid work in other countries; and the low employment level among women (who accounted for just 30% of researchers in 2020), which suggests that this population's potential is not being fully utilized, and which may be a negative consequence of the lack of services supporting the work-life balance. Research groups often exhibit little change, with the same people staying together throughout their careers, and thus failing to benefit from experience acquired elsewhere. New research centers have frequently failed to make significant international contacts, and are often ignored by (largely foreign-owned) manufacturing companies.

The R&D sector, including universities and research institutes, reacted proactively to the pandemic after the government organized various forms of support. COVID-19 testing developed rapidly, but Czechia's response to the pandemic has not helped the country move toward the forefront of international scientific development. The Czech government's National Recovery Plan, as approved by the European Commission in July 2021, includes some measures to support quality research, especially in medical sciences, but does not address the structural problems of the Czech R&I sector.

Greece

Score 5

Greece continues to rank below the EU average for public and private expenditure on research and innovation. In 2020, it devoted 1.49% of GDP to research and development, compared to an EU-27 average of 2.36% (Eurostat data). As usual, the main funding came from public money. However, Greece has made visible progress over time.

According to the latest European Innovation Scoreboard (EIS), published in 2021, Greece still belongs to the group of countries labeled "moderate innovators," but also to the five EU member states that improved the most (more than 25%) compared to the previous year. Improvements in Greece concerned innovation by small and medium enterprises (SMEs), linkages and cooperation, and employment opportunities. Generally, over the 2011–2020 period, Greece exhibited an upward trend with regard to innovation.

A lingering problem is a serious brain drain, depleting Greece's human resources for research and innovation. In 2008–2015, about 427,000 skilled employees or professionals holding at least one university degree left the country to seek employment abroad, mostly in northern and western Europe or the United States. The outflow of younger researchers (PhDs and post-doctoral researchers) continues today, as job opportunities and salaries offered abroad are attractive, compared to those offered in Greece.

Nonetheless and despite the outflow, the number of Greek researchers remains disproportionately high, compared to the levels of public and private expenditure on research. Greek research teams very often participate in international research consortia. For instance, the National Technical University of Athens actively participates in international projects, as does the Heraklion-based Institute for Technology and Research.

The Greek government has sought since 2016 to counter this outflow of skilled labor. For example, it has provided government funds for research through the newly established Hellenic Foundation for Research and Innovation (in Greek, ELIDEK).

Meanwhile, Greece continues to lack large corporate R&D investors. Links between academia and the private sector are weak, reflecting institutional weaknesses and cultural resistance to public-private collaboration. Most private sector companies are active in non-tradeable goods and services, are oriented toward the domestic market, and have little interest in R&D and innovation. The corresponding supply from universities and public research institutions is small.

Nevertheless, in 2021, the national association of Greek industrialists (SEV) started a campaign to attract digital innovation from foreign and domestic investors, based on the progress which Greece had accomplished in 2017–2020 with regard to

digitalization. The SEV's campaign matched a government policy shift. In 2020, the Ministry of Digital Governance devised a holistic digital strategy, and the Ministry of Development and Investments a corresponding strategy for the digitalization of Greek industry (the Greek Industry 4.0 strategy).

Moreover, despite economic adversity, there are clear "islands" of excellence at universities and SMEs in areas such as biology, IT and computer science, economics, engineering, archaeology, and history. Moreover, a number of private startup companies are using private capital to concentrate on the production of software and technological innovations.

Citation:
Data on expenditure on research is drawn on Eurostat, https://ec.europa.eu/eurostat/databrowser/view/tsc00001/default/table?lang=en

Information on Greece's brain drain in English is found in https://www.dw.com/en/greece-central-bank-reports-brain-drain-of-427000-young-educated-greeks-since-2008/a-19373527

Information in English on the Greek research and innovation policy and particularly on brain drain is available from the EU, https://rio.jrc.ec.europa.eu/en/country-analysis/Greece/country-report

Information on Greece's performance, as assessed by the European Innovation Scoreboard, is available at https://www.ekt.gr/en/news/26308

Information on the new innovation strategies of the SEV and the Greek government is available at https://www.sev.org.gr/wp-content/uploads/2021/11/Destination-Greece_Attracting-Digital-Innovation-Investment_LowRes.pdf

Hungary

Score 5

The innovation performance of the Hungarian economy has been relatively low (European Commission 2021). The innovation capacity of domestic SMEs has been limited and multinational enterprises have not done much R&I in Hungary. The weak financing of universities and the R&I sector, along with the Orbán governments' assault on civil rights and political liberties, has contributed to a substantial brain drain.

After years of neglect, the fourth Orbán government has recognized the growing significance of R&I for economic development and has realized that the European Union will focus more strongly on R&I in the common budget. The 2019 and the original 2020 budget provided for a substantial increase in public R&I spending. At the same time, however, the government has initiated highly controversial structural reforms that have infringed upon academic freedom and are likely to weaken the country's R&I performance. The creation of the new and powerful Ministry of Innovation and Technology (ITM) has gone hand in hand with a "privatization" of the universities and the "ruining" of the Academy of Sciences (MTA). The process of privatizing universities has involved placing eight universities under newly established "private" foundations controlled by loyal Fidesz supporters. The MTA has been deprived of its research institutes. Instead, the Lóránd Eötvös Research

Network (ELKH, Eötvös Lóránd Kutatási Hálózat) has been created. Officially justified as an attempt to make the public research sector more competitive, these changes have drastically reduced the autonomy of the institutions.

Citation:
European Commission (2021): European Innovation Scoreboard: Innovation performance keeps improving in EU Member States and regions, Brussels, June 21 (https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3048).

Turkey

Score 5

During the review period, the government continued to reinforce the country's research and innovation capacity. The Scientific and Technological Research Council of Turkey (TUBITAK) is the leading agency for the management, funding, and conduct of research. According to TURKSTAT (2020), total public and private R&D spending as a percentage of GDP increased from 1.06% in 2019 to 1.09% in 2020. During 2020, commercial enterprises accounted for 64.8% of R&D expenditure, the largest single share. While universities accounted for 28.4% of spending on R&D, public institutions accounted for 6.8%. A total of 199,371 people worked full-time in the country's R&D sector during 2019. Financial and non-financial corporations employed 65.3% of the country's R&D personnel, while 29.9% of R&D personnel were employed in higher education. Public institutions accounted for a 4.7% share. Educational statistics reveal that 32.1% of R&D personnel hold a doctoral degree or equivalent, 33.1% a bachelor's degree and 24.6% a master's degree.

As of September 2021, Turkey had 1,260 R&D centers, 203 of which were owned by foreigners or foreign shareholders. These centers have carried out 59,935 projects and own 27,983 patents. In terms of sectoral distribution, machine and equipment manufacturing centers topped the list (174), followed by the automotive subsidiary industry (130) and software centers (116).

The Supreme Council for Science and Technology (SCST) is the highest-ranking science and technology policymaking body in Turkey. In recent SCST meetings, an emphasis has been placed on intensifying R&D efforts in the energy, health and biotechnology sectors. Additionally, the government has cooperated with 12 research universities in Turkey to create five new investment funds for techno-entrepreneurs and startups worth a total of €105 million. It also was supporting 85 technology development zones as of January 2020.

Citation:
TURKSTAT. "Research and Development Activities Survey, 2020," October, 26. 2021.
https://data.tuik.gov.tr/Bulten/Index?p=Research-and-Development-Activities-Survey-2020-37439

Sanayi ve Teknoloji Bakanlığı. "AR-GE Merkezleri."
https://www.sanayi.gov.tr/assets/pdf/istatistik/ArGeMerkeziIstatistik2021.pdf

European Commission. "Turkey Report 2021. Commission Staff Working Document." October 19, 2021.
https://ec.europa.eu/neighbourhood-enlargement/turkey-report-2021_en

Croatia

Score 4

Croatia lacks a coherent and integrated policy framework for policy formulation, implementation and evaluation in the domain of research and development (R&D). Generally, most companies in the country have low technological capacity to support innovation, and technology-transfer mechanisms are inadequate. Since 2008, the World Bank's index measuring university-industry collaboration in R&D has shown a steady decline. In this area, Croatia is the worst performer among comparable member states. On the positive side, there are nascent ICT and electromobility companies with global presence and aspirations, but their success is more the result of individual talent and vision as opposed to the state's systemic support. It is to be hoped that their presence alone might have positive spill-over effects on other stakeholders, especially on policymakers, which might be induced to start catering to the needs of businesses by crafting and upgrading horizontal support measures.

Total gross domestic spending on R&D increased from 0.74% of GDP in 2010 to 1.27% in 2020, but this was primarily due to a fall in the value of the denominator. However, despite a severe recession in 2020, the absolute figure dedicated to R&D increased to €626 million. This was the 18th highest such share of GDP in the EU. The higher education, business and government sectors all increased their R&D spending. The NGEU program and the MFF 2021-2027 funds offer unprecedented potential for boosting the innovation agenda and driving further digitalization. In that regard, financial constraints will no longer constitute a plausible cover for underperformance or continuation of the status quo. On the other hand, potential bottlenecks are to be found in the excessive bureaucratization of the innovation process (e.g., public tenders) and a lack of policy coordination among key stakeholders.

In terms of the number of patent applications to the European Patent Office (EPO), Croatia fares poorly in contrast to other EU-27 countries, but has boosted its performance. For example, in 2018, Croatia filed 14 patents with the EPO, while in 2020 it managed to obtain a record-breaking 22 patents. Finally, according to the EU Innovation Scoreboard, the country was categorized as an "emerging innovator" in 2021, demonstrating an upward trend over the last couple of years.

Cyprus

Score 4

An upgraded effort to boost research and development was initiated in 2019. The European Union suggests that a major challenge is to strike a balance between spending on R&D, which lies mainly with higher education, and promoting cooperation between universities and businesses. Nevertheless, Cyprus ranks first among EU member states in terms of the amount of funding per capita the country has received from Horizon 2020.

After shaping a new research and innovation policy framework in 2019, under the National Council for Research and Innovation, the government established the Deputy Ministry for Research, Innovations and Digital Policy. The new institution is tasked with shaping and implementing policies on research and digitalization.

While Cyprus's position in the Global Competitiveness Index declined in 2021, after improving in the previous year, the country ranked second in the European Union's 2021 scoreboard for progress achieved in R&I.

In addition, the R&D expenditure target of 0.5% of GDP for 2020 was surpassed (0.85%), with the target revised to 1.5% of GDP for 2023.

Citation:
1. Council Recommendation on the 2020 National Reform Programme of Cyprus… 2020, May 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0513&from=EN
2. Eurostat, Gross domestic expenditure on R&D (GERD), update 14 December 2021, https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_20

Slovenia

Score 4

Slovenia's R&I activities have long been of both low quality and quantity. The objectives of R&I policy include a polycentric model of science development and networking of research organizations, autonomous guidance, monitoring and evaluation of R&D activities, and the promotion of science development cores in areas that are the basis of long-term socioeconomic development.
While public R&I spending increased between 2018 and 2021, it still doesn't comprise 1% of GDP (0.98% in 2021). In some areas of research, the extent of EU funding has declined, as Slovenia has experienced serious administrative difficulties in absorbing funds for R&I under the Šarec government, and two ministers resigned because they did not manage to increase EU funding absorption rates. The Janša government strengthened the Government Office for Development and European Cohesion Policy both in terms of funding and human resources, and EU funding absorption rates improved dramatically in the period under review, from 40% of allocated funds (2019) to 64% of allocated funds (2021).

Citation:
European Commission. (2021). Cohesion Data: Slovenia. (https://cohesiondata.ec.europa.eu/countries/SI).

Bulgaria

Score 3

Since 2009, Bulgaria has nearly doubled its R&D spending to 0.86% of GDP, which is up to three times less than the EU and OECD average (new EU states allocate 60% – 100% more).

In 2020, private sector spending on R&D was 2.6 times that of the state budget. Universities account for 6% of total private sector spending on R&D while NGOs account for 1%.

Bulgaria's official development strategy agenda "Bulgaria 2030" (2020) mentions the term "infrastructure" 114 times, in all imaginable connotations – from education, innovation and labor markets, to roads, railways and the energy sector, and includes the Sustainable Development Goals of the UN and all EU policy initiatives. In the narrow sense of infrastructure (i.e., physical infrastructure), the strategy plans to invest at least €28 billion in infrastructure by 2030, but does not mention where it will source this funding.

The government's focus on infrastructure from 2019 to 2021 left the investment in technological innovations almost entirely up to the private sector. The incumbent government promises to continue emphasizing infrastructure and has created a Ministry of Innovations and plans to allocate roughly 1% of GDP to high-tech innovation.

Mexico

Score 3

Overall, national spending on research and development (R&D) continues to be very low in comparison with other OECD countries and is inadequate for an economy the size of Mexico. Over recent years, public spending remained stable but the more important private sector spending on R&D has been very low and is the lowest of any OECD country. The private spending is dominated by large companies in a small number of sectors. Mexico has by far the lowest number of researchers per 1,000 employees of any OECD country.

In 2020, Mexico was ranked 60th out of 190 countries on the World Bank's Ease of Doing Business index, featuring low performance in components such as paying taxes, registering property, getting credit and having access to electricity. These conditions play against the attractiveness to create and fund startups in the new economy.

In a non-binding referendum in October 2018, a majority voted against the continued construction of the already partially built Mexico City Texcoco Airport. Following the referendum, the project was canceled by AMLO, despite opposition from the business sector. These and other sometimes abrupt decisions by the AMLO administration have led to a significant deterioration in the country's investment climate.

In April 2019, the president presented plans for the construction of a new airport at the Santa Lucía air base, 50 kilometers from Mexico City. This project, the construction of the Dos Bocas refinery by the state-owned oil company Pemex and

the construction of the Tren Maya, a new 1,525-kilometer train line in the southeast of the country, are flagship projects of the Mexican government. The three projects are seen as exemplifying the "fourth transformation" announced by AMLO, and are to be carried out regardless of difficulties. According to AMLO, they are at the center of "public interest and national security."

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Romania

Score 3

Romania adopted the National Strategy for Research, Development and Innovation in 2014, setting out domestic goals until 2020. Following a policy dialogue phase between the coordinating consortia and MECS, the final four priorities selected were bioeconomy; ICT, space and security; energy, environment and climate change; and eco-nano technologies and advanced materials. The Ministry of Education and Research is in charge of planning and monitoring research, development and innovation (RDI) undertakings, and is funded by the state budget and EU funds. Nevertheless, the efficiency of the RDI strategies was low. Due to the large research and development gap between Romania and western EU member states, insufficient budgets, and a brain drain of tech-industry workers, Romania's research and innovation systems are fragmenting, and are unable to integrate EU RDI dimensions into successful domestic policies. Because of said setbacks, Romania received the smallest amount of EU funds for RDI. Romania's participation in Horizon 2020, the European Union's largest research and innovation program, was modest, resulting in the country attracting some €215 million from the program's budget. Still, this capital injection was generated by the underfunding of research from public funds, difficulties in attracting private funds in research and innovation, and the lack of effective national policies to stimulate RDI activity. According to past government budgets and the Europe 2020 Strategy, Romania's government allocated between 0.13% and 1% of GDP to RDI – a drop from 2019 and a concern that has only been exacerbated by the pandemic. All these factors have resulted in a lackluster RDI environment and Romania being labeled as a "modest innovator," with a 50% gap between Romania and the EU RDI average. According to the European Innovation Scoreboard, Romania has ranked last for RDI in the European Union for the past several years. As a result, the Ministry of Education and Research launched a new RDI national strategy in Romania, coinciding with the EU Strategic Agenda for 2019–24 and the Cohesion Policy for 2021–27. Financially, the government has encouraged taxpayers engaged exclusively in innovation, research, development and related activities to continue their RDI activities by exempting them from corporate income tax during the first 10 years of activity. This tax relief is applied in

compliance with state aid regulations. State aid schemes (e.g., non-refundable grants) aimed at supporting R&D activities and investments in the R&D sector are also available.

Between 2014 and 2020, Romania received €43 billion in accordance with the 2014–20 MFF, of which the allocation for European Structural and Investment Funds (ESIF) made up €31 billion. Most of the funds were allocated to ESIF – operational programs of large infrastructure projects. Taking into consideration the COVID-19 pandemic, Romania saw a significant decrease in FDI. However, Romania's capabilities in the IT sector, logistics projects and retail development projects attracted investors, with 57 projects registered in 2020. The welcoming tax environment for foreign firms has resulted in investment confidence in 2021, with 75% of investors stating that the pandemic no longer influences their direct investments (versus 5% that are influenced). In order to maintain and see an uptick in confidence in the long run, Romania must continue to invest in reliable infrastructure and broaden regions for investment, outside of major urban centers.

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Slovakia

Score 3

Slovakia has a weak and underdeveloped research and innovation policy. R&D intensity, the number of patent applications and levels of employment in knowledge-intensive activities are all well below the EU average and are the lowest among the four Visegrád countries. Expenditure on R&D, both public and private, have stagnated between 2012 and 2020, at least relative to GDP, and stand at less than half of the EU average. In its Innovation Scoreboard, the European Commission (2021) ranks Slovakia among the last group, the "emerging innovators." According to the Scoreboard, Slovakia also is among the countries showing the least progress from 2014 to 2020.

The new center-right government has launched some initiatives to strengthen the research and innovation capacity of the Slovak economy (OECD 2022: 46-51). In addition to committing itself to increasing R&I funding from the national budget by

0.05% per year over the period 2021-30, it has announced its intent to improve the quality of tertiary education, to foster the remigration of talented Slovaks from abroad and to streamline the public governance of research and innovation. As Slovakia ranks among the EU member states with the lowest absorption of European Structural and Investment Funds (ESIF) for R&I, the government and the European Commission called upon the OECD to assist in developing recommendations for improving absorption (OECD 2021). As it stands, however, little reforms have been implemented.

Citation:
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