R&I and Infrastructure Report

Research and Innovation Policy

Sustainable Governance Indicators 2020

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.

Israel

Score 10

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.

In 2014, the government cabinet approved proposals to encourage technological innovation. The Israel Innovation Authority began its activity in early 2017. The authority was established based on the model of the Office of the Chief Scientist in the Israeli Ministry of Economy and Industry, with the goal of implementing the R&D law, and providing high-quality and effective services for the Israeli innovation ecosystem. The authority had a budget of close to ILS 200 million in 2017, but used only ILS 100 million of it. Nevertheless, in 2018, the authority's budget was increased by 6%. However, it has been reported that the authority is lacking around ILS 100 million, which Israeli companies, including startups, will need at the end of 2019.

A large portion of Israel's R&D policy is directed toward international cooperation. About ILS 104 million of the authority's budget is allocated to international cooperation. In 2019, Israel has engaged in around 70 different international cooperative research ventures with a variety of European countries and organizations. Overall, 90 Israeli companies have received grant or other financing to conduct R&D activities with companies from other countries. In 2017, 250 grant applications and projects had received €1.35 billion, while the return to Israeli

entities in the form of grants reached €1.7 billion. 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 both 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.

Citation:
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https://innovationisrael.org.il/en/sites/default/files/2018-19_Innovation_Report.pdf

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http://economy.gov.il/English/NewsRoom/PressReleases/Documents/2017IsraelInnovationAuthorityReport.pdf

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Cornell University, INSEAD, and WIPO, "The Global Innovation Index 2019: Energizing the World with Innovation," Ithaca, Fontainebleau, and Geneva, 2018: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019.pdf

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Sweden

Score 10

Sweden ranks 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.

While R&D spending has a long history, converting research and development concepts into valuable products was for a long time far more challenging for Sweden. The "Swedish paradox," as it is called, was precisely the inability to convert research findings into commercially viable products. However, as recent data show, Sweden now ranks first with regard to patent applications and license fees for intellectual property. This is a valid indicator that R&D is bearing fruit, as securing intellectual ownership of emerging products is a critical stage in the process from the research facility to the market. Public policy has targeted this issue lately, for instance, by simplifying the regulatory framework for private businesses, and the data suggest that R&D is now increasingly paying off.

Meanwhile, the new era of digital entrepreneurship has seen Sweden emerge as a global center of digital innovation. This applies to digital communication, computer games and IT-based services. The World Economic Forum, which views Sweden's tax levels as burdensome, suggests that the social welfare safety net has made Swedes less risk averse than entrepreneurs in many other countries. Overall, it appears that much of this success can be attributed to deregulation and other pro-business reforms introduced by the 2006 to 2014 center-right government.

Citation:
Edquist, C. and L. Hommen (eds) (2008), Small Country Innovation Systems (Cheltenham: Edward Elgar).

World Economic Forum (12 October 2017), "Why does Sweden produce so many startups?"

Germany

Score 9

Germany's performance in the area of research and development remains positive. According to the World Economic Forum, Germany's capacity for innovation is ranked best among the world's top performers. In the Global Competitiveness Report 2019, 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 is ranked at fourth place, a strong improvement relative to 2017, when Germany was ranked only 11th out of 140 countries (Global Competitiveness Report 2019: 241).

Regarding funding, the German government continues to raise budgets for research and development. Overall spending levels remain above the European average. The budget of the Ministry of Education and Research was increased to €14.0 billion in 2014, €15.3 billion in 2015, €16.4 billion in 2016 and €17.6 billion in 2017, setting a new record. In 2018, this level was kept at the same amount, but increased in 2019 to €18.3 billion (Bundesregierung 2019).

Unlike numerous other European countries, Germany has not previously offered general R&D tax incentives, instead focusing on the provision of targeted funding of specific programs. In this respect, 2019 saw a substantive turning point with the Research Allowance Act (Forschungszulagengesetz), which introduced a R&D tax incentive that will become effective starting with the year 2020. Spending on R&D staff will benefit from a 25% tax allowance that will be paid out if the entity makes a loss. The tax subsidy is capped at €500,000 per company per year.

Companies' expenditures on R&D are significant, but public-private partnerships and collaborations between universities and industry leave room for improvement. The federal government and states have agreed to continue the Joint Initiative for Research and Innovation, and intend to increase the program's budget by 3% every year between 2021 and 2030.

Over the past 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 (Global Competitive Report 2019: 240).

Citation:
Global Competitiveness Report 2019. World Economic Forum.
Bundesministerium für Bildung und Forschung – BMBF (2019):
https://www.bmbf.de/de/der-haushalt-des-bundesministeriums-fuer-bildung-und-forschung-202.html

Netherlands

Score 9

In 2019, the European Innovation Scoreboard has the Netherlands as an innovation leader, ranked fourth after Sweden, Finland and Denmark. The country was additionally ranked fourth out of 141 countries in the World Economic Forum's Global Competitiveness Report 2019, and was the most competitive in Europe.

Direct government expenditure on R&D is increasing, but lags behind the projected rise in gross domestic product. Direct government expenditure on R&D rose from €5.0 billion in 2017 to €5.6 billion in 2018, and is forecast to remain at around €5.5 billion over the medium term. Despite this increase, it is expected to fall after 2018, from 0.67% of GDP in 2017 to 0.65% in 2023. This is because budgeted government spending on R&D is not growing as fast as the economy. Between 2014 and 2017, government, the business enterprise sector and other investors together spent a total of 2.0% of GDP on R&D. Direct government R&D expenditure is in line with the average for the EU-28 (the entire EU), but lower than a number of reference countries such as Germany, Switzerland and the Scandinavian countries. To achieve the target of 2.5% of GDP by 2020, both the public and the business enterprise sectors will have to invest more. For the first time since 2010, research-specific program funding for applied research organizations has increased, thanks to investments provided for under the coalition agreement. TNO's program funding has shown the sharpest increase. Other policy-driven research expenditure is also increasing, mainly owing to additional funding from the Ministry of Economic Affairs and Climate Policy. However, the size of the expenditure (€875 million in 2019) is nowhere near the €1.1 billion spent in 2010. Compared with other OECD countries, a large proportion of government support for R&D consists of tax-based measures (0.17% of GDP). In addition to the national government, the European Union plays an important role in funding R&D and innovation. Researchers affiliated with Dutch institutions have so far received more than €3 billion in funding from the EU's Horizon 2020 Framework Program, in the range of €600 million to €700 million per year.

All in all, it is unclear whether the Netherland's R&D performance is due to government policies (coordinated by the Ministry of Economic Affairs and Climate). The country's policymakers aim to ensure that the Netherlands is one of the top five global knowledge economies, and to increase public and non-public R&D investments to 2.5% of GDP (€650 billion). Total expenditure on R&D as a percentage of GDP is stuck at 2%, lower than the EU target of 3%.

Citation:
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European Commission, Innovation Union Scoreboard 2019 (ec.europa.eu, accessed 1 November 2019)

World Economic Forum,The Global Competitiveness Report 2018 (reports.weforum.org, accessed 24 October 2018)

D. Lanser en H. van der Wiel (2011), Innovatiebeleid in Nederland: de (on)mogelijkheden van effectmeting, CPB Achtergronddocument (www.cpb.nl/sites/default/files/publicaties/download/cpb-achtergronddocumenten)

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 public R&D spending-to-GDP ratio is the highest in the world, while its private R&D outlay is the second highest. The country'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. In July 2019, Korea already had almost 2 million subscribers to its 5G mobile network. The country has an excellent research infrastructure, with many world-class universities and research institutes that produce internationally competitive research and patents. What impedes innovation is mostly the Korean market's oligopolistic structure, which makes it difficult for entrepreneurs and SMEs to succeed. The country has struggled to translate massive investments in research into productivity increases. Bureaucratic regulations remain intact in many areas. Moon's government has prioritized labor-friendly policies and income-led growth, while paying less attention to innovation-led growth. Moreover, initiatives within the sharing economy have been repeatedly frustrated due to political resistance and burdensome regulation.

Citation:
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Switzerland

Score 9

Switzerland's achievement in terms of innovation is considerable. It spends 3.4% of GDP (2017) on research, as compared to the EU average of 2%. 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. 69% 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 28%, 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.

Some deficits persist, however, 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. The resources for education, research and innovation should grow by 2% annually

Citation:
https://www.bfs.admin.ch/bfs/de/home/statistiken/bildung-wissenschaft/technologie.html

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

Denmark

Score 8

Among OECD countries, Denmark has the fourth highest ratio of public R&D spending to GDP, and seventh highest submission rate of patent applications.

The target for R&D investment is 3% of GDP. This figure was actually reached in 2009, with the public sector investing 1.02% of GDP and the private sector investing 2.1%. Various initiatives have been introduced to boost R&D investments, with particular focus on the SME segment.

The Liberal government that came to power in June 2015 set a target of 1% of GDP for publicly funded research, but the government subsequently cut public spending on research and education. Spending was reduced in 2016, while further cuts were announced for 2017 to 2020. Public debate about these cuts has been vivid, particularly regarding how these cuts would impact on the government’s aim to strengthen productivity and increase competitiveness.

The World Economic Forum’s 2019 report on the world’s most competitive economies ranked Denmark 10 out of 141 economies. The report pointed to Denmark’s competitiveness in terms of modern skills, a robust labor market and

widespread ICT adoption, but highlighted the reduced R&D investment. It further suggested that a relaxation on hiring foreign labor could contribute to making Denmark's labor market more efficient.

The new Social Democratic government, which came to power in June 2019, has promised to spend DKK 1 billion on green research.

Citation:
World Economic Forum, The Global Competitivenes Report 2019. (accessed 30 November 2019).http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

Produktivitetskommissionen, 2014: www.produktivitetskommissionen.dk

Finland

Score 8

Finland was earlier 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. Allocations for R&D activities in the 2019 budget increased by €107.9 million from the previous year, but the share of public research funding in GDP increased only marginally (from 0.80% to 0.83%). 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. Undermining commitments laid out in the government program, the Sipilä government repeatedly carried out dramatic cuts in government spending for education and higher learning. 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. The Rinne government proclaimed that it would invest strongly in education and research. Consequently, its budget proposal for 2020 contained an increase of €40 million for Finland's universities, and an extra €20 million for universities of applied sciences.

Citation:
"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
"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

France

Score 8

Having improved since 2007, France performs well in research and development policy. According to the EU Innovation Scoreboard 2019, France is ranked 11 out of 28 EU member 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." Overall spending on research and development constitutes 2.19% of GDP (2017), a slight decline since 2015 after a period of increase. 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 private investment, and limited broadband penetration, intellectual assets and employment in fast-growing enterprises.

On the positive side, the measures taken by the Hollande administration have encouraged the creation of new technology-based start-up firms. President Macron declared that he would "make France a start-up 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 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. Presently, France has become Europe's second-largest tech market by dollar funding, outpacing Germany and falling just behind the United Kingdom.

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 2019
(https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en)

Luxembourg

Score 8

With regard to its Europe 2020 strategy, Luxembourg set a goal of raising public expenditure on research and innovation to between 2.3% and 2.6% of GDP, of which 0.7 to 0.9 percentage points are earmarked for public use (0.73% in 2015) and 1.6 to 1.7 percentage points earmarked for private research. The overall European goal is 3% of GDP.

Luxembourg supports private research projects; innovation and research activities can benefit from financial support totaling up to 35% of costs. Private sector innovation can receive grants of up to 50% of a project's total spending, with up to 75% of the cost of feasibility studies subsidized. The Grand Duchy has a high proportion of high-skilled workers, with 59.5% of jobs demanding a high level of education or training. More than 40% of the working-age population has achieved a tertiary level of education and/or is employed in the science and technology sector. This creates synergies between public research and industry. Luxembourg ranks among the top 10 worldwide on the Innovation Output sub-index and is number 12 in the overall assessment of the 2017 Global Innovation Index (GII).

In the World University Rankings of 2018, the University of Luxembourg ranked 179th out of 1,000 universities. The new Belval campus, designed for 7,000 students, 3,000 researchers and about 6,000 residents, is one of the largest urban conversion projects in Europe. The relocation to Belval (with the exception of parts of the Faculty of Law, Economics and Finance) was to be completed in 2019. However, the campus has failed architecturally and looks quite sterile. The university does not own the buildings, but has to rent them from a "Belval Fund (Le Fonds Belval)," and conflicts exist between the two institutions. The lack of a university atmosphere in Belval may undermine the university's ability to attract professors and students from outside the country.

Citation:
"2018 Index of Economic Freedom." Heritage. https://www.heritage.org/index/pdf/2018/book/index_2018.pdf. Accessed 19 Oct. 2019.

"2019 Report." www.globalinnovationindex.org/gii-2019-report. Accessed 21 Nov. 2019.

"The World University Rankings 2018." www.timeshighereducation.com/world-university-rankings/2018/world-ranking#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/stats. Accessed 19 Nov. 2019.

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.

In its first three years, the Trump administration has afforded research and innovation, apart from defense, a low priority. It cut federal R&D spending by about 4.5%, except for Department of Defense R&D, which was projected to increase by 15% and includes $2 billion for a new program on artificial intelligence. Trump has cut scientific and engineering personnel in environmental and resource-related agencies and withdrawn support for alternative energy development. Trump's 2020 budget continued these trends, which included a 13% cut in funding for the National Science Foundation and a 12% cut in funding for the National Institute of Health. Furthermore, the Trump administration's budget proposes to eliminate several environmental programs at the National Oceanic and Atmospheric Administration agency.

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

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 bemoaned 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.

In 2017, the government announced that it would provide 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. The 2019 budget added very little to the aforementioned programs. The question of how effective government policy is in encouraging R&D investment and productivity gains remains a contentious one.

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

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 (2015) Canada's Innovation Challenges and Opportunities, State of the Nation, 2014, 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 national development priorities, which are reflected in a sophisticated set of strategies and action plans, and bodies and taskforces. The outcomes, however, have been poor. 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. At the end of 2018, all major political parties and higher education institutions signed an agreement that promised to increase public RDI expenditure to 1% of GDP over the next three years. However, half a year later, the government broke the promise and froze RDI expenditures at 0.71% of GDP for 2019 – 2021. In response, researchers, professors and several advocacy groups protested the decision, and warned that the freeze would negatively affect teaching and research.

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 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) by supporting collaboration between R&D institutions and companies.

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 Estonia's major universities. Advances in the development of patents, high-tech products and services are noticeable but less prominent. R&D personnel are increasingly concentrated in higher education and cooperation with businesses remains limited.

Citation:
ETAG (2019). Estonian Research 2019. https://www.etag.ee/wp-content/uploads/2019/04/Estonian_Research_2019_veeb.pdf (accessed 10.10.2019)

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. 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. 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 in the forefront in the competition to attract R&D-intensive investment.

Citation:
World Economic Forum Global Competitiveness Report 2019

Japan

Score 7

Science, technology and innovation receive considerable government attention and funding. Current policies are based on the Fifth Science and Technology Basic Plan (2016 – 2020). The government has determined to spend 1% of GDP on science and technology. A major focus is on creating a "super-smart" society, also dubbed Society 5.0. Concrete measures include a reform of the career system for young researchers, an increase in (international) mobility, measures supporting the development of a cyber society, and – as before – the promotion of critical technologies, including defense-related projects considered indispensable to Japan's security. A new high-priority project launched in 2019 ("Moonshot") is meant to help solve some of the major applied-sciences-related problems such as carbon

emissions. A total of JPY 100 billion (about €840 million, based on September 2019 exchange rates) have been earmarked for the initiative.

The government and outside observers realize that Japan's strong position among the world's top technology nations is declining, based on various indicators. A recent government survey even exposed a sense of crisis among the researchers interviewed. Relevant indicators include the often-used Nature Index, which showed a decline in high-quality scientific output of 3.7% in 2017. The ratio of high-quality research output to R&D input is particularly weak. One problem is that researchers find it difficult to pursue long-term projects, as they are pressured to produce short-term results. Another major issue is young researchers' difficulty in finding stable professional positions, an issue that the current Basic Plan takes seriously and tries to address.

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

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Norway

Score 7

Norway has increased its spending on research and development (R&D). Though innovation is limited by the fact that Norwegian industry and businesses spend less than their counterparts in other countries on research. However, government spending has increased slightly in recent years. Research policy is non-pluralistic, government-led and has historically not been strongly oriented toward enterprise or innovation. Priority research areas include energy and increasingly oceans. 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 in the so-called STEM subjects. Research funds are mainly public, distributed through a single research council, and recent reforms have moved in the direction of adopting a center of excellence approach.

In 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 interesting to note that the share of 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.

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 or information and communications technology (ICT). Performance has been weaker in terms of overall R&D spending, which continues to fall well short of EU targets, 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 the UK economy does not have the industrial base to support a large-scale R&D effort, so it is necessary to look at other indicators, such as ICT spending (which matters more for service industries), to better understand trends in innovation in the United Kingdom.

Over the decades, attempts have been made by successive governments to improve this situation, for example, by targeting weaknesses in technical education on 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.

Despite tentative agreement that the United Kingdom will remain involved in EU research programs, there is still uncertainty about how this will evolve after Brexit and the status of researchers who are EU nationals working in the United Kingdom. This could have an adverse effect on UK universities, although they are lobbying intensively to prevent a negative outcome. While the potential loss of EU funds is not huge, and it has to be recalled that the United Kingdom has always been a net contributor to the EU budget, researchers are more apprehensive about barriers to collaboration with counterparts in the European Union. This all comes despite a year-long debate about how best to attract highly skilled immigrants to the UK science sector. Yet, the number of EU students applying to UK universities increased by 3% in 2018. University officials interpret the upturn either as a last-minute rush

before Brexit or as a sign that the attractiveness of UK universities simply outshines the grim political prospects.

The challenge facing the UK government will be how to maintain its research and innovation effort if obstacles arise to collaboration with other EU member states. This could affect not only the university sector, but also the corporate sector – for example in areas like life sciences and pharmaceuticals where the United Kingdom maintains a prominent research role – if the supply networks of UK research facilities are disrupted.

Citation:
https://www.theguardian.com/education/2018/feb/05/uk-universities-rise-in-applications-eu-students (31.10.18)

Australia

Score 6

After the Abbott government was elected in September 2013, government support for research and innovation was reduced considerably and has not materially recovered. The Abbott government cut funding to the Australian Research Council scheme, which funds non-medical university research, and abolished the Australian Renewable Energy agency, which acted to support renewable energy projects in their start-up and early stages. Also telling was the fact that under the Abbott government there was no science minister for the first time since 1931. However, with the replacement of Abbott by Malcolm Turnbull as prime minister in September 2015, a new cabinet was formed that included a science minister, and the Department of Industry and Science was expanded to become the Department of Industry, Innovation and Science. The National Innovation and Science Agenda was announced in December 2015, emphasizing science, research and innovation as long-term drivers of economic prosperity, jobs and growth. As part of this agenda, AUD 1.1 billion was committed over four years to 24 measures aimed at encouraging entrepreneurship, fostering collaboration between industry and researchers, developing and attracting talent, and by government "leading by example." 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.

As of the end of the review period, there had been no notable developments in the area of research and innovation policy under the Morrison government. In December 2019, the Morrison government announced changes to the R&D tax-incentive system, but these had not yet passed into legislation as of February 2020.

Citation:
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Emma Alberici: Innovation is still the key to jobs and growth. ABC. 17 May 2018. Available at https://www.abc.net.au/news/2018-05-18/innovation-the-key-to-jobs-and-growth/9772938

Austria

Score 6

Public research in Austria is mainly university centered. However, this is a challenging environment, as universities are overburdened by high numbers of students, while researchers in some disciplines are overwhelmed by teaching obligations. The Austrian Academy of Sciences is plagued by insufficient funding. The Austrian Science Fund (Fonds zur Förderung der Wissenschaftlichen Forschung) is tasked with coordinating academic research but has shown only partial success in this task. Research funded by private corporations has little tradition in Austria, and at least in the near future, offers little hope of improving this situation. The deficiencies in public-funded research cannot be counterbalanced by privately funded operations. The whole sector is in acute need of more funding, but the budgetary situation and the growing shift of public funds from the young toward older generations, a trend driven by demographic change, make the outlook quite dire. The coalition that governed Austria between 2017 and 2019 seems to have been aware of this critical situation and some steps have been taken to improve the financial situation of universities. However, successive governments have failed to significantly improve university-based research.

The strong dependence on government funding implies that any new orientation of the incoming government could be decisive. There is an expectation that innovation policy may significantly change. But, at the moment, the focus of the new government seems to be oriented first and foremost to balancing the budget. This could mean that there will be no significant increase in spending on innovation and research.

This does not prevent excellent research from being conducted in some fields. Important and significant innovations in disciplines such as biological science and medical research are still possible in Austria. The consequences of Austria's membership in the European Union and the European Single Market is opening Austrian universities and other research institutions to non-Austrian scholars. Step by step, this provides a more transnational attitude to research and innovation.

More broadly, links between industry and science are sound, and a high 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 medium- to low-tech manufacturing sector. Although Austria does not feature any of the world's top 500 corporate R&D investors, there are – according to OECD data – some dynamic startups on the Austrian market. These startups, however, are not a direct result of Austrian research policy.

It currently seems that the new government will continue to improve the financial basis of Austria's universities. Thus, the overall trend (i.e., a gradual improvement in the financial situation of Austrian universities) will continue. Though this does not affect the depth and breadth of research outside the universities, which is still comparatively underdeveloped. Due to European competition, non-university research will probably be strengthened, too.

Belgium

Score 6

R&D policy is shared between the central government, which can offer tax incentives, and the subnational (regional and community) governments, which are responsible for managing 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 Start-up 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)."

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

Iceland

Score 6

Combined 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 in the biotechnology, pharmaceutical, and high-tech manufacturing sectors. 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 were then hurt by the króna's gradual recovery, before once again benefiting from the depreciation of the króna during 2018. The economic collapse in 2008 led to a cut in R&D expenditure to 1.8% of GDP in 2013. According to the most recent available data, R&D expenditure was 2.1% of GDP in 2017, still well below the 2006 level. This is evidence of the long-lasting damage caused by the 2008 collapse, which compelled public authorities to drastically cut public expenditure and then change the composition of public spending following the country's recovery – changes that would have been difficult to implement during normal times.

Citation:
Statistics Iceland, https://hagstofa.is/talnaefni/atvinnuvegir/visindi-og-taekni/rannsoknir-og-throun/ Accessed 16 September 2019.

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Latvia

Score 6

Even though there has been some improvement in Latvia's performance in research and development investment over time (0.62% of GDP in 2015, 44% of GDP in 2016 and 0.51% in 2017), investment remains lower than the EU average.

At the same time, investment into R&D from foreign sources in Latvia is significantly higher than the EU average. In 2013, the EU average was 9.9% of GDP, while in Latvia it was 44% of GDP in 2014 and 45% in 2015. In 2014 and 2015, private sector investment in R&D was 0.19% and 0.12% of GDP respectively, significantly below the EU average of 1.3% of GDP in 2014.

Even though Latvia's productivity growth has been solid, innovation performance remains average at best. In the Union Innovation Scoreboard 2018, Latvia ranked 24 out of 28 EU member states in terms of innovation, up from 25 in 2017. Consequently, Latvia remained in the category of "moderate innovators." The share of high-tech companies in the Latvian economy is small, as is the private sector's demand for R&D activities. In budgetary debates, innovation remains a low priority.

Nevertheless, the OECD has recognized Latvia for improving its research and development, and innovation framework, noting the consolidation of research institutions, the introduction of quality-based financing models and incentives to boost research. For example, a support program for the development of new products and technologies has been set up, managed nationwide by eight competency centers. The program seeks to attract at least €12.8 million in private sector investment for research and development. Nearly 200 projects have been launched thus far, which signals an appetite for similar incentives to be introduced in the future.

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. In the light of the European Union's 2020 strategy target that 3% of GDP in the European Union should to be invested in R&D, Latvia has also set a target of increasing R&D funding to 1.5% of GDP by 2020 and to 3% by 2030. In the coming years, the quality of public R&D has to increase, and links between academia and business need to be strengthened.

Citation:
1. Central Statistical Bureau of Latvia (2019), Latvia 2019: Statistics in Brief, Available at: https://www.csb.gov.lv/sites/default/files/publication/2019-

05/Nr_03_Latvia_Statistics_in%20Brief%202019_%2819_00%29_EN.pdf, Last assessed: 11.11.2019.

2. European Comission (2019), European innovation scoreboard: Country Profiles: Latvia, Available at: https://ec.europa.eu/docsroom/documents/35899, Last assessed: 11.11.2019

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 assesed: 11.11.2019.

4. European Commission (2018), Research and Innovation performance and Horizon 2020 Country Participation for Latvia, Available at: http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=country-profiles-detail&ctry=latvia, Last assessed: 11.11.2019

6. OECD (2017) Going for Growth-Latvia 2017. http://www.oecd.org/eco/growth/Going-for-Growth-Latvia-2017.pdf. Last assessed 11.11.2019.

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. However, its overall innovation performance has improved since 2008. The country was ranked 40 out of 126 countries assessed in the 2018 Global Innovation Index. The country has set an ambitious target of spending 1.9% of GDP on R&D by 2020. In 2017, Lithuania's R&D investment was 0.9% of GDP. Moreover, the share of this sum spent by the business sector was very low (totaling just 0.3% of GDP in 2017), 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, and Lithuanian enterprises remain only weakly integrated into global value chains. The recent OECD review of the country's innovation policy recommended introducing favorable framework conditions for innovation, developing innovation-oriented higher education and skills training, improving governance in the innovation system, balancing the policy mix and supporting international knowledge linkages.

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. 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.

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 terms of absorbing the Lithuanian University of Educational Sciences and the Aleksandras Stulginskis University into the Vytautas Magnus University). Further consolidation of funding and staff is unlikely before the next parliamentary elections in 2020. In 2018, the Skvernelis government significantly increased the size of stipends for PhD students, with the goal of attracting more young researchers into the R&I ecosystem. Furthermore, as part of its structural-reform program, the current government has focused on innovation, successfully promoting the growth of new and innovative companies in the Lithuanian market. Virginijus Sinkevičius, who led this reform as the minister for economy and innovation in the Lithuanian government, was nominated to serve on the 2019 – 2024 European Commission.

Citation:

The EU Innovation Scoreboard is available at http://ec.europa.eu/enterprise/policies/innovation/facts-figures-analysis/innovation-scoreboard/

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

Global Innovation Index 2018 Report: https://www.globalinnovationindex.org/gii-2018-report#

OECD, Review of Innovation Policy: Lithuania, Overall Assessment and Recommendations, June 2016.

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. Eurostat data published in 2019 showed that in 2017, Malta had the third-lowest R&D expenditure level, at 0.55% of GDP.

The National Research and Innovation Strategy highlights the need to increase the R&D knowledge base, particularly by attracting more doctoral and post-doctoral graduates to the area. Nonetheless, there have been some relative improvements. The 2019 European Innovation Scoreboard classifies Malta as a moderate innovator whose performance has increased relative to that of the EU since 2011. Nonetheless, the 2019 European Commission Malta Working Document also highlights the fact that, "R&D intensity remained flat in recent years (0.55% of GDP in 2017 against 2.07% for the EU) and the country is likely to miss its target of 2% R&D intensity by 2020. The recent slight increase in public R&D intensity is partly explained by the significant inflow of structural funds. The low level of public R&D investment in the public science base limits the full usage of the country's scientific and technological potential."

A better innovation ecosystem would enhance the capacity of innovative companies to scale up their activities; thus, the government has devised a rolling research and innovation action plan that is intended to reduce fragmentation and overlap. The government has additionally engaged a panel of EU experts to provide advice on how to R&D levels can be boosted. This panel indicated that more leadership, public participation and transparency were needed, along with strategic changes as to how resources are allocated, better synergy between the public and private sectors, and more long-term investment from both. A full-fledged competitive funding system also needs to be created. A process of public consultation is currently underway, with the goal of devising the country's R&I strategy in the post-2020 period. Furthermore, Esplora, Malta's Interactive Science Center, is intended to instill a broader interest in science and innovation within the general public. 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 (e.g., Malta Marittima), the applied research framework 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 with the aim of promoting digital innovation activities. A new space fund has also been set up. Despite limited funding, Malta is contributing to cutting-edge

R&D; two such cases include the development of a computer program that can help airplanes land safely by learning from data on thousands of flights contained in a NASA database, and the use of a new bioinformatics method for the creation of new drugs.

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
National Research and Innovation Strategy 2020 p.18
European Innovation Scoreboard 2019 p.60
Commission Staff Working Document – Country Report Malta 2019 SWD (2019) 1017 final p.35
https://mcst.gov.mt/psi/ri-strategy-post-2020/
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National Reform Programme Malta 2018 p. 34
https://www.maltaenterprise.com/industries/life-sciences
Malta National Reform Programme 2019 p. 49
European Commission (2019) Peer Review Maltese Research and Innovation System Horizon 2020 Policy Support Facility https://rio.jrc.ec.europa.eu/en/file/12748/download?token=ZFZRzMnV

New Zealand

Score 6

The OECD has identified deficiencies in the New Zealand government’s commitment to R&D strategies and expenditure, high-technology employment, and patent indicators. The problem stems from New Zealand’s small size and geographic isolation as well as the absence of large companies operating at an international level. While the National Party-led government increased spending on tertiary training in engineering and science, as well as increasing domestic expenditure on R&D as a percentage of GDP (1.3%), New Zealand continues to be ranked low on these metrics among OECD countries – including its closest economic partner, Australia. Recognizing these deficits, the current Labour administration chose “Foundations for the Future” as the theme for its 2018 budget, with the aim to increase R&D expenditure to 2% of GDP over the next 10 years. The main vehicle to achieve this goal is a tax credit on eligible R&D expenditure. Since the scheme was first announced, the originally proposed 12.5% tax break has been upped to 15%, while the minimum of R&D spending has been halved to NZD 50,000 from NZD 100,000. In addition, the maximum amount that can be claimed by any company in any one year has been increased to NZD 18 million and the definition of R&D has been broadened, shifting the focus from “scientific research” to “systematic approaches to solving scientific and technical uncertainty.” While these changes address key concerns expressed by critics, it remains unclear how start-up companies – which generally do not have profits to claim tax breaks – will benefit from the government’s R&D scheme. More generally, funding for blue sky research through the government’s contestable funding sources for Crown Enterprises and the University sector has not increased significantly over the past decade.

Citation:
New Zealand Government, Budget 2018: Foundations for the Future (https://www.beehive.govt.nz/feature/budget-2018-foundations-future)
Pullar-Strecker, Tax break for R&D upped to 15pc, with stop gap help for startups, Stuff (https://www.stuff.co.nz/business/107538937/tax-break-for-rd-upped-to-15pc-with-stop-gap-help-for-startups)

Poland

Score 6

While the Polish R&I system has been significantly restructured since 2010, its performance has remained relatively weak. Polish universities have ranked low in international comparisons, while cooperation between universities and business has been limited, and is highly dependent on EU funds and personal connections, and the innovation capacity of the economy has been weak. The PiS government has sought to stimulated cooperation between universities and business by expanding tax incentives for R&D and startups, and simplifying 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 strong reliance on tax relief has been criticized for a lack of efficiency. According to recent empirical research, such a policy might have a greater impact on the economy, but is 2.5 times more costly than additional government spending on R&D. Within the framework of his "constitution for science," Minister of Science and Higher Education Jarosław Gowin has sought to strengthen university-led research. In April 2019, he announced a new initiative to promote research-oriented universities. As it stands, however, R&I spending in Poland, in both the public and the private spheres, however, has remained far below the European Union's 2020 targets. The National Institute of Technology (NIT), which was intended to start work as a bundle of 35 existing research institutes in January 2018, still does not exist.

Citation:
Brandt, N. (2018): Strengthening innovation in Poland, OECD Economics Department, Working Paper No. 1479, Paris.
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Portugal

Score 6

Portugal's rank in the World Economic Forum's 2019 Global Competitiveness Index remained stable compared to the 2018 index, standing again at 34 (albeit now out of 141 countries) in 2019. It also saw a marginal improvement of 0.2 in its score vis-à-vis 2018. Portugal's score improved in two out of the four index components, including the innovation ecosystem component.

The European Union's 2019 Innovation Scoreboard continues to classify Portugal as a "moderate innovator," the second-lowest category (out of four). However, it also

shows that Portugal's position improved in relation to the EU average. Thus, Portugal's performance relative to the European Union stood at 90% in 2018, a 10 percentage point increase compared to 2017, and five percentage points above the previous best of 2010 and 2011.

As in the previous SGI report, out of the 10 dimensions considered by the 2018 scoreboard, Portugal is above the EU average in three: attractive research systems; innovators; and an innovation-friendly environment.

The government continues to place a great deal of emphasis on research and innovation, with a particular interest in developing the tech sector. During the review period, Lisbon hosted the Web Summit (4 – 7 November 2019), the largest tech conference in the world, dubbed by Bloomberg the "Davos for geeks." As noted in the previous report, in October 2018 the government announced a deal that will keep the event in Lisbon until 2028, with a public investment of €110 million over the next 10 years.

This is beginning to have some impact. The 2018 State of European Tech Report highlights that Portugal has one of the fastest growing tech sectors, with the fastest growing population of professional developers and the second fastest growing tech workforce in 2018. Likewise, Porto is the third fastest growing tech hub in Europe.

However, the 2018 State of European Tech Report also highlights the very low position from which Portugal is developing. Thus, consistent with the Innovation Scoreboard results, these tech results and initiatives are only slowly percolating through to the general economy.

Citation:
Atomico & Slush (2018), "The State of European Tech 2018," available online at: https://2018.stateofeuropeantech.com (published on 4 December 2018)

Atomico & Slush (2017), "The State of European Tech 2017," available online at: https://2017.stateofeuropeantech.com (published on 30 November 2017)

"European Innovation Scoreboard 2019 – Portugal." Available online at: https://ec.europa.eu/docsroom/documents/35906

"European Innovation Scoreboard 2018 – Portugal." Available online at: https://ec.europa.eu/docsroom/documents/30696

World Economic Forum (2019), "Portugal: Global Competitiveness Index 4.0 – 2019 edition," available online at: http://reports.weforum.org/global-competitiveness-report-2019/economy-profiles/?doing_wp_cron=1572725125.5966029167175292968750#economy=PRT

World Economic Forum (2018), "Portugal: Global Competitiveness Index 4.0 – 2018 edition," available online at: http://reports.weforum.org/global-competitiveness-report-2018/country-economy-profiles/#economy=PRT

https://www.pordata.pt › … › Despesas em I&D e Dotações Orçamentais

https://tek.sapo.pt/…/mercado-tic-em-portugal-cresce-para-os-8-240-milhoes-de-euros…

Spain

Score 6

Research and technology policy remained a weak point during the period under review, 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. Due to the failure to approve the 2019 budget, investments in R&D account for just 1.2% of GDP in 2019 in comparison to EU and OECD averages that are above 2%. The main Spanish research centers criticized the inaction of the caretaker PSOE government in October 2019. While the government presented an urgent action plan to address the paralysis in the science sector in March 2019, only a few minor measures could be implemented because of the budget deadlock.

However, according to the latest report published by Cotec (a Spanish public-private foundation that promotes innovation), some positive signs can be identified. The European Commission's 2019 Innovation Scoreboard stresses that Spain's performance has increased relative to 2010 with regard to several indicators, with human resources the strongest performing innovation dimension. Spain also scores high on sales of new-to-market and new-to-firm product innovations, broadband penetration, and doctorate graduates. However, private investment in R&D continues to be the weakest performing innovation dimension. Other low-scoring indicators include SME in-house innovation, knowledge-intensive service exports and SME product or process innovation. Spain also came out relatively well in the 2019 Nature Index, ranking as the 11th most prolific country worldwide in terms of scientific performance.

Citation:
EC(2019), European Innovation Scoreboard
https://ec.europa.eu/docsroom/documents/35912

Cotec(2019), Informe para la innovación
http://informecotec.es/media/INFORME-COTEC-2019_versionweb.pdf

Nature Index(2019)
https://www.natureindex.com/country-outputs/spain

El Pais, November 2019, Spain's scientists burdened by legal uncertainty and lack of funding., https://elpais.com/elpais/2019/10/31/inenglish/1572520930_378460.html

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 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 51st out of 129 countries in the latest version of the Global Innovation Index (2019). Given its previous-year ranking of 47th out of 126 countries, the country's innovation performance appears to be stable.

Citation:
http://www.expansiva.cl/media/en_foco/documentos/17032010150429.pdf
http://www.scidev.net/america-latina/innovacion/noticias/tres-paises-lideran-innovacion-en-latinoamerica.html
https://www.globalinnovationindex.org/

Czechia

Score 5

The Babiš government has 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. However, actual spending remains below 2% of GDP, and even this has always been dependent on EU support, which can be expected to decline. Five foreign-owned companies and the automotive sector (which includes vehicle production businesses) accounted for 50% of total research in the business sector. Foreign and domestic businesses alike benefit from indirect subsidization, as 100% of R&D expenditure is supposed to be 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 rate of effectiveness for much of what has been spent. Problems include the perception that the government lacks a strategy in this area; the failure to attract and retain young, qualified researchers, who take advantage of the EU's free movement of people to find better-paid work in other countries; and the low employment level among women (who accounted for just 23% of researchers in 2017), 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 that rely on research centers in their home countries. In 2019, the government adopted the "Innovation Strategy of Czechia 2019 – 2030. The Country for the Future." Despite broad-based participation in this strategy's formulation, only a small number of Czech-owned companies were consulted, reflecting the absence of larger Czech companies with a record of innovation. The document was largely composed of well-meaning generalizations.

Citation:
Council for Research, Development and Innovation (2019): Innovation Strategy of the Czech Republic 2019-2030. Prague (https://www.vyzkum.cz/FrontAktualita.aspx?aktualita=867990).

Greece

Score 5

Greece continues to rank below the EU average for public and private expenditure on research and innovation. As usual, the main funding came from public money.

The European Innovation Scoreboard (EIS), published in June 2019, noted an improvement in Greece's innovation performance in 2018. Greece was ranked 20th among the 28 EU countries (up from 22nd place in 2017). Generally, over the 2011 – 2018 period, Greece exhibited an upward trend on the EIS Summary Innovation Index, increasing from 61st in 2011 to 82nd in 2018. During that timeframe, Greece showed the second-best performance in the EU with regard to improvements in the area of innovation.

However, despite progress in research spending, a serious brain drain remains underway, 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 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 National Foundation for Research and Innovation (NFRI-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. There is little private demand for R&D and innovation, and the corresponding supply from universities and public research institutions is small. Nevertheless, despite economic adversity, there are clear "islands" of excellence at universities in areas such as biology, IT and computer science, economics, engineering, archaeology, and history. Moreover, a number of private start-up companies are using injections of private capital to concentrate on the production of software and technological innovations.

Nonetheless, Greek researchers, the number of which is disproportionately high compared to the levels of public and private expenditure on research, actively

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. Individual researchers from Greece frequently participate in international forums.

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

European Innovation Scoreboard 2019 (https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en)

Cyprus

Score 4

Research and development in Cyprus is underdeveloped. The EU observes that the largest R&D expenditure lies with higher education, while public and private expenditure is among the lowest in the Union. This contrasts with the situation EU-wide, where the share of expenditure from business is higher. This notwithstanding, Cyprus ranks first in the EU in terms of per capita funds from Horizon 2020.

The shaping of a coherent policy on research is the target of a new scheme for the National Council for Research and Innovation. The Council of Ministers also appointed a chief scientist to orchestrate and grow the country's research and innovation ecosystem. The latest development is a decision taken in September 2019 to set-up a ministry for innovation and digital policy, subject to a vote by the House of Representatives.

Cyprus's capability for innovation, according to the 2019 edition of the Global Competitiveness Index, scored 46.3 points compared to 44.7 in 2018, while in R&D it progressed to 34.7 from 33.9 points. The country ranks 43rd out of 141 countries in this assessment.

If the R&D expenditure target for 2020 remains at 0.5% of GDP, which is the lowest in the EU, it would offer very little prospects for substantial progress.

Citation:
1. Global Competitiveness Index 2019, Cyprus, Innovation, http://reports.weforum.org/global-competitiveness-report-2019/economy-profiles/#economy=CYP
2. European Commission Semester Country Specific Recommendations, Cyprus, June 2019, https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-specific-recommendation-commission-recommendation-cyprus_en.pdf
3. Cyprus National Board for R&I, https://www.nbri.gov.cy/

Hungary

Score 4

After years of neglect, research and innovation policy has become a cornerstone of the technocratic modernization project of the fourth Orbán government. The 2019 budget provided for a substantial increase in public R&I spending, which, for several years, was among the lowest in the European Union. The 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.

However, the increase in funding has gone hand-in-hand with a centralization of research and innovation policy. By intensifying the control and colonization of scientific research and higher education, the government has sought to capture one of the remaining autonomous social sectors. The dismemberment of the Hungarian Academy of Sciences (HAS) has been highly controversial, and has led to massive protests inside and outside Hungary. In the process, some critical scholars and scientists have been dismissed. The fact that the government has ignored all criticism and all reform suggestions from the HAS has increased the bitterness in academia about the loss of academic freedom. While a new research network (ELKH) has been established under the control of the Ministry of Innovation and Technology (ITM), which is led by the new strongman of the Orbán government, László Palkovics, the future institutional structure of the R&I sector remains unclear.

Italy

Score 4

In recent years, Italian governments' research and innovation policies have been weak, underfunded and not strategically coordinated. The current government has not been able to make much headway in this regard given the tight budgetary context. In spite of complaints from universities, which are severely underfunded compared to other European countries, public funding for universities and R&D has not been increased. The existing policy of linking university funding to the quality of research outputs has been continued and slightly strengthened. 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. However, the first Conte government showed no interest in strengthening research and innovation policies, and did not renew its predecessor's Industry 4.0 incentives. The second Conte government seems willing to change direction, but as of the time of writing, it was too early to see whether promises would be implemented.

Citation:
http://www.sviluppoeconomico.gov.it/images/stories/documenti/Industria_40%20_conferenza_21_9

Mexico

Score 4

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. A very large number of "micro" firms have little or no institutionalized access to state R&D spending, while large and efficient firms undertake their own R&D spending. There is growing awareness of this problem within Mexico itself, but it still ranks below most OECD member countries on indices relating to R&D. The OECD has stated that R&D spending in Mexico is quantitatively and qualitatively inadequate. Mexico has by far the lowest number of researchers per 1,000 employees of any OECD country.

In 2019, Mexico was ranked 54 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.

The 2016 election of Donald Trump and his anti-immigration policies motivated speculation about increased opportunities in Mexico for starting innovative businesses in the IT sector, offering the economic and political environment to attract startups and human capital. Though the number of venture capital institutions and other organizations have generally increased (especially in Guadalajara and Monterrey), most of the country has yet to see the potential benefits of IT investments.

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 López Obrador, despite opposition from the business sector. 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.

The Consejo Coordinador Empresarial has demanded greater state investment in the energy sector, infrastructure and production chains. However, the president has also announced his support for the construction of the Dos Bocas refinery by the state-owned company Pemex. Shortly after assuming office, President López Obrador announced the start of construction of Tren Maya, a new 1,525-kilometer train line in the southeast of the country. The rail project aims to connect the most popular tourist destinations in five states via two routes.

In general, Mexico's electronic infrastructure (e.g., cable and wireless networks) is above average. Likewise, Mexico has a good system of highways.

Citation:
http://www.doingbusiness.org/data/exploreeconomies/mexico
https://www.ft.com/content/7fe8f64c-4c74-11e7-a3f4-c742b9791d43
http://www.milenio.com/elecciones-mexico-2018/asi-esta-mexico-en-cuanto-a-ciencia-y-tecnologia
https://elpais.com/internacional/2019/06/14/mexico/1560472397_790021.html
https://amerika21.de/2019/01/219492/mexiko-tren-maya-indigene-widerstand

Slovenia

Score 4

Slovenia's R&I activities have long been of both low quality and quantity. While public R& I spending increased in 2018 and 2019, it still does not comprise 1% of GDP. 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. The Šarec government has failed to address this issue. In the period under review, two ministers resigned because they did not manage to increase absorption rates.

Turkey

Score 4

During the review period, the government continued to strengthen the country's research and innovation capacity. The Scientific and Technological Research Council of Turkey (TUBITAK) is the leading agency for management, funding and conduct of research in Turkey.

According to the Turkish Statistical Institute, total public and private R&D spending as a percentage of GDP was 0.94% in 2016 and increased to 0.96% in 2017. During 2017, commercial enterprises accounted for the largest share of R&D expenditure, at 56.9%. While universities accounted for 33.5% of spending on R&D, public institutions accounted for 9.6%. In terms of full-time employment, 266,478 people worked in the R&D sector during 2017, an increase of 10% compared with the previous year. The universities employed 57.1% of R&D personnel, while 38% of R&D personnel worked in the private sector and public institutions employed 4.8% of R&D personnel.

In 2019, Turkey adopted the Eleventh Development Plan, covering the period 2019 – 2023. The plan aims to improve science, technology and innovation, as one of the building blocks for innovative production and steady economic growth. In Turkey, the Supreme Council for Science and Technology (SCST) is the highest-ranking science and technology policymaking body in Turkey. In the last few SCST meetings, emphasis was placed on intensifying R&D efforts in the energy, health and biotechnology sectors.

According to the European Commission (2018), the participation of Turkish researchers and other Turkish R&D actors in European framework programs, notably in the EU research and innovation program Horizon 2020, has not increased in recent years.

Citation:
European Commission (2018) 'Turkey 2018 Report,' SWD(2018) 153 final, Brussel.

Turkish Statistical Institute, 'Science, Technology and Information Society Statistics,' Ankara

Bulgaria

Score 3

Bulgaria ranks among the lowest in the European Union in terms of spending on R&D. Nominally, 2018 R&D expenditures recovered to their 2015 levels, but as a percentage of GDP, they remain markedly below 1%. The structure remains unchanged, with about 22% of spending done by the public sector and 78% by the private sector. Research and innovation activities in Bulgaria are characterized by weak links between producers and relevant research institutions, as well as by far-reaching institutional fragmentation. Participation in and implementation of EU-funded programs has been weak. The implementation of the existing National Strategy for Development of Scientific Research 2017 – 2030 ("Better Science for a Better Bulgaria") has not yet been evaluated.

Croatia

Score 3

Croatia lacks a coherent and integrated policy framework, companies have low technological capacity to support innovation, and technology-transfer mechanisms are inadequate. Total gross domestic spending on R&D increased from 0.74% of GDP in 2010 to 0.97% in 2018. The small increase was driven by increased R&D expenditure by both the sector and higher education sectors, while R&D expenditure by the government stagnated. European Structural and Investment Funds are a new and important source of scientific research funding. However, managing EU-funded scientific projects remains burdensome given the large scope of domestic red tape imposed on the scientific community by implementation bodies. In relation to the EU average, R&D expenditure has been falling and Croatia closed 2019 in the group of worst performers. Similarly, in terms of the number of patent applications to the European Patent Office, Croatia fares poorly in contrast to other EU-28 countries, with only three registered patents to one million inhabitants. Overall, the EU Innovation Scoreboard categorizes Croatia as only a "moderate innovator."

Romania

Score 3

Romania's weak performance in the areas of research and innovation has continued in the year under review. As of 2019, the country ranked among the lowest in the EU in indicators including research and development expenditure (0.48% of GDP), number of patents per capita, employment in knowledge-intensive activities, and rates of international scientific publications. Performance in innovation has consistently deteriorated over the past decade, with start-up success rates falling in tandem. There are discernible gaps between industry needs and curriculum in higher education institutions, while Romania's noted "brain drain" of skilled migrants, particularly in science, technology, engineering, and mathematics, further hampers the country's success in these areas. Another identified issue is the lack of policy efforts attempting to leverage the research and development efforts of foreign-owned and operated companies in Romania domestically. Ultimately, despite the clear need for substantial public and private investment in research and development as a starting point for improvements in this arena, there have been no clear plans from the government to pursue this. In 2019, however, for the first time since 2016, Romanian researchers were allowed to compete for national grants awarded by UEFISCDI, the national granting agency. While applicants are unsure whether the research funds promised by the Romanian government will be disbursed to successful teams, many of them are hopeful that the new competition will support the creation of new products.

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, has gradually risen, but from a very low level and remains relatively low. The increased private sector investment in R&D has not been sufficient to compensate for the state failure in managing R&D. Corporate funds account for only a quarter of the total Slovak funding, and almost 90% of all foreign resources are EU money.

Two recent developments might help to improve R&I performance. First, the IT security provider Eset plans to build a large research and innovation campus near Bratislava. Second, in October 2019, the Ministry of Education, Science, Research and Sport announced the largest ever investment in science and research in Slovakia. Between 2019 and 2023, Comenius University and the Slovak University of Technology will receive €111 million, largely from EU funds, to improve their R&D and innovation capacities. While this project will improve the country's research infrastructure, it also highlights Slovakia's dependence on EU funding for research and innovation.

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