European Commission

JRC SCIENCE FOR POLICY REPORT

RIO Country Report 2017: The Netherlands

Research and Innovation Observatory country report series

Van den Broek, J., Deuten, J., and Jonkers, K.

2018

Joint Research Centre

EUR 29183 EN

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JRC Science Hub
https://ec.europa.eu/jrc

JRC111333

EUR 29183 EN

PDF ISBN 978-92-79-81700-7 ISSN 1831-9424 doi:10.2760/66601

Luxembourg: Publications Office of the European Union, 2018

How to cite this report: Van den Broek, J., Deuten, J., and Jonkers, K., *RIO Country Report 2017: The Netherlands*, EUR 29183 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81700-7, doi:10.2760/66601, JRC111333.

RIO Country Report 2017

The R&I Observatory country report 2017 provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. Data is from Eurostat, unless otherwise referenced and is correct as at January 2018. Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

Summary

Key findings

The Dutch economy is on a steady economic growth path. The 2016 annual growth rate was 2.2%. It is expected that this will continue onto 2017. Labour productivity has been increasing at a slow pace in recent years, but is expected to pick up in 2018 (CPB, 2017). Unemployment has decreased remarkably swiftly in 2016 to 5.4%, surpassing ex-ante expectations of around 6.1% (Statistics Netherlands, 2017). The Netherlands is performing very well on almost all indicators for competitiveness and innovation. On the European Innovation Scoreboard, the Netherlands increased its performance and secured its position as an Innovation Leader (European Commission, 2017). Total financial public support for R&D and innovation has grown from € 6.13b in 2015 to € 6.50b in 2016. The total government budget shows, however, a small decrease to € 6.38b in 2017. In absolute terms, expenditures of business on R&D are rising. In 2016, R&D expenditure by firms rose remarkably by 6.05%, to € 8.132b, compared to 2015.

Challenges for R&I policymaking in the Netherlands

***Increasing private RDI expenditure and economic restructuring**:* despite a small increase in private R&D expenditure over the last years, the goal of 2.5% of GDP R&D expenditures (public and private) is still out of reach. A new facility, InvestNL, was introduced with the aim to generate more venture capital for start-ups and scale-ups.

Finding the right level of public expenditure on applied research organisations: the Evaluation Committee Schaaf warned that lower levels of public funding for applied research may harm the strong knowledge position of Dutch RTOs. In the newly presented coalition agreement, substantial investments in both applied and fundamental research are announced. This includes an extra investment in large technological institutes that address market needs.

***Maintaining and improving the human capital base for R&I**:* there is a continuing pressure on the labour market, especially for STEM and ICT related jobs. The Dutch Technology Pact 2020 is implemented to address these needs, but in the short term the challenge remains.

***Governance of challenge-oriented R&I**:* grand societal challenges are becoming increasingly central in R&I policy. This is acknowledged in the top sector policy and new instruments such as City Deals. The challenge lies in coordination between government departments and across the various levels of government (local-regional-national).

Main R&I developments in 2017

- Establishment of a New finance and investment organisation Invest-NL
- Launch of the National Plan Open Science
- Extra impulse for application of scientific knowledge

Smart specialisation

No new policy developments directly concerning the RIS3 strategies were implemented, although there have been renewals of regional innovation strategies with a link to the RIS3 strategies. In all four regions with a RIS3 strategy, ERDF funding is being allocated in alignment with the RIS3 strategies and all regions are also active on the thematic RIS platforms. Concrete evidence of impact is not yet available although there are signs of impact in different areas.

Foreword

The R&I Observatory country report 2017 provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. Data is from Eurostat, unless otherwise referenced and is correct as at January 2018. Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

Acknowledgements

The report has benefited from comments from Xavier van den Bosch (RTD); Karel Haegeman; Leslie Potter; Miguel Sanchez Martinez and Tauno Ojala (JRC); Sander Kes and Johanneke Henstra (Ministry of Economic Affairs. Dolf Grasveld (Ministry of Education, Culture & Science), and Henry van der Wiel (CPB)

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Contents

1 Economic context for R&I[1]

The Dutch economy is on a steady economic growth path. The 2016 annual growth was 2.2%. It is expected that economic growth will reach 3.2 in 2017. Whereas growth in 2016 was mainly export driven, in 2017 it is expected to be equally driven by export and private consumption. Households have seen rising real incomes, partly driven by a tax stimulus. Employment is growing, with unemployment set to fall below 4% in 2019. However, wages and inflation are not keeping pace with developments in the economy and the labour market (CPB, 2017). After a government budget surplus of 0.4% in 2016, the expectation is that this surplus will increase to 0.7% in 2017 and 0.5% in 2018. Government debt is expected to fall to 57.7% of GDP in 2017 and to 54.9% in 2018. The policy initiatives initiated by the new Cabinet Rutte III will impact upon both the public budget and the government debt levels.

The Netherlands has one of the highest labour productivity levels of the OECD countries. Labour productivity growth is (therefore) relatively low, compared to OECD average. Nonetheless, labour productivity has been increasing at a slow pace recently, with an increase in 2015 and 2016 and it is expected to pick up further in 2018 (CPB, 2017). Multifactor productivity declined sharply as a result of the economic crisis but increased again in 2013 and 2014. Still, the Netherlands is found in the lower ranks of OECD countries in terms of multifactor productivity growth (Statistics Netherlands, 2015).

1.1 Structure of the economy

The Netherlands is characterised by an increasing role of the service sector. The share of the service sector grew from 56% of gross value added (GVA) in 1969 to 78% of GVA in 2016. More than 60% of the service sector consists of knowledge intensive services (46.97% of GVA). The Netherlands is the sixth largest services export country in the world (Statistics Netherlands, 2017), with total exports amounting to around € 42 b in 2017. The manufacturing sector is growing strongly, showing higher productivity figures each quarter, compared to the same quarter in the previous year, for the past one-and-a-half years. Also, producers' business confidence indicators are improving (Statistics Netherlands, 2017). SMEs are responsible for over 62% of GVA and 71% of employment in the Netherlands. The strong growth in micro-entrepreneurship remains a concern in the Country Specific Recommendations 2017 alongside the more general concern about the constraints for hiring personnel on a permanent basis. In the new coalition agreement a new law on employment relations is announced, which will include a minimum hourly rate for micro-entrepreneurs. Moreover, steps will be taken to make permanent contracts less permanent and flexible contracts less flexible (VVD, CDA, D66 and ChristenUnie, 2017).

Business environment

In the World Economic Forum Global Competitiveness Index the Netherlands has climbed from the 8th place in 2015, to the 5th in 2016 and to the 4th in 2017. Important strengths are technological readiness (3rd place), Higher Education and training (4th place), Infrastructure (3rd place) and Business sophistication (4th place). On the World Bank Doing Business 2018 ranking, the Netherlands ranks 32th, reaching the 1st place on the *trading across borders* dimension but ranking 105 on the ease of getting credit. Also in the Digital Economy and Society Index (DESI) index, the ranking of the Netherlands remains high at the 4th place in both 2016 and 2017. The Netherlands remains the highest-ranking country in connectivity, while performing well on digitisation of public services. Its e-government development ranking has decreased since 2012 and is now at the 7th position. The Netherlands underperforms in comparison to similar economies in the technology adoption by businesses, although this is already above the EU-average.

[1] The introductory context section is heavily based on (EC, 2017)

On the Global Innovation Index (GII) the Netherlands ranked 3rd in 2017, coming from a 9th place in 2016. This sharp rise is mainly due to methodological improvements which lifted the Netherlands higher on the knowledge and technology output dimension and on business sophistication.

According to the SME Performance Review, the Netherlands performs well on almost all of the dimensions of the Small Business Act, especially on 'Entrepreneurship' (i.e. creating an environment in which entrepreneurs and family businesses can thrive and entrepreneurship is rewarded), 'Second chance' (i.e. ensuring that honest entrepreneurs who have experienced bankruptcy are promptly given a second opportunity to succeed) 'Responsive Administration' (i.e. making public administrations responsive to the needs of SMEs), 'Skills and Innovation' (i.e. upgrading of skills and innovation in SMEs) and 'Single Market' (i.e. helping SMEs to benefit more from the opportunities offered by the Single Market) (European Commission, 2017). Despite considerable policy efforts, the Netherlands lags relative to comparable economies on 'Access to finance' for SMEs and 'public procurement'. Altogether, the Netherlands has a competitive business environment with good framework conditions and a good overall performance.

2 Main R&I actors

R&I policies in the Netherlands are mainly centralised at the national level. The central government remains the main financing body, but policymaking and focus areas are gradually becoming more regionalised. Direct support to business R&I is also increasingly provided at the regional level, partly because R&I have become more prominent in the EU Structural Funds. The main policy actors in R&I are the Ministries of Economic Affairs and Climate (EAC) and Education, Culture and Science (ECS). EAC and ECS share the responsibility for enterprise policy, which includes innovation policy. ECS is responsible for science and education policies and the allocation of institutional funding to the universities. The main R&I policy implementation bodies are the Netherlands Organisation for Scientific Research (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW), and the Netherlands Enterprise Agency (RVO). Non-profit organisations and foundations do not play a large role in R&I funding in the Netherlands.[2]

In 2017, the research council NWO was reorganised in response to the 2025 Science Vision of the Ministry of ECS. The NWO now consists of a board of directors, a separate NWO-I organisation for its research institutes, and four domains: Science; Applied and Engineering Sciences; Social Sciences and Humanities; and the Netherlands Organisation for Health Research and Development. This means that the Technology Foundation STW, the Foundation for Fundamental Research on Matter (FOM) and the Netherlands Organisation for Health Research and Development (ZonMW) have been integrated into the new NWO organisational structure. Alongside the domains and the institutes of NWO-I, NWO houses the cross-domain unit WOTRO Science for Global Development as well as three temporary taskforces (the National Initiative for Brain and Cognition; the Netherlands Initiative for Educational Research; and the National Taskforce for Applied Research SIA). The goal of the reorganisation is to make NWO more flexible, more decisive, more collaboration oriented and more responsive to developments within science and society.

Amongst the most prominent research performers in the Netherlands, we find 13 research universities. They perform well in international rankings. In addition, there are 37 universities of applied sciences, which are focused on technical and vocational training. Research is also being conducted in eight university medical centres in which (medical faculties) of universities collaborate with academic hospitals. There are six Applied Research Organisations which receive public funding. The largest is the

[2] A recent study by the Advisory Council for Science, Technology and Innovation (AWTI) estimated that charitable organisations, especially in the health field, was 3.3% of GERD – similar to shares found in other European countries. (AWTI 2014).

Netherlands Organisation for Applied Scientific Research (TNO). As part of Dutch enterprise policy, nine 'top sectors' with strategic importance for the Netherlands were identified in 2010. A main objective of the top sector policy is to improve public-private collaboration in R&I through so-called Top Consortia for Knowledge and Innovation (TKIs). Roughly 90 % of all private R&D takes place within the top sectors.[3]

The Netherlands is home to a large number of 'hotspots', 'valleys', 'technology campusses' and other regional initiatives. Although the central government does not have an official regional policy in place anymore, merely a coordination agreement, it has appointed three so-called mainports: Mainport Schiphol (airport), Mainport Rotterdam Harbour (seaport) and Brainport Eindhoven (high-tech region). In response, the Brainport Eindhoven area has launched a national action agenda for Brainport asking for a € 10 b investment from the central government in the regional economy. This reflects the growing importance and acknowledgement of regional actors in the Dutch R&I system.

3 R&I policies, funding trends and human resources

Main R&I policy developments in 2017

Document title, hyperlink and date of publication/announcement	*Short description*
11 January 2017 € 5 m for 100 female professors	The Ministry of ECS has provided a one-off budget of € 5 m for universities to appoint one hundred female professors and fund their professorship for five years.
11 January 2017 More room for educational tasks in review of researchers	In her letter about scientific talent, the Minister of ECS has urged the universities to take educational tasks more seriously in the review process of researchers.
17 January 2017 Strategic agenda Research facilities TO2	The cabinet presented an inventory of extra investments in large-scale research facilities. The six members of the TO2 federation have plans to invest € 551 m in their facilities. These can be partly funded by firms and their own resources. They ask € 455 m additional funding from the government. The recently presented coalition agreement reserves € 100 m for this investment.
19 January 2017 Extra impulse for application of scientific knowledge	In a letter to Parliament, the Minister of ECS urges universities to develop valorisation indicators and strengthen their TTOs. To support this, the minister will provide an extra € 10 m of funding for

[3] These top sectors are Agri & Food; Horticulture; Chemical industry; Creative Industry; Energy; High Tech Systems & Materials; Life Sciences & Health; Logistics; and Water. (Statistics Netherlands, 2015). Top Sector Monitor 2015. In Dutch.

	the NWO Take-off programme for start-ups and broaden access to this programme to allow researchers from universities of applied science to partake. The Minister also announced to provide € 10 m to fund 'industrial doctorates'. Together with NWO the Ministry will institute a national valorisation price.
27 January 2017 National Smart City Strategy	A national Smart Cities Strategy has been developed and presented to the Prime Minister.
9 February 2017 National Plan Open Science	A National Plan Open Science was presented by ten organisations in the Dutch science system. The aim of the plan is to have full open access of scientific articles and research data in 2020.
10 February 2017 New finance and investment institute: Invest-NL	The cabinet has announced to invest € 2.5b in a new finance and development organisation called Invest-NL. The goal is to increase venture capital for innovative start-ups and scale-ups. Invest-NL will also try to attract public and private capital from other funds, such as the EFSI-fund and the EIB. Most existing risk financing and venture capital funding, such as the SEED capital scheme, will be grouped together within this facility.
3 March 2017 Extension of right to award a PhD	Parliament has approved a new law giving a broader range of researchers, specifically associate professors, the right to supervise PhD candidates and award PhDs.
17 March 2017 Evaluation and continuation of MIT-scheme	The MIT-scheme (SME Innovation Top Sectors scheme) has been evaluated and will be prolonged. The evaluation committee is positive about the effectiveness and efficiency of the scheme.
19 June 2017 New venture capital fund worth € 75 m	A new fund (Innovation Industries) was developed to close the gap between university spin-offs and the market . The fund will invest € 75 m in the next ten years in about twenty high-tech companies.
27 June 2017	The top sectors jointly developed and presented a new instrument for learning,

New instrument for top sectors: Learning Communities	working and innovating called 'Learning Communities'.
27 July 2017 Evaluation top sector policy 1 & 2 – Letter to Parliament	The top sector policy was positively evaluated by the consultancy firm Dialogic. No evidence for direct impact on radical new innovation was found yet.
27 September € 250 m extra funding for scale-ups and start-ups	The ministry of EA, together with the EIB. invests, € 100 m in a scale-up fund which is expected to be matched with € 100 m from venture capitalists. For start-ups an extra investment of € 49.5 m will be made available through the SEED-capital scheme.
3 October 2017 NWO takes measures to reduce high application pressure	NWO has announced a range of measures to reduce the current high application pressure through closer collaboration with universities, postponing calls, new assment criteria and by starting an experiment with the sandpit model.
10 October 2017 New coalition agreement 'Trust in the future' is presented	The new coalition agreement consists of a range of new proposals which will be implemented in the coming months and years. This consists of an ascending extra yearly investment up to € 200 m in fundamental research and another € 200 m in applied research as well as an incidental investment of € 100 m in large technological institutes.

R&I funding trends

The Netherlands secured its position as an 'Innovation Leader' on the European Innovation Scoreboard and moved up one position, to the 4th place among EU countries (European Commission, 2017). The strengths of the Dutch R&I system include its research system, a well educated workforce and strong linkages between business and science. Business expenditure in R&D remains relatively low in comparison to other countries in the Innovation Leader's group.

Gross domestic expenditure on R&D (GERD) increased from € 13.3 b to € 14.2 b between 2014 and 2016. Although presented as signs of progress in the Dutch NRP 2015, GERD as a share of GDP has increased only gradually over the past few years. The 2.03% of GDP measured in 2016 is similar to the EU28 average, but well below the national target of 2.5%.

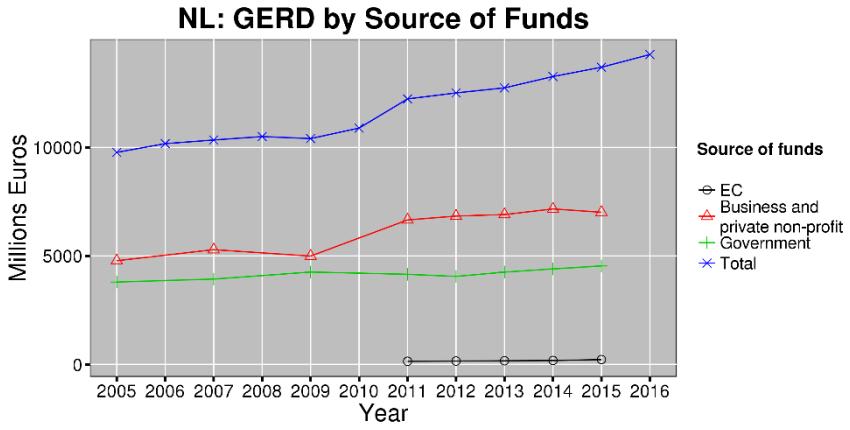

Figure 1 Development of government funding in total GERD.
Data source: Eurostat, November 2017.

The figure above shows that more than 50% of GERD is financed by the business sector and private non-profit. Almost one-third of GERD is financed by the government. The rest (ca. 16%) is financed from abroad (EC).

3.1 Public allocation of R&D and R&D expenditure

Total financial public support for R&D (GBAORD) grew from € 4.8 b in 2015 to € 5.0 b in 2016, but remained stable at 0.71% of GDP. The government budget for 2017 shows a small decrease to € 4.8 b. In the period 2017-2021 total public support for R&D and innovation (totalling € 6.4 b in 2017 as shown in table 1) will gradually decline to € 6.28 b[4] (Vennekens & Van Steen, 2017). The largest part (77% in 2017) of total public support for R&D and innovation is in the form of direct expenditures on R&D, while a small part goes to direct expenditures on innovation (not R&D). A growing share (17%) is expenditure in the form of indirect fiscal support for R&D.[5] Relative to GDP, total public support for R&D and innovation is expected to decrease from 2016 to 2021 (Vennekens & Van Steen, 2017). Dutch direct public funding of R&D in terms of GDP is close to the EU28 average, but considerably below similar economies such as the Nordic countries and Germany.

A relatively large part of Dutch R&D support takes the form of indirect financial support, mostly in the form of tax credits. The share of tax credits in the total support increased from 8% in 1999 to 17%[6] of the public support in 2017 (Vennekens & Van Steen, 2017). This shift in balance from direct R&D support towards more indirect (fiscal) support is a result of a policy strategy that was introduced in 2010. This involved a dismantlement of the Fund for enhancement of the Economic Structure (FES), less direct subsidies and a strengthening of fiscal instruments.

Besides domestic expenditures on R&D there is an inflow of funding from EU programmes (Framework Programme) of approximately € 600 m per year or around 12% of direct public R&D expenditures in the Netherlands. The Netherlands holds the sixth position in terms of successful FP applications: representing almost € 1.6b between 2014 and February 2017.

In 2017, the Innovation Box, one of the two most important tax credit policy instruments for innovation, has been changed to fulfil the requirements of the international

[4] It should be noted that these annual projections of future GBAORD tend to be subject to upward revisions
[5] This does not include the indirect fiscal support given via the Innovation Box – only the WBSO/RAD scheme. The budgetary size of the Innovation Box amounts to € 1.39 b in 2016 and € 1.37 b in 2017.
[6] These percentages do not include the Innovation Box.

agreements (OECD) on base erosion and profit shifting (BEPS).[7] The most important changes imply that profit related to outsourcing of R&D can no longer be accounted for as tax credit. Other changes are stricter requirements and differentiating between small and large tax payers. As a result, indirect financial support for R&D via the Innovation Box in terms of foregone tax revenues is expected to decline slightly in 2017 (Vennekens & Van Steen, 2017).

The table below shows that while the total level of R&D expenditures has risen, this has not been enough to lead to a larger total public R&D intensity(total expenditures as share of GDP) (Vennekens & Van Steen, 2017).

Total public support for R&D and innovation in 2015-2017 (in million euro and % of GDP)

	2015	2016	2017
Public funding to R&D (GBAORD)	4.880,7	5.022,1	4.887,3
Funding funding to innovation, not R&D	241,9	324,0	281,7
Fiscal incentives for R&D and innovation[8]	1.009,8	1.153,8	1.215,8
Total financial support for R&D and innovation	**6.132,4**	**6.499,8**	**6.384,7**
Expenditure on R&D, as % GDP	0,72	0,72	0,69
Expenditure on innovation, not R&D, as % GDP	0,04	0,05	0,04
Fiscal incentives for R&D and innovation, as % GDP	0,15	0,17	0,17
Total support for R&D and innovation, as % GDP	**0,91**	**0,93**	**0,90**

Table 1 Total public support for R&D and innovation in 2015-2017.
Data source: Vennekens & Van Steen, 2017.

3.2 Private R&D expenditure

The biggest funder of business R&D is business itself at 79% of BERD in 2016. The government is a modest funding source of business R&D with 2% of BERD in 2016.[9] Funding from abroad is a much more important source of funding for business R&D: almost 19% in 2016.

In absolute terms, business expenditure on R&D shows a remarkable increase from € 7.669 b in 2015 to € 8.132 b in 2016. Within the business sector, Industry is responsible for 57%, whereas Services spend 37% of private R&D expenditures. Approximately 90% of private R&D is spent on applied and experimental research. The remaining 10% is spent on basic research (Rathenau Institute, 2017).

The companies that spend most on R&D in the Netherlands are Philips, ASML, Unilever and NXP. These are ranked 22nd, 39th, 41st and 54th respectively on the 2016 European Industrial R&D Scoreboard (European Commission, 2016). These positions are based on total R&D spent, which does not necessarily imply expenditure in the Netherlands. Firms such as STMI Electronics are based in the Netherlands, but appear to do relatively little R&D in the country. In terms of R&D spent within the Netherlands, Philips took over the first rank position of ASML as it increased its expenditures with € 52 m compared to 2016. Philips spent € 820 m on R&D in the Netherlands in 2017, compared to € 744.4 by ASML (Technisch Weekblad, 2017).

[7] "*Base erosion and profit shifting* (*BEPS*) refers to tax avoidance strategies that exploit gaps and mismatches in tax rules to artificially shift profits to low or no-tax locations. Under the inclusive framework, over 100 countries and jurisdictions are collaborating to implement the *BEPS* measures and tackle *BEPS.*" *www.oecd.org/tax/beps/*

[8] Excluding the innovation box

[9] This figure does not include tax incentives

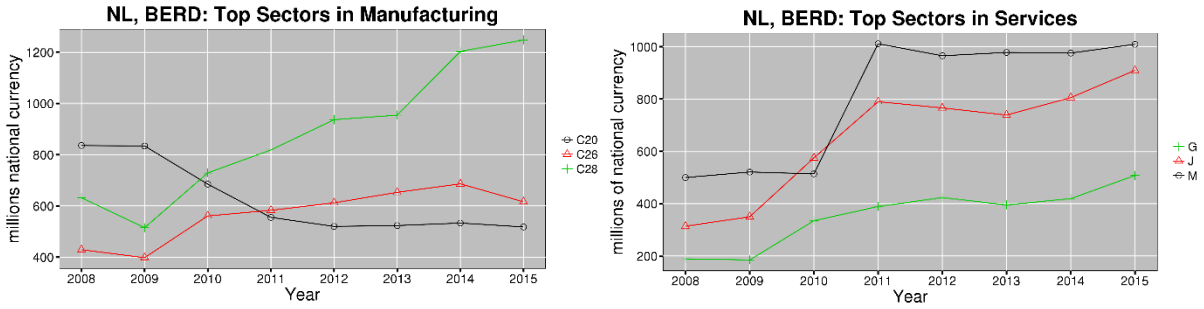

Figure 2 Top manufacturing and service sectors by BERD

Top sectors in manufacturing by BERD are ("Manufacture of machinery and equipment" (C28), "Manufacture of computer, electronic and optical products" (C26) Manufacture of chemicals and chemical products (C20). The top service sectors by BERD are: "professional, scientific and technical activities" (M); Information and communication services (J) and wholesale and retail trade (G).

3.3 Supply of R&I human resources

Unemployment decreased in 2016 to 5.4%, surpassing ex-ante expectations of around 6.1%[10] (Statistics Netherlands, 2017). This decrease is continuing as unemployment reached 5.1% in March 2017 (Statistics Netherlands, 2017). Employment rates for the population aged 25-64 with completed tertiary education, are still rising. The share of employees having completed tertiary education (as % of the active population) is also rising. The same holds for the share of scientists and engineers in the age group 25-64. The share of female researchers is slowly rising; 20% of professors are now females. However, if the trend continues at its current pace it will not be until 2035 when full gender equality in professorships is achieved (Chiong Meza & De Jonge, 2017). Compared to the EU-average (33.44% in 2015) the Netherlands (25.38% in 2015) is strongly behind in the share of female researchers. The Ministry of ECS announced an investment of € 5 m to appoint 100 female professors in the next five years. It will also invest in 'industrial doctorates' and promote 'societal doctorates' at government departments to broaden career possibilities for researchers (Ministry of ECS, 2017).

In comparison with the EU-average, the Netherlands has considerably more new doctorate graduates per 1,000 in the population aged 25-34 (EU: 1.07 in 2013; NL: 1.88 in 2015). The number of 6.68 researchers per 1,000 people (2015) is also higher than the EU-average of 5.61 (2015). Dutch scientists are among the most mobile scientists in the world. There is a balance between outgoing and incoming researchers, both quantitatively in terms of number of researchers as well as qualitatively in terms of citation scores. The (temporary and permanent) immigration and emigration of researchers is in balance, as shown by a recent report by the Rathenau Instituut (Koier, De Jonge, & Scholten, 2017).

The number of new STEM graduates in the Netherlands is well below EU-average (EU: 2.32 per 1,000 in 2015); NL: 0.72 per 1,000 in 2013). Since 2013 there is intense policy action on stimulating the take-up of STEM studies by students and on keeping people in STEM jobs. An updated version of the Dutch Technology Pact 2020 was presented in 2016 as labour market demand for STEM graduates and the number of vacancies in technical and ICT professions is still rising. The first results of the Pact show that the inflow of new students into technical studies is rising, as is the share of female students (Techniekpact, 2017). As it will take time before these students will access the labour market, shortages are expected to remain until then. These shortages are most pressing in technical and ICT jobs according to the Dutch employee insurance agency (UWV) which compiled a list of jobs with most pressing shortages (Van der Aalst & Van den Beukel, 2017). Statistics Netherlands (2017) reports that one in four ICT firms had labour shortages in the second quarter of 2017.

[10] Eurostat still reports 6% for 2016.

4 Policies to address innovation challenges

4.1 Challenge 1: Increasing private RDI expenditure and economic restructuring

Description

Despite modest growth in private R&D expenditure over the last years, the goal of 2.5% of GDP R&D expenditures in 2020 (public and private) is still out of reach. As described in the RIO Country Report 2016 the business sector as a whole invests less in R&D than in comparable countries. BERD as a percentage of GDP increased to 1.16% in 2016 which ranks the Netherlands at the 9th place among EU countries. The relatively low performance on this indicator can partially be explained by the Dutch economic structure which has a strong specialisation in services and some other sectors which have a relatively low formal R&D component.

Policy response

The Minister of Economic Affairs acknowledged the difficulty of reaching the 2.5% target in 2020 (Ministry of Economic Affairs, 2017), but also pointed out that this should not be a goal in itself as investment in R&D is a means to an end. He described four lines on which the Dutch government tries to facilitate and create the conditions for R&D investments. It aims to do so by strengthening the R&D investment climate through attracting foreign R&D investments, facilitating public-private partnerships (PPP) for R&D and maintaining a fiscal climate that is conducive to innovation. The government expects good results from the generic, indirect instruments of WBSO and the Innovation Credit as well as the SME Innovation Stimulation Topsectors (MIT) scheme. Through the PPP-allowance for R&I (formerly TKI-allowance) the government creates a lever for private R&D investments: in cash contributions and a limited amount of in-kind contributions by firms are matched with a public PPP-allowance. Finally, by attracting foreign R&D investments the government aims to compensate for the domestic sector structure that is less geared towards R&D investments. A concrete new policy instrument that is announced is Invest-NL. This new facility should lead to increased venture capital availability for innovative start-ups and scale-ups. Invest-NL will also try to attract public and private capital from other funds, such as the EFSI-fund and the EIB. Most existing risk financing and venture capital funding, such as the SEED capital scheme, will be grouped together under this facility.

Assessment

According to the OECD (2014), the current R&D support system with a large role for R&D tax credits, is well-designed but does not serve all of the varying needs of the business sector. Rebalancing the system with a sufficient focus on competitive, well-designed direct support instruments could be more effective in stimulating innovation. The Invest-NL initiative might be able to address parts of this need. Increasing private R&I expenditure through attracting FDI in R&I can be a fruitful route, but one that is time-consuming and long-winded. The PPP-allowance was evaluated (mid-term) with a positive assessment of its functioning. It was deemed to be an attractive stimulus for PPPs. Existing PPP networks have been consolidated and have been broadened. New actors, including SMEs, have entered PPP networks (Dialogic, 2016). An important recommendation, echoed by the advisory council AWTI (2016), was to increase the percentage of the allowance, because this would increase the attractiveness of the instrument and signal the importance of PPP. Similar results were obtained by the evaluation of the MIT scheme (Technopolis group and SEO Economisch Onderzoek, 2017). The scheme is appreciated by the beneficiaries and seems to be effective in stimulating innovation. However, a noteworthy critique is the swift depletion of the instrument in successive rounds. As there are few available direct subsidies for innovation, the demand is very high.

4.2 Challenge 2: Finding the right level of public expenditure on applied research organisations

Description

The strong education system and science base of the Netherlands provide a sound basis for boosting innovation and growth via education and R&D activities. The public component of the gross domestic expenditure on R&D, i.e R&D expenditure by the government sector (public research institutes) and the higher education sector is somewhat lower than in some other advanced economies, though at 0.87% of GDP it is not too far removed from Germany (0.93%), Denmark (1.14%) and Sweden (0.99%). Government funded R&D in both the public and the private sector is, at 0.66 % of GDP, considerably below Germany (0.81%) Finland (0.84%) and Denmark (0.87%). Although the government's budget provisions for R&D (GBOARD) has remained relatively stable over the years, the budget allocation has shifted towards the enterprise policy and away from direct funding of applied research institutes. Furthermore, GBAORD and allocations for innovation support are forecasted to fall in the coming years (Vennekens & Van der Steen, 2017). In particular the group of public knowledge organisations outside the academic research system have seen their income fall by 8.2% between 2010 and 2015 (Rathenau Instituut, 2017). Their base funding has decreased even further, but was partly compensated by a rise in other income streams, such as from the Topconsortia for Knowledge and Innovation. Decreasing levels of public support for applied research institutes leads to the risk of erosion of the more applied part of the public research system.

Policy response

The Ministry of Economic Affairs (2017) acknowledged that public R&D investments as percentage of GDP are set to fall further in the coming years as investments stagnate and the economy grows – though indicated that the non-inclusion of part of the indirect support (the innovation box) may blur the picture. In the newly presented coalition agreement (VVD, CDA, D66 and ChristenUnie, 2017) investments in both applied and fundamental research are announced. The budget for fundamental research will be increased gradually, up to € 200 m structurally per year from 2020. The budget for applied research and innovation will also be increased up to € 200 m per year from 2020. The exact way this extra budget will be allocated is not clear yet. The coalition agreement also announced an incidental investment of 2 x € 50 m in large technological infrastructures in 2018 and 2019 (Ibid, pp. 58).

Assessment

A recent evaluation of the organisations for applied research (TO2 organisations), showed that these organisations have performed very well in terms of impact and quality, while they have spent the available resources effectively and efficiently (Evaluation Committee Schaaf, 2017). However, according to this Evaluation Committee the vitality of the TO2 organisations is jeopardised by the lower levels of public (base) funding of these institutes. As a result, they can invest less in developing new research paths and in research infrastructures. This already resulted in a diminishing knowledge base of several applied research organisations in terms of resources available for specific knowledge domains. This development is expected to continue (AWTI, 2017). The investments announced in the coalition agreement may help to dampen this expected development.

4.3 Challenge 3: Maintain and improve the Human Capital Base for R&I

Description

The Netherlands has a highly educated workforce, but has faced challenges to respond to emerging and changing labour market needs. A main challenge remains the lack of science and engineering students to meet prospective labour demand. Although the number of graduates in STEM per 1,000 inhabitants in the age 20-29 is growing, it is still considerably lower than the EU average, and this gap is growing. At the same time, there is a very high demand for people with technical and ICT expertise in the Dutch labour market (Van der Aalst & Van den Beukel, 2017; ROA, 2017). Within the technical professions this demand is high at all levels of education, whilst within the ICT sector it is mainly a demand for highly skilled professionals. In 2017, one quarter of the employers in the ICT sector experienced difficulties to attract people with the right skill set (Statistics Netherlands, 2017). A telling indication of the challenge in human capital for R&I is the low ranking of the Netherlands on tertiary education (49th place) and specifically the number of graduates in STEM (88th place) in the Global Innovation Index of Cornell University, INSEAD, and WIPO – even though the Netherlands ranks 3rd in the total index.

The Dutch PhD training system functions well, but given the "overproduction" of PhD graduates relative to labour demand in academia, it is important to further develop alternative career paths. In general the unemployment levels of PhD holders are negligible, but there may be room to improve the use of this highly skilled labour force in the Dutch knowledge economy.

Policy response

This challenge has been acknowledged by the Dutch government for several years. Initiatives have been taken to address it. Most notably the Dutch Technology Pact 2020 was implemented to reduce the shortage of labour by establishing better connections between education and the labour market. In addition, each top sector has developed and implemented a sector-specific human capital agenda with the aim to strengthen connections between the labour market and education in specific sectors.

The Ministry of ECS has made an agreement with universities to enhance private sector involvement in the training of PhD candidates. It has announced an increase in the number of industrial PhDs and is planning to experiment with joint academia public sector PhD schemes. Meanwhile an experiment is carried out by the ministry to give PhD candidates scholarships rather than employment contracts. This could increase the number of PhD graduates further. Finally, the government has extended the right to reward a PhD to include associate professors, next to full professors.

Assessment

This challenge is well known and action has been taken by the government. The impact of these actions will only take effect in the longer term, however. At the same time there is already a pressing need for technical and ICT personnel (Statistics Netherlands, 2017). The impact of this challenge differs strongly per region. New regional initiatives are already being taken by provincial governments, such as Gelderland, which invests € 14 m in collaborations between firms and education. Another interesting initiative in this regard is taken by a consortium led by Brainport, called the Talent Coalition Netherlands (2017), which urges for a national action plan to attract international talent to fill the gaps in the labour market.

The Council of State advised against both the plans for extending the right to reward a PhD and the experiment with PhD students. It warns about the risk of crowding out employees by PhD students and the risk of creating "second class PhDs" (Raad van State, 2015). With regard to the extension of the right to award a PhD, the Council notes

that the reasons to extend this right are poorly motivated. It points at the risks of hollowing out the responsibilities granted to full professors in the law on higher education (Raad van State, 2015). Despite these reservations of the Council, both initiatives have been implemented. Meanwhile, university boards appear to struggle with how to deal with both PhD students and the right to award a PhD (VSNU, 2017). It may take some time for the Dutch system to adapt to these changes.

4.4 Challenge 4: Governance of challenge-oriented research and innovation

Description

Grand Societal Challenges (GSCs) are becoming increasingly central in R&I policy. For instance, in the top sector policy, the GSCs rank high in relevance in the joint development of public-private R&I agendas. Large scale societal transitions are required to address the GSCs. This requires concerted efforts by many stakeholders, including government bodies at various levels, industry, research institutes, civil society organisations, etc. In challenge-oriented R&I policy, the government cannot rely on generic policy instruments, but has to play an active role in finding and creating innovation routes towards the transformative change that is needed to address the GSCs. Currently, there are many boundaries and barriers between various policy domains within the central government and across the various levels of government (local-regional-national).

Policy response

Both in the Enterprise policy and in the Science Vision 2025 there is an acknowledgment that addressing GSCs will become an important part of R&I policy. In the Enterprise policy, it is mainly left to the respective top sectors and their 'top teams' to address GSCs, with the cross-sectoral theme Biobased Economy as an exception. The idea is that top sectors can combine entrepreneurial and competitiveness goals with societal goals of the GSCs. GSCs are framed as a business opportunity. The Ministry of EA estimates that 72% of the budget for innovation is spent on sustainable innovation initiatives (Ministry of Economic Affairs, 2017). In the Science Vision 2025, the policy ambition is that the Dutch science system is more connected with society and business and has maximum societal impact. Several instruments and initiatives were developed, such as the National Science Agenda and the National Plan Open Science.

At the regional level, the smart specialisation strategies of all four regions mention the importance of addressing the societal challenges in their region. The strategy of the Northern Netherlands explicitly focusses on four challenges that are most urgent for the region and for which the business sector is expected to have innovative solutions (SNN, 2013). Instruments such as the City Deals in which several departments of the central government, municipalities, business and other societal actors jointly make agreements on specific policy initiatives, are another example of policy experiments to address GSCs in the Netherlands.

Assessment

The Dutch government is aware of the importance of addressing GSCs and the benefits it can produce for society both in terms of solutions that are needed and business opportunities that can be created. However, since the introduction of the Enterprise policy in 2010, Dutch R&I policy clearly favours generic over direct private R&I support. Besides generic policy instruments, the government has several policies and instruments in place that explicitly recognize the importance of addressing GSCs, such as City Deals, Green Deals and the SBIR scheme. Moreover, the recent top sectors' Knowledge and Innovation Agendas have a stronger focus on the GSCs, although most actions remain within sectors rather than being cross-sectoral (Ministry of Economic Affairs, 2017). In its evaluation of the top sector policy, Dialogic (2017) found that the policy did not (yet) lead to groundbreaking innovations – which was not an explicit goal of the top sector approach. In general, the central government continues to search for its appropriate role in addressing the GSCs, for example when it concerns the shift towards a more circular economy (SER, 2016). In the new coalition agreement the government announced to shift the Top Sector Policy to three societal themes. The City Deals are found to stimulate the necessary number of multilevel government collaborations and provide room for

experiment and learning by doing with the goal of accelerating transitions (Hamers, Dignum, & Evers, 2017).

5 Focus on R&I in National and Regional Smart Specialisation Strategies[11]

New policy developments

Northern Netherlands
At the level of the RIS3 strategy, there were no new policy developments in the Northern Netherlands. At the instrument level a new instrument was launched under the ERDF programme: the Open Innovation Call. The goal of this call for proposals is to connect promising initiatives to strengthen the innovation ecosystem. The scheme is developed as an open call with only a limited set of conditions as to provide the innovation actors with maximum space for creativity and initiative. With this call SNN aims to stimulate the entrepreneurial discovery process amongst actors.

Southern Netherlands
No new policy developments at the level of the RIS3 strategy. The strategy remains unchanged. Brainport Development, the economic development agency of Brainport Eindhoven, has presented the *Brainport National Action Agenda* in which it asks for national support for the continuing development of the Brainport area[12]. The strategy of the area is underpinned by principles that are in line with 'smart specialisation thinking'. For example it focuses on four flagships of newly emerging technologies combined with leveraging the existing culture of collaboration in the area.

Western Netherlands
No new policy developments at the level of the RIS3 strategy. There are new policy initiatives such as the Randstad Europe Strategy and the Smart Randstad Region. Smart Randstad Region aims to promote the Randstad (i.e. the four largest cities Amsterdam, Rotterdam, The Hague and Utrecht, and their surrounding areas) as a living lab for Europe's major challenges.

Eastern Netherlands
A new innovation strategy 'Innovation Profile Eastern Netherlands' was developed as part of the 'Europe strategy' of the provinces of Overijssel and Gelderland (Eastern Netherlands). The RIS3 strategy provided the starting point for this document which has the goal of providing a basis for Horizon2020 proposals. The Innovation profile strategy was jointly developed by a large number of stakeholders from networking organisations, knowledge institutes, employer organisations and provincial governments. The Innovation Profile is organised under two 'flagships,' each with three separate focus areas: *Smart and sustainable industries* and *Concepts for a healthy life*[13].

Progress on implementation
In all four regions, the most direct sign of progress in the implementation of the RIS3 strategies is in the impact they have on the development of ERDF instruments. The projects that are selected for co-financing by the Operational Programmes need to be in line with the RIS3 strategies. In the regions Eastern and Northern Netherlands the RIS3 strategies have formed the basis for a renewed, more concrete strategy that forms the basis of most innovation policy activities in both regions. In the Northern Netherlands this

[11] *We made use of both publicly available sources, short telephone interviews and questions asked by e-mail to write this section*
[12] For the strategy see: https://www.brainport.nl/actieagenda
[13] More information on: http://east-netherlands-region.eu

Northern Innovation Agenda and the RIS3 strategy are governed by a new Innovation Board. The extent to which this leads to a continuous entrepreneurial discovery process is not yet clear. In the Southern Netherlands there already existed a strong innovation policy culture and a policy with a strong foundation in society: Brainport2020. This strategy formed the backbone of the RIS3 strategy and is further developed into the Brainport Next Generation strategy which shows clear elements of the 'smart specialisation logic'. Within the Brainport area one can observe a continuous search for new and developing technology fields and applications, in line with idea of the entrepreneurial discovery. In the Western Netherlands the strategy only seems to function as a framework of the ERDF programme. The Western Netherlands consists of the four largest cities of the Netherlands with different economic strengths and focus areas and their own innovation policies. On the one hand, the RIS3 does not seem to function as an overarching framework for all these policies. But on the other hand, the RIS3 has such a broad scope that most policies fit in it.

In all four regions ERDF funding is being allocated to the areas of strength as identified in the RIS3 strategies. The respondents indicate that no mismatches have been identified yet. The Western Netherlands is the only ERDF programme with revolving instruments in the policy mix. The other three programmes use subsidy instruments only. However, these three programmes all have complementary revolving instruments in their regions. Especially in the Southern and Eastern Netherlands these instruments are also focused on the RIS3 areas of strength. In the Northern Netherlands they are focused on a broader range of firms and topics, but also include the RIS3 focus areas. The Eastern Netherlands programme is currently exploring the possibilities of implementing a new revolving instrument using ERDF funding.

All four regions are active on the thematic smart specialisation platforms, mainly related to industrial modernisation and agro-food. Southern Netherlands is the most active, with a leading or participating role in 10 different partnerships. Examples from other regions include the Western Netherlands on the topic of hightech farming and the Northern Netherlands on bio-energy. The Eastern, Western and Southern Netherlands are members of the Vanguard initiative which strives to strengthen the competitive advantage and internationalisation of the manufacturing industry in 30 European regions. Also, all four regions are engaged in several INTERREG programmes and projects with a focus on smart specialisation. Examples are the *Clusterfy* project and the *Beyond EDP* project that the Northern Netherlands is actively engaged in. The regions also participate in several Horizon2020 projects on smart specialisation such as Manunet (East) and OnlineS3 (North). The Northern Netherlands has developed collaboration with North East Romania on strengthening links between innovation environments across borders. The possibility to use 15% of Structural Funds for external actors is used by all four regions, although most seem rather cautious in doing so. This is partly related to some uncertainty about the interpretation of Article 70 of the regulation, and partly to political considerations. This 15% is both used for actors from abroad and from other regions in the Netherlands.

Universities play an important role on both the programme level and project level. They partake in steering committees, advisory groups and governing bodies in the regions, and are also important players in many projects financed by ESIF and Horizon2020. In many consortia, they take a leading and coordinating role and function as drivers of the developments.

Monitoring mechanisms and the feedback loop

There are three main monitoring mechanisms in place. First, there is the monitoring of the Operational Programme which is carried out in line with the regulations and is coordinated amongst the four regions. Second, there is a monitoring mechanism that is also jointly coordinated by the four regions. This mechanism entails the regionalisation of

a small number of innovation indicators by Statistics Netherlands[14]. Third, there are additional monitoring mechanisms. In the Southern Netherlands there is a yearly Brainport monitor in which also innovation relevant monitoring is taking place. In 2018 a first monitoring of the RIS3 will take place. In the Northern Netherlands there is a new monitor developed to monitor the innovation activities of firms in the region, which is co-financed by SNN (the management authority of the ERDF programme North). In the Western Netherlands there are several monitors for the respective cities and provinces regions in which innovation relevant indicators are monitored.

Evidence of impact

There are no evaluations or monitoring reports available yet that can inform about the impact of the RIS3 strategies on the regions. As most strategies were finalised in 2014 and the ERDF programmes have been active since 2015, most projects have only just started or just recently finished. From interviews conducted for this report, one can infer that in two regions, East and North, the RIS3 process set in motion a series of new initiatives on regional innovation policy making. Although on the basis of this evidence one cannot state that this is a continuous entrepreneurial discovery process, there are signs that smart specialisation is helping these regions prioritize and focus on key (future) strengths. In the South region this process was actually already in motion and the available evidence shows that it is still one of the most competitive regions in Europe. It is difficult to provide insights on the West region as it is a region that consists of several strong, but different cities and provinces with different goals and strategies. The impact of the RIS3 process seems to be limited here, but the region has been and still is the largest regional economy in the Netherlands with multiple strengths and growth paths.

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Abbreviations

AWTI	Advisory Council for Science, Technology and Innovation
BERD	Business Expenditures on Research and Development
CBS	Statistics Netherlands
CIS	Community Innovation Survey
CSR	Country Specific Recommendations
CPB	Netherlands Bureau for Economic Policy Analysis
DESI	Digital Economy and Society Index
EA	Ministry of Economic Affairs (from 26 October 2017: Ministry of Economic Affairs and Climate)
EC	European Commission
ERA	European Research Area
ERC	European Research Council
ESC	Ministry of Education, Science and Culture
ESIF	European Structural and Investment Funds
EU	European Union
EU-28	European Union including 28 Member States
FDI	Foreign Direct Investment
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditures on R&D
GOV	Government
GVA	Gross Value Added
GVC	Global Value Chain
HEI	Higher Education Institute, including universities and polytechnics
HGIE	High Growth Innovative Enterprises
IA	Internal Affairs
ICT	Information and Communication Technology
KNAW	Royal Netherlands Academy of Science
NGO	Non-governmental Organisation
NL	The Netherlands

N.W.O.	Dutch Research Council
OECD	Organisation for Economic Cooperation and Development
PBL	Netherlands Environmental Assessment Agency
PRO	Public Research Organisation
R&D	Research and development
R&I	Research and innovation
RDA	R&D Aftrek (R&D tax incentive); R&D Tax Deduction
ROA	Research Centre for Education and the Labour Market (*ROA*)
ROM	Regional Development Organisations
RVO	Netherlands Enterprise Agency
SBIR	Small Business Innovation Research
SIA	Taskforce for Applied Research – part of N.W.O.
SME	Small and Medium-sized Enterprise
STEM	*Science, Technology, Engineering and Mathematics*
TFP	Total Factor Productivity
TKI	Top Consortia for Knowledge and Innovation
TNO	Netherlands Organisation for Applied Scientific
TWIN	Overzicht Totale investeringen in Wetenschap en Innovatie (Rathenau publication)
UAS	University of Applied Science
WBSO	R&D tax credit

Factsheet

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
GDP per capita (euro per capita)	37400	38000	38500	38500	38900	39300	40400	41300	
Value added of services as share of the total value added (% of total)	75.54	75.96	75.94	76.1	76.67	77.65	77.92	78.18	
Value added of manufacturing as share of the total value added (%)	11.74	11.81	12.07	11.83	11.33	11.38	11.89	12.15	
Employment in manufacturing as share of total employment (%)	9.3	9.1	8.95	8.86	8.81	8.77	8.7	8.63	
Employment in services as share of total employment (%)	81.47	81.9	82.15	82.4	82.73	82.91	83.13	83.28	
Share of Foreign controlled enterprises in the total nb of enterprises (%)	0.97	0.97	1.12	1.11	1.17	1.18			
Labour productivity (Index, 2010=100)	97.9	100	100.7	100.5	101.2	101.9	103.6	103.8	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34			1.58	1.69	1.82	1.89	1.88		
Summary Innovation Index (rank)	7	7	6	6	5	4	4	4	
Innovative enterprises as a share of total number of enterprises (CIS data) (%)				51.4		55.3			
Innovation output indicator (Rank, Intra-EU Comparison)			9	9	9	9			
Turnover from innovation as % of total turnover (Eurostat)		10.4		11.8					
Country position in Doing Business (Ease of doing business index WB)(1=most business-friendly regulations)						25	28	28	28
Ease of getting credit (WB GII) (Rank)						65	69	72	
Venture capital investment as % of GDP (seed, start-up and later stage)	0.028	0.026	0.029	0.026	0.024	0.029	0.032		
EC Digital Economy & Society Index (DESI) (Rank)						4	4	4	4
E-Government Development Index Rank		5		2		5		7	
Online availability of public services – Percentage of individuals having interactions with public authorities via Internet (last 12 months)	61	64	62	67	79	75	75	76	
GERD (as % of GDP)	1.69	1.72	1.9	1.94	1.95	2	2	2.03	
GBAORD (as % of GDP)	0.79	0.77	0.77	0.72	0.73	0.74	0.71	0.71	
R&D funded by GOV (% of GDP)	0.69		0.65	0.63	0.65	0.66	0.66		
BERD (% of GDP)	0.79	0.83	1.08	1.1	1.09	1.12	1.12	1.16	
Research excellence composite indicator (Rank)	3	2	1	1	1	1			
Percentage of scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country		14.85	14.71	14.64	14.29	14.27			
Public-private co-publications per million population	88.99	103.47	112.15	99.82	97.44	93.82	72.66		
World Share of PCT applications	2.32	2.01	1.62	1.84	1.76	1.68	1.88		
Global Innovation Index				4	5	4	9	3	

Data sources: various, including Eurostat, European Commission and International scoreboard data

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KJ-NA-29183-EN-N

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doi:10.2760/66601
ISBN 978-92-79-81700-7