Rathenau Instituut

Total Investment in Research and Innovation (TWIN) 2017-2023

Facts & Figures

This TWIN publication reveals that direct government spending on research and development (R&D) is increasing, but trailing behind forecast economic growth. As a result, the Netherlands is lagging further behind its target of spending 2.5 per cent of its gross domestic product on R&D.

It also shows that, for the first time since 2010, programme funding at applied research organisations ('TO2 institutes') is increasing, as is other policy research expenditure.

Finally, this report makes clear that Dutch researchers are benefiting from the EU Horizon 2020 Framework Programme. EU funding for R&D and innovation is likely to increase further under the new framework programme.

Content

Summary

The Netherlands spent € 14.7 billion on research and development (R&D) in 2017. Almost a third of this expenditure consists of direct government funding. In addition, government funds non-R&D innovation and uses tax measures to stimulate R&D and innovation.

This *Facts & Figures* on Total Investment in Research and Innovation ('TWIN') 2017-2023 provides an overview of trends in government support for R&D and innovation over the 2017-2023 period, based on the 2019 National Budget. In the years ahead, direct government expenditure on R&D will amount to € 5.5 billion and expenditure on non-R&D innovation to € 0.35 billion (in 2019), with tax measures coming to a total € 1.34 billion. This will bring total government support for R&D and innovation to € 7.2 billion.

We also discuss provincial and EU spending on knowledge and innovation, amounting to a total of approximately €0.9 billion annually. Our analysis of government funding in these categories leads us to draw the following main conclusions:

1. **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[1] and is forecast to remain at around €5.5 billion over the medium term. The increase between 2017 and 2023 comes to 11 per cent, whereas the previous TWIN publication[2] projected an increase of 2.6 per cent. The higher percentage can be attributed mainly to the extra investment in R&D provided for in the Dutch Government's 2017 Coalition Agreement, which we take into account in this TWIN publication for the first time.

   Despite this increase, we expect direct government spending on R&D as a percentage of gross domestic product (GDP) to fall after 2018, from 0.67 per cent in 2017 to 0.65 per cent in 2023. This is because the budgeted government spending on R&D is not growing as fast as the economy, according to forecasts by the Netherlands Bureau for Economic Policy Analysis (CPB). **To achieve the 2.5 per cent GDP spending target by 2020, extra investments will be required.**

   Between 2014 and 2017, government, the business enterprise sector and other investors together spent 2.0 per cent of GDP on R&D. This puts total Dutch R&D expenditure below the averages of the OECD, EU-15 and EU-28 country groups. 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 for the Netherlands, such as Germany, Switzerland and the Scandinavian countries.

1 Provisional figures at the time of publication of the National Budget for 2019.

2 Vennekens, A. and J. de Jonge. *Total Investment in Research and Innovation (TWIN) 2016-2022*. The Hague: Rathenau Instituut, 2018. See also https://www.rathenau.nl/en/vitale-kennisecosystemen/total-investment-research-and-innovation-twin-2016-2022

To achieve the 2.5 per cent GDP target for R&D by 2020, both the public and the business enterprise sectors need to invest more. If the ratio between public and private R&D expenditure remains the same, government would have to invest an additional € 1.3 billion per year on top of the annual € 500 million already budgeted.

3. For the first time since 2010, research-specific programme funding for applied research organisations (the 'TO2 institutes') has increased, thanks to the investments provided for under the Coalition Agreement.

After years of decline, the investments provided for under the Coalition Agreement have led to an increase in programme funding for the 'TO2 institutes' or applied research organisations, up 16 per cent between 2017 and 2023. TNO's programme funding shows 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.

4. The Netherlands relies on a large proportion of tax-related support for R&D, comparatively speaking.

Compared with other OECD countries, a large proportion of government support for R&D consists of tax measures (0.17 per cent of GDP). Only Belgium, France and Ireland have a higher percentage of tax-related support for R&D.

In 2019, government tax-related support for R&D and innovation stands at € 1.4 billion. The Dutch Research and Development (Promotion) Act (WBSO), meant to stimulate R&D, accounts for most of this amount. After a slight dip in 2018, the WBSO tax benefit will increase from € 1.2 billion to € 1.3 billion in 2023. The remaining € 139 million is linked to non-R&D innovation schemes, i.e. the Environmental Investment Rebate (MIA) and the Indiscriminate Depreciation of Environmental Investments (VAMIL).

5. The EU can be expected to play an even greater role in R&D funding.

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 Programme, in the range of € 600 to 700 million per year. The value of EU funding has increased from 9 per cent of total public R&D funding under the previous, 7th Framework Programme (FP7, 2007-2013) to 11 per cent for Horizon 2020 (forecast).

For the next Framework Programme (2021-2027), the European Commission has proposed a total budget that exceeds the Horizon 2020 budget by more than 20 per cent. If the Netherlands remains as successful as it has been, revenue from the next Framework Programme could increase to € 800 million per year.

Introduction

In the present *Facts & Figures* on Total Investment in Research and Innovation (TWIN) 2017-2023, the Rathenau Instituut surveys government support for R&D and innovation in the Netherlands. We do this every year based on the most recent national budget, in this case the 2019 Budget. Our focus in this report is on trends in government support for R&D and innovation between 2017 and 2023.

This publication discusses three categories of national government support:

1. **direct R&D expenditure**, meant to expand the knowledge base and develop new applications
2. **direct expenditure on non-R&D innovation**, meant to promote innovation but with no R&D component
3. **indirect support for R&D and innovation***,* consisting of tax instruments meant to stimulate R&D and innovation in enterprises.

To help us frame public spending properly, this TWIN publication also discusses a number of other topics. We look at total R&D expenditure in the Netherlands (including the business enterprise sector, private non-profit organisations and foreign investments), chart EU and regional public investments, and compare Dutch spending on R&D with R&D expenditure in a number of reference countries.

Reader's guide

The types of figures presented here are the same as in previous editions,[3] but the sequence in which we present them has changed. Section 1 starts with an overview of total R&D expenditure in the Netherlands, based on data from Statistics Netherlands (CBS) on research activities in the Netherlands. We then look at total public investment in R&D and innovation based on data from the National Budget (in this case the 2019 National Budget) that the Rathenau Instituut collects from the Ministries each year. Section 2 examines trends in government support between 2017 and 2023. Section 3 looks at EU and regional funding for R&D and innovation. Section 4 compares Dutch spending on R&D with expenditure in a number of reference countries.

1. R&D expenditure in the Netherlands

How much is spend on R&D in the Netherlands? And who does the spending? In this section, we look what government, business enterprises, private non-profit

[3] See previous TWIN publications at https://www.rathenau.nl/en/vitale-kennisecosystemen/total-investment-research-and-innovation-twin-2016-2022

organisations and foreign parties are spending on research, with a special focus on government.

We also examine how this expenditure relates to government's target of spending 2.5 per cent of GDP on R&D.

We will see that, despite the additional funds earmarked for basic and applied research under the 2017 Coalition Agreement, public sector investment is growing at a slower rate than GDP after 2018. Without additional spending on R&D, the percentage of GDP invested in R&D will decline and fall further behind the 2.5 per cent target.

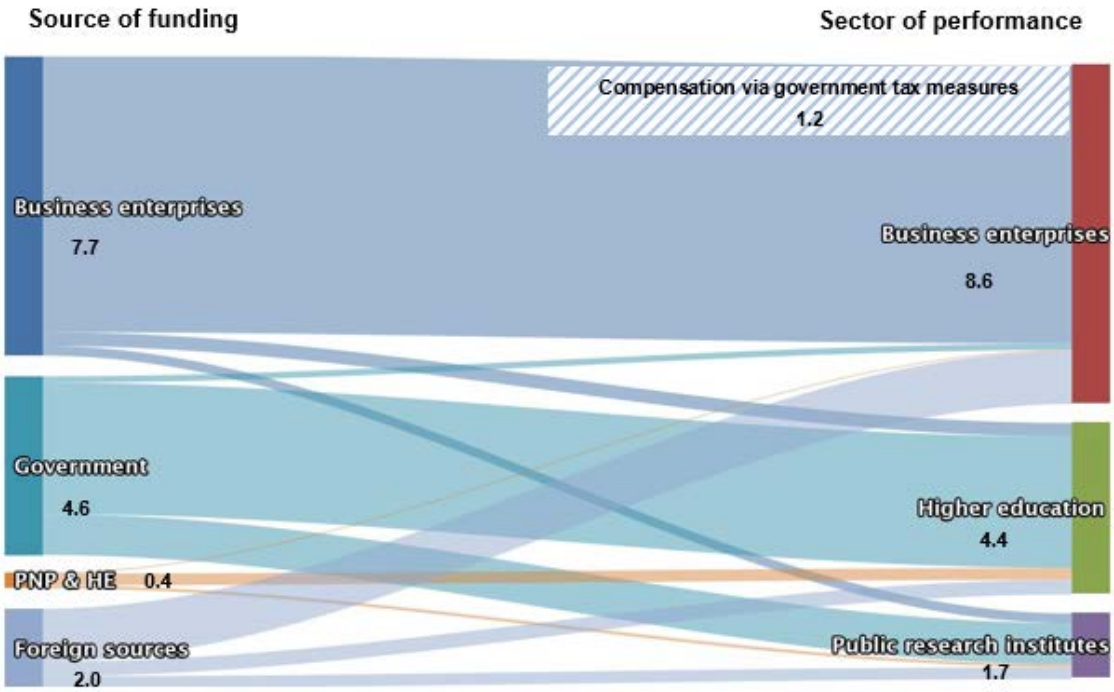
1.1. Total R&D expenditure

In 2017, € 14.7 billion was spent in total on R&D performed within the borders of the Netherlands (Statistics Netherlands, preliminary figures).[4] Businesses fund the most (€ 7.7 billion or 52 per cent), followed by government (€ 4.6 billion or 31 per cent). The remaining funds come from private non-profit organisations, from institutes of higher education and from abroad.

Businesses also perform the largest share of R&D, accounting for 59 per cent of research. Thirty per cent of research is performed by institutes of higher education. The rest is conducted by the Netherlands Organisation for Applied Scientific Research (TNO), the Netherlands Institute for Public Health and the Environment (RIVM), the National Forensic Institute (NFI), and other research institutes.

4 Indirect tax-related government support for R&D is already included in this figure because it concerns reduced tax charges for R&D expenditure that businesses have actually incurred. That expenditure is attributed to the businesses themselves. Tax-related support lowers tax revenues for government and reduces the cost of R&D for businesses.

Figure 1 R&D performed in the Netherlands, by funding source and sector of performance, 2017 (in billions of €)



Source: CBS StatLine. Adapted by the Rathenau Instituut.
Note 1: Under businesses, the shaded portion indicates that the businesses that perform their own R&D receive government tax relief compensating them for €1.2 billion of their R&D expenditure under the Dutch Research and Development (Promotion) Act (WBSO). Tax relief under the Environmental Investment Rebate (MIA) and the Arbitrary Depreciation of Environmental Investments (VAMIL) is aimed at innovation and not specifically at R&D activities, and is therefore not included in this figure (€ 139 million).
Note 2: We have combined funding by private non-profit organisations and institutes of higher education.

1.2. Expenditure on R&D and innovation by the national government

In this section we discuss total expenditure on R&D and innovation by the Dutch national government. We make use of other data than those provided by Statistics Netherlands, cited in the previous section. That is also the case for the rest of this section and Section 2. Every year, the Rathenau Instituut collects data on R&D and innovation expenditure from the Dutch Ministries for its TWIN report. Because these data are based on information provided by the funding source and not by the sector of performance (as is the case for Statistics Netherlands), small discrepancies may occur.

In addition, the TWIN data also include expenditure by Ministries on R&D undertaken abroad (in particular spending on international institutions such as the European Space Agency (ESA)). The Statistics Netherlands data focus on government expenditure of R&D undertaken in the Netherlands. As a result, the amounts differ slightly.

Table 1 summarises the Dutch national government's expenditure on R&D and innovation in the 2017-2023 period, in nominal amounts. Table 2 links these amounts to GDP, revealing the significance of this spending for the economy.

Of the total amount in state aid reserved for R&D and innovation in 2019, 81 per cent consists of direct R&D expenditure. This includes (see also Table 4):

- expenditure on university research through the first funding stream (the government block grant for universities, i.e. the general university funds or GUF) and through NWO;
- expenditure on research carried out by public research institutes;
- expenditure on contract research;
- expenditure on supporting R&D in the business sector.

Approximately 20 per cent of this direct R&D expenditure is innovation-relevant. Direct spending on innovation accounts for 5 per cent of the budget for R&D and innovation. Nearly 20 per cent is made up of indirect tax support. These percentages are fairly stable from year to year.

Trends in the 2017-2023 period vary from one category to the next:

- Direct expenditure on R&D increased by 12 per cent to € 5.6 billion in 2018 and is projected to decrease slightly after 2020 to € 5.5 billion in 2023 (-1.5 per cent).
- Direct expenditure on innovation is set to increase until 2019, but then drop below the 2017 level to 29 per cent. Because this is a small category, the relative changes are more significant.
- Indirect tax support fell slightly in 2018, but is forecast to rise again (+9 per cent).

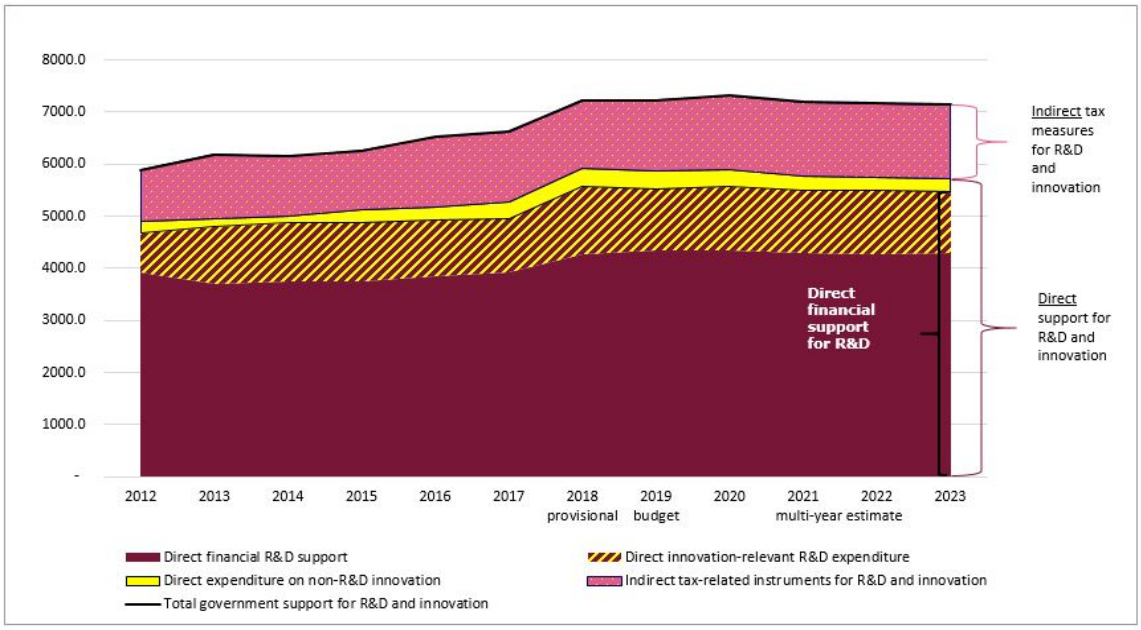
Table 1 Direct and indirect government financial support for R&D and innovation, 2017-2023 (in millions of €)

	2017	2018	2019	2020	2021	2022	2023
	Actual	Provisional	Budget	Multi-year estimate			
Direct expenditure on R&D	4,957.9	5,566.3	5,521.8	5,566.7	5,501.3	5,485.3	5,482.0
of which innovation-relevant	*1,042.5*	*1,303.2*	*1,180.8*	*1,211.7*	*1,209.0*	*1,210.5*	*1,194.2*
Direct expenditure on non-R&D innovation	326.4	351.6	352.4	318.3	264.5	255.5	232.1
Indirect tax-related support for R&D and innovation	*1,329.0*	*1,308.0*	*1,350.0*	*1,426.0*	*1,426.0*	*1,426.0*	*1,426.0*
Of which *- WBSO (R&D)*	*1,188.0*	*1,169.0*	*1,211.0*	*1,287.0*	*1,287.0*	*1,287.0*	*1,287.0*
- MIA/VAMIL (innovation)	*141.0*	*139.0*	*139.0*	*139.0*	*139.0*	*139.0*	*139.0*
Total	**6,613.4**	**7,225.8**	**7,224.3**	**7,311.0**	**7,191.8**	**7,166.8**	**7,140.1**

Source: TWIN report 2017-2023.
Note 1: As in previous years, tax-related support does not include the 'Innovation Box'. See the explanation on p. 19.
Note 2: The WBSO and the Research & Development Allowance (RDA) were merged in 2016, see section 2.3.
Note 3: The figure for the WBSO in 2019 does not include the € 32 million increase based on a motion attached to the tax plan; see the Parliamentary document *Invulling moties over Small Business Innovation Research (SBIR) en verhoging tweede schijf WBSO*, *Kamerstuk* 33009 no. 67, 21-12-2018. The total amount in tax credit will therefore come to € 1.24 billion in 2019 instead of € 1.21 billion. WBSO figures for 2020 and beyond include an additional € 76 million in tax credit, which has not yet been added to the budget.

Figure 2 shows trends in the various categories of government spending on R&D and innovation, as shown in Table 1, from 2012 onwards.

Figure 2 Government support for R&D and innovation, by category, 2012-2023 (in millions of €)



Source: TWIN budget reports 2014-2019
Note: The timeline starts in 2012 because that was the first year in which data on innovation expenditure were collected.

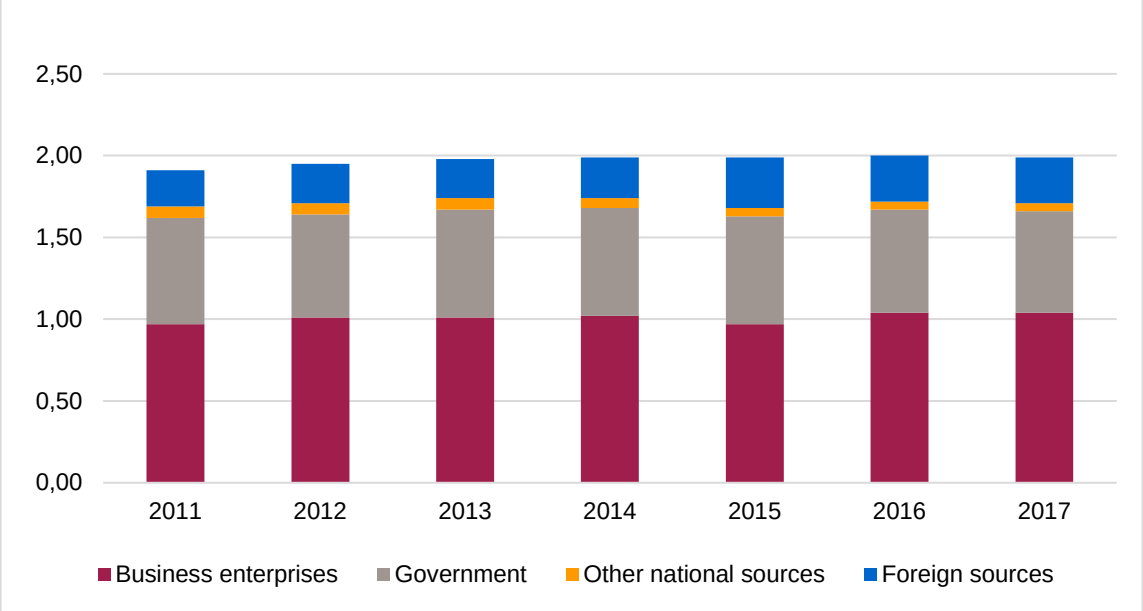
1.3. R&D expenditure from an economic perspective

As a member of the EU, the Netherlands has agreed to spend 2.5 per cent of its GDP on R&D by 2020. This refers to expenditure by the parties mentioned in the previous section – government, businesses, private non-profit organisations and foreign parties – in the Netherlands. Expenditure on non-R&D innovation is not included.

In 2017, the Netherlands spent 1.99 per cent of its GDP on R&D.[5] As Figure 3 shows, this has increased slightly in recent years, rising from 1.90 per cent in 2011 to 1.99 per cent in 2017.

5 CBS StatLine, provisional figure for 2017.

Figure 3 R&D expenditure in the Netherlands as percentage of GDP, by funding source



Source: CBS StatLine. Adapted by the Rathenau Instituut.
Note: PNP stands for private non-profit organisations, such as the health fundraising organisations.

To meet the target of 2.5 per cent by 2020, an additional investment will be needed. In the light of the most recent GDP trend forecasts, the required investment amounts to €5.6 billion on top of the €14.7 billion spent in 2017. Assuming a constant ratio of investments by government, the business enterprise sector and other sources (1: 1.7: 0.5), this means that government will have to invest an additional € 1.8 billion per year. Over and above the more than € 500 million extra annually compared with 2017 (including the R&D investments provided for in the Coalition Agreement), an additional € 1.3 billion net will be necessary from government. The business enterprise sector will need to invest an additional € 2.9 billion per year. Foreign sources would have to invest € 0.9 billion extra in R&D carried out in the Netherlands.

Based on the 2019 National Budget, however, we see that direct government expenditure on R&D as a percentage of GDP is in fact falling, from 0.67 per cent of GDP in 2017 to 0.65 per cent in 2023 (Table 2). As we will observe in the next section, the Dutch government's annual spending on R&D during this period will increase by 11 per cent compared with 2017 (€ 524 million), but that will not translate into a larger percentage of GDP because the economy is projected to grow even faster.

Table 2 Direct and indirect government financial support for R&D and innovation, 2017-2023 (in percentage of GDP)

	2017	2018	2019	2020	2021	2022	2023
	Actual	Provisional	Budget	Multi-year estimate			
Direct expenditure on R&D	0.67	0.72	0.69	0.69	0.67	0.66	0.65
Direct expenditure on innovation	0.04	0.05	0.04	0.04	0.03	0.03	0.03
Indirect tax-related support for R&D and innovation	0.18	0.17	0.17	0.18	0.17	0.17	0.17
Total government support for R&D and innovation	**0.90**	**0.94**	**0.90**	**0.90**	**0.88**	**0.86**	**0.85**
GDP (in € billions)	*737.0*	*771.0*	*800.1*	*812.1*	*821.8*	*830.1*	*838.4*

Source: TWIN report 2017-2023. GDP figures for 2017-2019 refer to the nominal figures from the CPB's March 2019 Central Economic Plan (CEP), key indicators. The volume growth rates in the CPB's March 2019 CEP have been used to calculate GDP from 2020 onwards.

2. Trends in government support for R&D and innovation

In this section, we survey trends in the national government's expenditure on R&D and innovation. Sections 2.1 and 2.2 discuss direct R&D expenditure by the various Ministries and its apportionment to research organisations. We then consider trends in tax-related support for R&D (section 2.3) and national government expenditure on innovation (section 2.4).

2.1. Direct expenditure on R&D, by Ministry

Total direct government spending on R&D rose between 2017 and 2018 from € 5.0 billion to € 5.6 billion. From 2019 it will dip to € 5.5 billion. Whereas the previous TWIN report showed spending rising by € 126 million (+3 per cent) across the entire period covered, the present report shows an increase of € 524 million (+11 per cent). The higher figure is due mainly to the extra investments provided for under the 2017 Coalition Agreement (rising to € 400 million in 2020), which were not included in the previous national budget.

Table 3 indicates direct R&D expenditure by Ministry. The Ministries are listed by size of their R&D expenditure in 2017. The table shows that the Ministry of Education, Culture and Science is the most important source of research funding in the Netherlands, accounting for 73 per cent of all R&D expenditure (2019); in 1999, that was 64 per cent. The Ministry of Economic Affairs and Climate Policy is next, accounting for 14 per cent in 2019.

Table 3 Direct R&D expenditure by Ministry (cash basis, in millions of €)

	2017	2018	2019	2020	2021	2022	2023	Difference: 2017-2023	
	Actual	Provisional	Budget	Multi-year estimate				x € m	%
Education, Culture & Science	3,701.9	3,940.1	4,039.2	4,063.4	4,045.3	4,052.4	4,075.7	373.7	10.1%
Economic Affairs	657.1	922.1	782.0	832.2	805.4	805.3	792.5	135.4	20.6%
Health, Welfare & Sport	230.2	270.6	299.4	275.3	257.8	240.2	234.2	4.0	7.9%
Agriculture, Nature & Food Quality	158.3	200.2	182.9	180.7	181.7	180.0	172.4	14.1	8.9%
Infrastructure & Environment	76.1	82.0	69.9	66.5	61.6	57.4	58.4	-17.7	-23.3%
Defence	54.8	67.1	70.2	72.3	72.3	72.3	72.3	17.6	32.1%
Foreign Affairs	39.0	39.6	33.4	32.1	32.1	32.0	32.0	-7.0	-17.8%
Justice & Security	21.9	22.1	22.0	21.6	21.7	21.7	21.7	-0.2	-0.7%
Social Affairs & Employment	10.8	11.4	13.4	12.9	12.7	12.7	12.7	1.9	17.7%
Interior & Kingdom Relations	7.4	10.3	8.8	9.0	10.2	10.6	9.6	2.2	30.1%
General Affairs	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.1	16.5%
Total	**4,957.9**	**5,566.3**	**5,521.8**	**5,566.7**	**5,501.3**	**5,485.3**	**5,482.0**	**524.1**	**10.6%**

Source: TWIN report 2017-2023
Note: Detailed figures on the national government's expenditure on R&D and Innovation (per budget line) can be found in the underlying data, which can be retrieved from: https://www.rathenau.nl/nl/vitale-kennisecosystemen/totale-investeringen-wetenschap-en-innovatie-twin-2017-2023 (page is in Dutch only)

Table 3 shows the impact of the additional investments provided for in the 2017 Coalition Agreement. Increased spending by the Ministries of Education, Culture and Science (+ € 374 million), Interior and Kingdom Relations (+ € 135 million) and Agriculture, Nature and Food Quality (+ € 14 million) can be attributed almost entirely to the additional investment in basic and applied research provided for in the Coalition

Agreement. The Ministry of Economic Affairs has stepped up its support for the TO2 institutes and increased the available budget for the PPP Allowance (see also Box 1 on the PPP Allowance) and the SME Top Sectors Innovation Support Scheme (MIT).

The sharp increase between 2017 and 2018 at the Ministry of Economic Affairs is mainly due to a one-off expenditure of € 117 million at the Energy Research Centre of the Netherlands (ECN) related to radioactive waste remediation (see 2019 budget for the Ministry of Economic Affairs, p. 20 and Table 4 on p. 13). The increase at Ministry of Agriculture, Nature and Food Quality is attributable to additional investments in Wageningen Research.

The spending hike at the Ministry of Education, Culture and Science can be attributed mainly to increasing spending on universities, universities of applied sciences and NWO funding.[6] In the case of the universities of applied sciences, the increase partly stems from the extra funding stipulated in the Coalition Agreement, whilst the Ministry had already decided to spend more on practice-oriented research at universities of applied sciences.

Table 3 also shows that, in addition to the investments specified in the 2017 Coalition Agreement, expenditure by the Ministry of Defence and the Ministry of the Interior rose by over 30% (i.e. by € 18 million and € 2 million respectively). Spending at the Ministry of Infrastructure and Water Management and the Ministry of Foreign Affairs clearly fell, by 23 per cent and 18 per cent respectively.

Most of the budget for R&D (67 per cent) is allocated through institutional funding, i.e. financial expenditure (1) for which institutions do not compete and (2) that is (usually) not based on direct project or programme selection.[7]

The share earmarked for project funding varies over time but has risen gradually from 23 per cent in 2005 to 33 per cent in 2019. It also differs considerably from one Ministry to the next, as can be seen in our online data publication on trends in Dutch government support for R&D by type of funding, available on the Rathenau Instituut's website.[8] A separate data publication shows the allocation of the government budget by various socio-economic objectives.

6 For the specific purposes of these investments, see Ministry of Education, Culture and Science, 09-03-2018, *Kamerbrief Uitwerking investeringen wetenschap en onderzoek*. Although some of the funds allocated to the sector-wide plans are still in the hands of NWO, they will eventually be transferred to the block grant meant for the universities.

7 Exceptions to the second criterion are ECN's, NLR's and TNO's programme subsidies.

8 https://www.rathenau.nl/en/science-figures/investments/how-much-does-netherlands-spend-rd/government-support-rd-netherlands

Box 1 PPP Allowance

The Ministry of Economic Affairs has reserved a budget line for the funds that Top Consortia for Knowledge and Innovation (TKIs) allocate to public-private partnership projects, known as the PPP Allowance. The allowance plays an important role in encouraging public-private partnerships within the context of the government's Top Sectors Policy.

In the 2013-2017 period, a total of more than 1,377 PPP Allowance projects were launched, involving almost 6,457 participants and representing a total of € 1.56 billion in budgeted project costs. PPP Allowance awards increased from € 27 million in 2013 to € 118 million in 2017. A further increase has been forecast for the coming years, rising to an annual € 172 million in 2023.

2.2. Trends by type of institution

Table 4 shows how direct R&D expenditure is distributed among the different types of institutions that perform R&D or that distribute grants, broken down by:

- institutes for higher education, research funded through the Netherlands Organisation for Scientific Research (NWO), the Netherlands Organisation for Health Research and Development (ZonMw) and the Royal Netherlands Academy of Arts and Sciences, and international research institutes;
- the TO2 institutes for applied research[9] (institutional funding only);
- other spending by the Ministries (both institutional and project funding).

Much of the research funded by government is carried out by institutes for higher education (research universities, university hospitals and universities of applied sciences), by institutes that receive funding through NWO, ZonMw and the Royal Academy, and at international research institutes funded by the Ministry of Education, Culture and Science (CERN, ESA, ESO, EMBL and EMBC). Most of the research performed by these organisations is basic in nature.[10]

9 Since 2010, TNO, Wageningen Research (formerly DLO) and the Large Technological Institutes (LTIs: Deltares, MARIN and NLR) have joined forces under the 'TO2 institutes' banner. The TO2 institutes focus on applying the results of basic research on behalf of government, business, industry and public institutions.

10 See https://www.rathenau.nl/en/science-figures/investments/how-much-does-netherlands-spend-rd/total-rd-netherlands-sector. 58 per cent of all research performed in the higher education sector and more than 25 per cent in the research institute sector (including the TO2 institutes) is basic research. It should be noted that the 'research universities' tend to focus on basic research, whereas the 'universities of applied sciences' concentrate more on practice-based research. 61 per cent of all research carried out by research institutes is applied research.

The TO2 institutes, on the other hand, tend to focus on applied research. That is also true of research expenditure by the other Ministries, which is mainly directed at policy-oriented research. They provide project and institutional funding destined for public knowledge organisations (PKOs) such as RIVM, NFI and the policy assessment agencies. Research supported by this funding is often used to prepare, assess and implement policy. For more information about the various types of research organisations and their missions, see the fact sheet on the Rathenau Instituut website explaining how the Dutch knowledge infrastructure is organised.[11]

The institutes of higher education, the international research institutes, the TO2 institutes and the Royal Academy carry out the research for which they receive the funding themselves. NWO disburses most of the funds it receives by issuing competitive calls for proposals intended to meet various objectives, for example to implement the Dutch National Research Agenda or to promote excellence in research (through the 'NWO Talent Scheme'). The research projects funded in this way are undertaken mainly at institutes of higher education (research universities, university hospitals and universities of applied sciences).[12] In 2019, 13 per cent of the research funding destined for NWO will be earmarked for its own institutes (€ 122 million). The remaining € 833 million will be distributed mainly through competitive calls for proposals.

11 See https://www.rathenau.nl/en/science-figures/policy-and-structure/infrastructure-knowledge/dutch-knowledge-infrastructure. More information about public knowledge organisations can be found at https://www.rathenau.nl/en/kennisgedreven-democratie/public-knowledge-organisations-netherlands

12 Approximately 90 per cent of the lead applicants for projects funded by NWO and ZonMw are either a university, a university hospital or a university of applied sciences. Since the amount of funding awarded varies from project to project, this does not necessarily mean that 90 per cent of the total funding sum goes to institutes of higher education. Funding for applied research that is channelled through the Taskforce for Applied Research (SIA) has been excluded from this calculation; almost all such funding goes to universities of applied sciences. Table 4 lists this funding under 'Universities of applied sciences, research funding'.

Table 4 Direct R&D expenditure by national government, by funding recipient, 2017-2023 (in millions of €)

	2017	2018	2019	2020	2021	2022	2023	Difference 2017-2023	
	Actual	Provisional	Budget	Multi-year estimate				Millions	%
-Research universities, research funding	2,693.9	2,742.8	2,772.5	2,798.3	2,785.6	2,792.9	2,816.2	122.3	4.5%
-Universities of applied sciences, research funding	103.3	126.2	130.3	135.3	135.4	135.4	135.4	32.2	31.1%
-NWO institutes	87.7	97.1	122.2	122.2	122.2	122.2	122.2	34.5	39.3%
-NWO, other	634.1	795.4	832.8	824.9	819.4	818.4	818.4	184.3	29.1%
-ZonMw	135.5	171.8	192.9	174.1	156.5	137.2	131.0	-4.5	-3.3%
-Royal Academy	68.1	68.8	68.7	68.7	68.9	69.0	69.0	0.9	1.3%
-International institutes, funding from Min. of Education, Culture & Science	95.8	91.9	91.9	91.9	91.9	91.9	91.9	-3.8	-4.1%
Subtotal	**3,818.4**	**4,094.0**	**4,211.3**	**4,215.6**	**4,179.9**	**4,167.1**	**4,184.2**	**365.8**	**9.6%**
-TNO, programme funding	181.7	231.9	214.4	234.5	227.0	227.0	227.0	45.3	24.9%
-LTIs,* programme funding	56.4	177.6 **	58.4	48.7	56.8	56.8	56.8	0.4	0.8%
-Wageningen Research, programme funding	142.9	183.1	162.6	161.8	161.6	161.1	158.4	15.6	10.9%
TO2 institutes, subtotal	**381.0**	**592.6**	**435.3**	**445.1**	**445.4**	**444.9**	**442.2**	**61.3**	**16.1%**
Other research expenditure	**758.6**	**879.7**	**875.3**	**906.1**	**876.0**	**873.3**	**855.6**	97.0	12.8%
Total	**4,957.9**	**5,566.3**	**5,521.8**	**5,566.7**	**5,501.3**	**5,485.3**	**5,482.0**	**524.1**	**10.6%**

Source: TWIN report 2017-2023
Note: The TWIN figures are clustered whenever amounts have clearly been allocated to a single organisation. This is not necessarily the only funding received by these organisations, however; they may also acquire funding through other budget appropriations (for project funding). Table 4 mainly concerns institutional funding through the general university funds (GUF) received by universities, but some of NWO's funding, for example, consists of project funding. 'Other research expenditure' by Ministries is a combination of institutional funding and project funding. The research funding allocated to the universities of applied sciences includes SIA funding, intended to support practice-based research projects, since such projects are carried out almost entirely by these institutions.
*LTI stands for Large Technological Institutes. These are NLR, ECN, MARIN and Deltares.
** The sharp increase in funding for the LTIs between 2017 and 2018 is mainly due to a one-off investment of € 117 million at the Energy Research Centre of the Netherlands (ECN) for radioactive waste remediation (see 2019 budget for the Ministry of Economic Affairs, p. 20 and Table 3).

Table 4 shows that research funding for almost every type of institution is on the rise. For institutes of higher education and NWO, the increase follows a trend to some extent, as expenditure has been rising steadily in these two categories since 2010. The annual increase in university research funding will rise from € 49 million in 2018 to € 122 million in 2023 (+5 per cent). In 2023, research funding destined for universities of applied sciences will be over € 32 million higher than in 2017 (+31 per cent). In the same period, the difference in the category 'Other NWO funding' will come to € 184 million. This increase is mainly due to the extra budget allocated to the Dutch National Research Agenda in the Coalition Agreement. In addition, this amount includes € 60 million earmarked for the sector-wide plans; this sum will be transferred to the first funding stream from 2019 onwards.[13]

One notable point is that, for the first time since 2010, spending on international institutions by the Ministry of Education, Culture and Science has fallen and will continue to fall (by 4 per cent) from 2018 onwards. This includes funding destined for such international research institutions as the European Space Agency (ESA) and the European Laboratory for Particle Physics (CERN).[14]

In the other two categories, the turning point marks a rise rather than a decline in funding. Whereas the previous TWIN publication recorded a decrease in (institutional) programme funding for the TO2 institutes, we now see an increase of € 61 million (+16 per cent). TNO is seeing the sharpest rise in programme funding, mainly because much of ECN was merged into TNO in April 2018.[15] After peaking in 2018 (the result of a one-off investment of € 117 million in ECN for research into radioactive waste remediation), programme funding for the TO2 institutes is declining steadily but remains well above 2017 levels. Even so, it is 7 per cent (€ 36 million) below the 2010 level. 'Other research expenditure' will increase by € 97 million (+13 per cent) between 2017 and 2023, mainly because the Ministry of Economic Affairs is investing more in applied and policy-

13 Source: Decision by the Minister for Education, Culture and Science of 10 January 2019, no. OWB/1456772, setting up the Science and Technology Sector-wide Plan Committee and the Social Sciences and Humanities Sector-wide Plan Committee (*Instellingsbesluit Commissie sectorplan Bèta en Techniek en de Commissie sectorplan Social Sciences and Humanities*). Decision of 22-02-2019: Internal rules, *Staatscourant 2019*, 9819.

14 The international scientific institutions to which the Netherlands contributes are the European Laboratory for Particle Physics (CERN), the European Space Agency (ESA), the European Southern Observatory (ESO), the European Molecular Biology Conference (EMBC) and the European Molecular Biology Laboratory (EMBL).

15 The merger concerned ECN's sustainable energy activities (ECN Sustainable). Its nuclear division, which had previously been grouped into its subsidiary Nuclear Research and Consultancy Group (NRG), will continue as a separate organisation. We will continue classifying the new venture's institutional funding under 'LTIs, programme funding'.

oriented research. Here too, however, projected expenditure shows a peak: after increasing to € 906 million in 2020, the category 'Other expenditure' is expected to drop back to € 855 million. That amount is nowhere near the € 1.1 billion spent in this category in 2010.

2.3. Tax-related support for R&D

In addition to direct forms of funding, government also supports R&D by means of tax measures. Their purpose is to promote innovation and economic growth by encouraging businesses to undertake R&D.

The Research and Development (Promotion) Act (WBSO) has been in effect in the Netherlands since 1994. Under the WBSO, businesses pay less tax on staffing costs associated with R&D. Another scheme, the Research & Development Allowance (RDA), was introduced in 2012 and allows for extra tax deductions on R&D investments and commercialisation. The two schemes were merged in 2016 into a single WBSO tax facility, which is offset against wage tax. The scheme is administered by the Netherlands Enterprise Agency (RVO). Only businesses that conduct research themselves can make use of the WBSO tax facility.

In this paragraph, we do not provide further details on environmental tax incentives, in which R&D plays only a limited role.[16] The tax advantage stemming from these schemes is also not included in international statistics concerning tax-related support for R&D.[17] We will discuss these schemes in the section below on innovation.

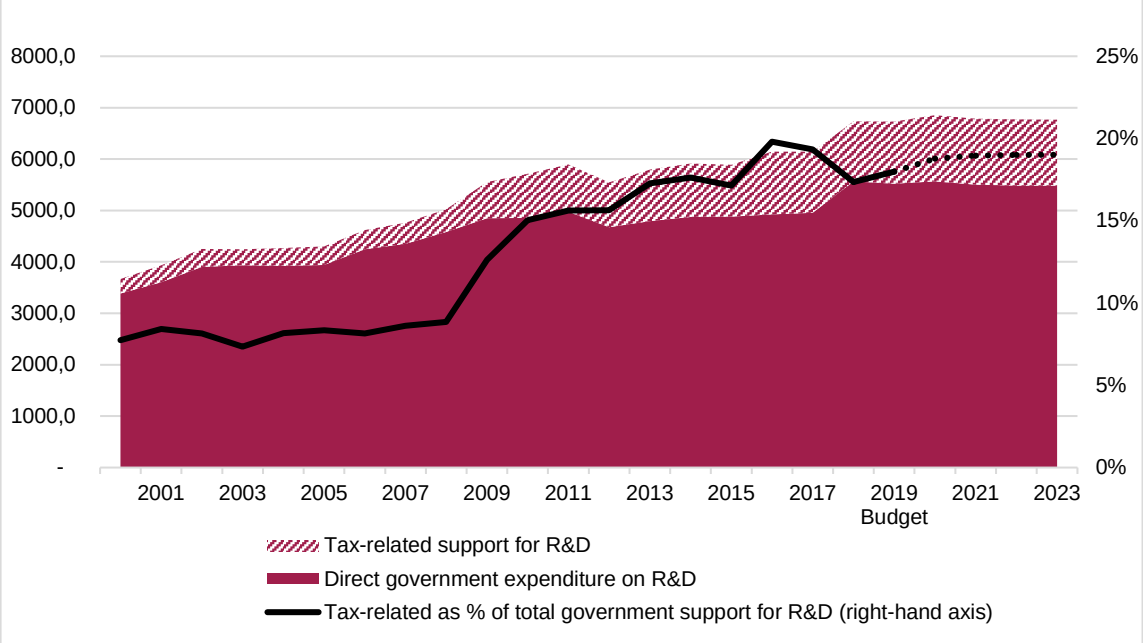
Tax-related support for R&D increased steeply between 2008 and 2019 from € 445 million to € 1.2 billion. According to multi-year estimates, tax-related support for R&D will stand at an annual € 1.29 billion from 2020 onwards.

Figure 4 shows a sharp increase in the share accounted for by tax-related support for R&D in total government R&D funding, from 8 per cent in 2008 to 20 per cent in 2016. This was followed by a small dip in 2018, mainly due to the stepping up of direct support for R&D. The share rises again in 2019 and multi-year estimates show it stabilises at around 19 per cent of total government expenditure on R&D.

16 These are the Environmental Investment Rebate (MIA) and the Arbitrary Depreciation of Environmental Investments (VAMIL). For 2019, the innovation component has been estimated at € 139 million.

17 http://www.oecd.org/sti/rd-tax-stats.htm

Figure 4 Trends in direct and indirect (tax-related) government support for R&D, 2000-2023 (in millions of €)



Source: TWIN data, Ministry of Economic Affairs
Note 1: The figures for 2020-2023 are multi-year estimates. They do not include the Environmental Investment Rebate (MIA) and the Arbitrary Depreciation of Environmental Investments (VAMIL), which are not explicitly intended to encourage R&D.
Note 2: The figure for the WBSO in 2019 does not include the € 32 million increase based on a motion attached to the tax plan (see *Kamerstuk* 33009 no. 67, 21-12-2018). WBSO figures for 2020 and beyond include an additional € 76 million in tax credit, which has not yet been added to the budget. Source: *Kamerstuk* 35 000. *Nota over de toestand van 's Rijks Financiën.* No. 72. https://zoek.officielebekendmakingen.nl/kst-35000-72.html.

As in previous years, tax-related support does not include the 'Innovation Box'. That is because the tax regime of the Innovation Box differs from that of the WBSO. The Innovation Box provides a lower tax rate on profits generated by past R&D or innovation activities, rather than the WSBO's tax benefit on R&D spending. It has been agreed in international statistics not to include 'patent boxes' such as the Innovation Box in R&D and innovation statistics.[18]

2.4. Trends in spending on innovation

This section looks in more detail at government support meant to encourage innovation. Table 5 shows the types of government support aimed at innovation and their share of total government spending on R&D and innovation.

18 For further details, see TWIN 2015-2021, p.11-12 and the OECD Frascati Manual 2015, p. 346. The Innovation Box is not a budgeted scheme; its future budgetary share and associated take-up are therefore unlimited. Between 2011 and 2017, the Innovation Box's budgetary share increased from € 625 million to € €1.6 billion. According to estimates, the budgetary share of the Innovation Box fell to € 1.5 billion before rising again to € 1.6 billion in 2019.

Table 5 Government support for innovation, including innovation-relevant R&D expenditure, 2017-2023 (in millions of €)

	2017	2018	2019	2020	2021	2022	2023	Difference 2017-2023	
	Actual	Provisional	Budget	Multi-year estimate				x € m	%
Direct innovation-relevant R&D expenditure	1,042.5	1,303.2	1,180.8	1,211.7	1,209.0	1,210.5	1,194.2	151.70	14.6%
Direct expenditure on non-R&D innovation	326.4	351.6	352.4	318.3	264.5	255.5	232.1	-94.30	-28.9%
Tax-related instruments for R&D and innovation	1,329.0	1,308.0	1,350.0	1,426.0	1,426.0	1,426.0	1,426.0	97.00	7.3%
of which - WBSO (R&D)	*1,188.0*	*1,169.0*	*1,211,0*	*1,287.0*	*1,287.0*	*1,287.0*	*1,287.0*	*99.00*	*8.3%*
- MIA/VAMIL (innovation only)	*141.0*	*139.0*	*139.0*	*139.0*	*139.0*	*139.0*	*139.0*	*-2.00*	*-1.4%*
Total government support for innovation	**2,697.9**	**2,962.8**	**2,883.3**	**2,956.1**	**2,899.5**	**2,892.0**	**2,852.3**	**154.40**	**5.7%**
As % of total spending on R&D and innovation	***40.8***	***41.0***	***39.9***	***40.4***	***40.3***	***40.4***	***39.9***		

Source: TWIN report 2017-2023
Note: The figure for the WBSO in 2019 does not include the € 32 million increase based on a motion attached to the tax plan (see Parliamentary document on Implementation of motions on Small Business Innovation Research (SBIR) and increase in second WBSO bracket, *Kamerstuk* 33009 no. 67, 21-12-2018. The total amount in tax credit will therefore come to € 1.24 billion in 2019 instead of € 1.21 billion. WBSO figures for 2020 and beyond include an additional € 76 million in tax credit.

Government support for innovation accounts for about 40 per cent of all direct and indirect government support for R&D and innovation. Half of this amount consists of tax instruments. This is the first TWIN publication to include the tax instruments used by the Ministry of Infrastructure and Water Management to promote sustainable innovation. The Ministry of Economic Affairs and Climate Policy funds the lion's share of innovation activities, i.e. 71 per cent of total government support for innovation (2019). The Ministry of Education, Culture and Science accounts for 14 per cent and the Ministry of Infrastructure and Water Management for 8 per cent. While there has been a rise in innovation-related R&D expenditure and tax instruments supporting innovation, after 2019 direct government expenditure on (non-R&D) innovation will fall far below the 2017 level.

3. EU and regional funding

In addition to the Dutch national government, regional and international authorities also fund R&D and innovation in the Netherlands. To sketch an accurate picture of public investment in R&D and innovation in the Netherlands, it is important to consider these expenditures as well.[19] For example, the European Union is becoming increasingly important as a source of funding for research performed in the Netherlands. It offers support primarily through its Framework Programmes, in which the Netherlands competes favourably with other countries. Provincial authorities, EU funds, regional economic development agencies (REDAs), local authorities and several new semi-public organisations are responsible for regional funding of research and innovation.

3.1. EU funding at national level: Horizon 2020

The European Union funds R&D and innovation through its Framework Programmes (FP). The current Framework Programme, Horizon 2020, is the eighth one; it began in 2014, will run until 2020 and has a total budget of almost € 80 billion.[20] Of this amount, more than € 40 billion has been allocated to projects so far.[21]

To date, researchers affiliated with Dutch knowledge and research institutions and business enterprises have received 7.7 per cent of the available Horizon 2020 funding. Table 6 shows that Dutch researchers have been very successful in Horizon 2020. Only five other countries have received a larger share of the funding granted.

The Netherlands' rate of return in Horizon 2020 is approximately one and a half times its investment (the Netherlands covers 5.2 per cent of the total EU budget). The acceptance rate for Dutch applicants is above average at 16 per cent, compared with 13.7 per cent on average for the EU-28.

19 The OECD's *Frascati Manual*, the basis for R&D data collection in EU and OECD countries, also recommends that, where significant, funds provided by the provinces should be included in data sets on government budgets.

20 European Commission, Factsheet: Horizon 2020 budget. http://ec.europa.eu/research/horizon2020/pdf/press/fact_sheet_on_horizon2020_budget.pdf. These are current prices, i.e. the final budget adjusted for inflation. The original budget topped € 70 billion.

21 Horizon 2020 Dashboard: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard

Table 6 Funding awarded under Horizon 2020, as percentage of total allocations and contribution to overall EU budget

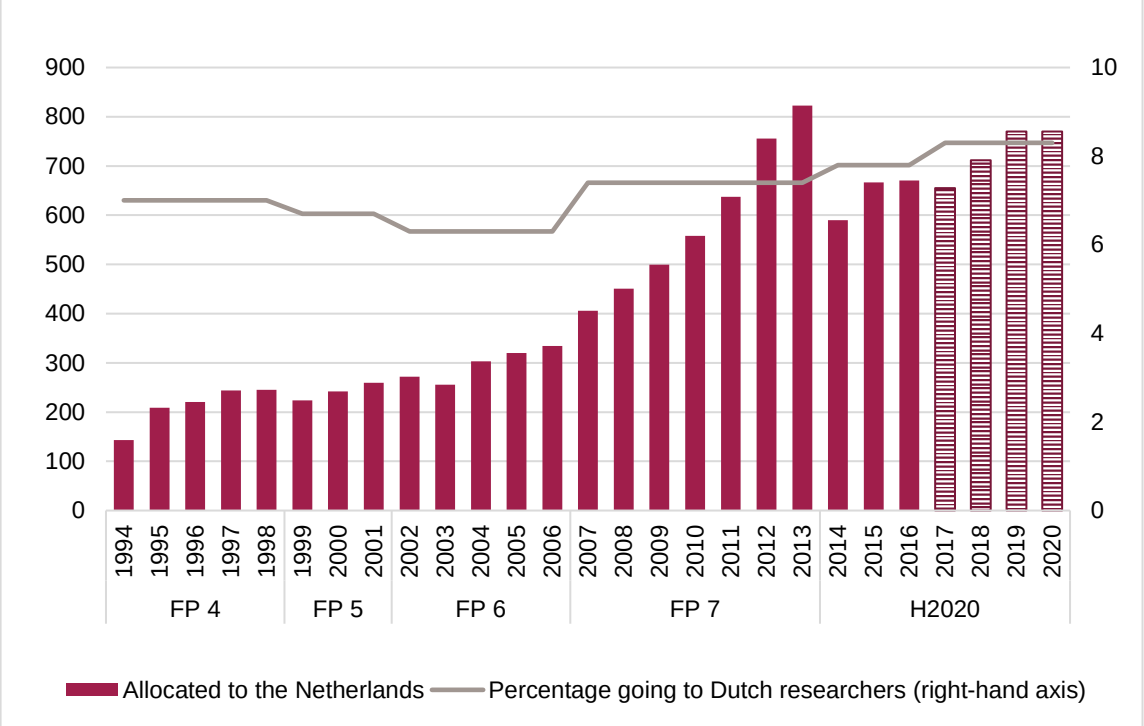
Country	Allocated under Horizon 2020 (€ millions)	% of total	% of contribution to EU budget (2014-2017)	Rate of return	Acceptance rate
Germany	6,231.1	15.8	20.5	0.77	15.1
United Kingdom	5,403.8	13.7	12.7	1.08	14.6
France	4,288.9	10.9	15.8	0.69	15.5
Spain	3,565.3	9.1	8.2	1.10	12.9
Italy	3,271.2	8.3	12.0	0.69	11.5
Netherlands	3,029.0	7.7	5.2	1.48	16.0
Belgium	1,865.5	4.7	4.2	1.13	17.4
Sweden	1,377.9	3.5	2.8	1.24	14.9
Austria	1,110.2	2.8	2.2	1.27	16.5
Denmark	988.8	2.5	1.9	1.32	15.3

Source: Horizon 2020 Dashboard (reference date 13 March 2019), for all data except contribution to the EU budget 2014-2017: European Commission, EU expenditure and revenue tables 2014-2020.
Note 1: As we have no information available on each country's actual contribution to the Horizon 2020 budget, we have assumed that it is comparable to the share that each one contributes to the EU budget.
Note 2: Only EU-28 countries have been included in the top 10. At 2.8 per cent, Switzerland receives a higher percentage of Horizon 2020 funding than Denmark but is not listed because it is not an EU Member State. As an Associated Country, however, Switzerland has full access to Horizon 2020.
Note 3: The Horizon 2020 figures refer exclusively to revenue generated under the Work Programme. Part of the Horizon 2020 budget is appropriated for other purposes (such as different forms of public-private and public-public partnerships and the European Institute of Technology (EIT)), which are not included here.

The EU is a growing and increasingly important source of research funding. If we add up direct government support for R&D and EU funding, we see that EU funding accounted for 9 per cent of the total sum during the 7th Framework Programme and that its share has since risen to 11 per cent under Horizon 2020. Dutch researchers are now getting as much funding in the form of ERC Grants as they are getting from the NWO Talent Scheme. The Rathenau Instituut's website provides more information on Dutch participation in the EU Framework Programmes.[22]

22 See: https://www.rathenau.nl/en/science-figures/investments/european-funds

Figure 5 Trends in funding allocated to Dutch researchers from EU Framework Programmes (in millions of €)



Source: 1994-2013: Europese Commission, *Development of Community research-commitments (total expenditure on Framework Programmes (FP)).* Evaluations of 5th and 6th FP by Senter (2003) and SenterNovem (2006). 2014-2016: Interim evaluation of Horizon 2020. 2017-2018: Horizon 2020 Dashboard (2018 is provisional). 2018-2020: European Commission, *Fact Sheet: Horizon 2020 Work Programme from 2018 to 2020*.
Note: The Horizon 2020 figures refer exclusively to revenue generated under the Work Programme. Part of the Horizon 2020 budget is appropriated for other purposes (such as different forms of public-private and public-public partnerships and the European Institute of Technology (EIT)), which are not included here.

So far, Dutch researchers have secured more than € 3 billion in Horizon 2020 funding, approximately € 600 to € 700 million annually. The 9th Framework Programme (Horizon Europe) will run from 2021 to 2027 and the European Commission has proposed a budget of € 94.1 billion, even larger than the existing one.[23] If the Netherlands remains as successful as it has been, annual revenue from the next Framework Programme could increase to € 800 million.

For Dutch researchers to be able to take advantage of the larger FP9 budget, adequate supporting public and institutional policies are required. One example would be to introduce measures aimed at reducing the pressure on universities, as the main recipients of Horizon 2020 funding.[24] Such pressure takes the form of heavy

23 Europese Commission (2018). *EU Budget for the future Horizon Europe.* 7 June 2018.
24 Universities are the recipients of approximately 50 per cent of all Horizon 2020 funds awarded to the Netherlands. Source: Horizon 2020 Dashboard: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard

workloads,[25] rising student numbers,[26] a significant proportion of temporary staff[27] and major fundraising and matching costs for project research.[28]

3.2. EU regional funds

In addition to the Framework Programmes, the European Regional Development Fund (ERDF) is an important source of revenue for R&D and innovation. Like Horizon 2020, the current ERDF programme began in 2014 and will continue until 2020. The ERDF is a structural fund that aims to strengthen economic and social cohesion in the European Union. Incentivising research and innovation is an important part of the programme. The ERDF accounts for about a third of total regional expenditure on research and innovation in the Netherlands. It consists of two types of programme:

1. The regional programmes, distributed between the northern, eastern, southern and western regions of the Netherlands.
2. European Territorial Cooperation or INTERREG, for cross-border (INTERREG A), transnational (INTERREG B), and interregional and intraregional (INTERREG C) cooperation.

Under the regional programmes, a budget of € 510 million is available to the Netherlands in the 2014-2020 programme period, with € 454 million being earmarked for research and innovation. That brings the ERDF budget for R&D and innovation to an annual average of € 65 million.[29] A project can only qualify for funding if it is receiving at least 50 per cent of its budget through public or private national co-financing. Research and innovation funding is concentrated mainly in the priority areas ‘research and innovation’ and ‘low-carbon economy’. Table 7 shows that by the end of 2017, almost half of the regional ERDF budgets (excluding co-financing) reserved for research and innovation had been allocated.[30]

25 See: https://www.scienceguide.nl/wp-content/uploads/2018/02/onderzoekwerkdrukuniversiteiten.pdf
26 See: https://www.rathenau.nl/nl/wetenschap-cijfers/geld/inkomsten-uitgaven-van-universiteiten-en-hogescholen/inkomsten-en (available in Dutch only)
27 See: https://www.rathenau.nl/en/science-figures/personnel/university-staff/university-personnel-function-category-and-temporary
28 See: https://www.rathenau.nl/nl/wetenschap-cijfers/geld/inkomsten-uitgaven-van-universiteiten-en-hogescholen/het-onderzoek-aan (available in Dutch only)
29 Comparable to the research and innovation component of ERDF 2007-2013, which amounted to € 62 million.
30 Table 8 shows co-financing covered by provincial budgets. Co-financing by the national government falls under the budget of the Ministry of Economic Affairs, shown in Table 3.

Table 7 ERDF budget for regional programmes for research and innovation in the Netherlands (budget and allocations, in millions of €)

	Research and Innovation		**Low-carbon economy**		**Total ERDF for priorities related to research and innovation**		
	Budget 2014-2020	Allocated by year-end 2017	Budget 2014-2020	Allocated by year-end 2017	Budget 2014-2020	Allocated by year-end 2017	% Allocated
North	78.7	32.3	20.7	9.3	99.4	41.6	42%
East	66.0	34.2	30.0	13.5	96.0	47.7	50%
South	75.0	42.0	34.1	18.3	109.1	60.3	55%
West	113.0	54.8	36.0	6.2	149.0	61.0	41%
Total	**332.7**	**163.2**	**120.8**	**47.3**	**453.5**	**210.5**	**46%**

Source: Regional operational programmes for 2014-2020 and RVO.nl
Note: The table does not include budgets for priorities that have no direct relationship to research and innovation. The amounts shown under the priority headings therefore do not add up to the total ERDF amount made available by the EU.

INTERREG also began in 2014 and will run until 2020. The Netherlands will receive a total of € 390 million in this period, 94 per cent of which will go to project implementation. Estimates show that approximately € 30 million of this amount is destined for Dutch 'research and innovation' projects each year.[31] In early 2019, 89 per cent of the available budget for research and innovation under INTERRG A had been allocated to projects.[32] Of the innovation-related priorities under INTERREG B and C, three quarters of the budget had been allocated to projects by the end of 2018. [33] A breakdown of the allocations by participating countries is expected at the end of the programme period.

3.3. Provincial resources

Regional parties – provincial authorities, REDAs, and other regional and municipal organisations – also spend money on R&D and innovation. Some of the regional resources are used as ERDF co-financing (see section 3.2). Because the regional landscape is complex, with overlapping funding streams, it is difficult to obtain a complete, clear-cut picture of regional investment (see TWIN 2014-2020, p. 21).[34]

31 *Factsheet grensoverschrijdende samenwerkingsprogramma's* (Ministry of Economic Affairs and Climate Policy) and *overzicht INTERREG B en C* (31-12-2016).
32 Source: *Interreg A Stand van zaken budget januari 2019* (Ministry of Economic Affairs and Climate Policy), calculations by the Rathenau Instituut.
33 Rvo.nl
34 A. Vennekens and J. van Steen (2016). *Totale investeringen in wetenschap en innovatie (TWIN) 2014-2020.* Den Haag, Rathenau Instituut. https://www.rathenau.nl/nl/digitale-samenleving/totale-investeringen-wetenschap-en-innovatie-2014-2020 (available in Dutch only)

In this section, we examine provincial resources for knowledge and innovation. Because the financial basis and system underpinning the regional figures differ from those for the national budgets, it is not possible to simply add up the figures presented in this section and the figures provided in sections 3.1 and 3.2. Table 8 presents the regional figures. It should be noted that they only concern public funds for research and innovation recorded in the provinces' own budgets and that the provinces are authorised to spend. These are funds drawn from the general provincial budget, the provinces' own resources and decentralised targeted grants.[35]

Table 8 Provincial expenditure on research and innovation (in millions of €)

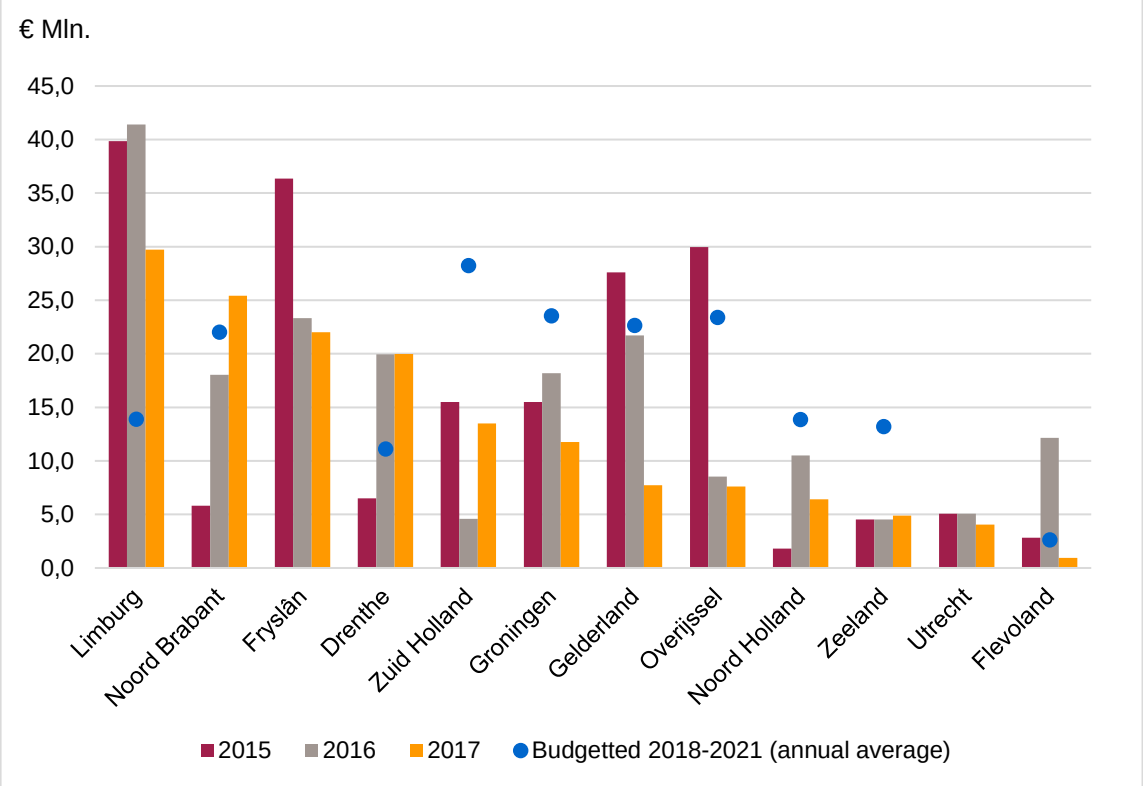
Province	**2017**						**2018-2021**
	Schemes	Projects	REDAs	Innovation Funds	Other	Total committed in 2017	Budgeted
Limburg	3.7	14.5	1.7	6.7	3.1	**29.7**	55.5
N-Brabant**	4.2	7.1	6.7	-	7.4	**25.4**	88.1
Fryslân	1.5	19.0	-	1.5	-	**22.0**	nnb
Drenthe	4.8	0.4	0.3	-	14.5	**20.0**	44.4
Z-Holland	13.5	-	-	-	-	**13.5**	112.9
Groningen	5.1	5.0	0.5	1.2	-	**11.8**	*70.6
Gelderland	5.0	-	2.7	-	-	**7.7**	*60.8
Overijssel	7.6	-	-	-	-	**7.6**	*46.8
N-Holland***	5.4	-	-	1.0	-	**6.4**	55.4
Zeeland	3.8	-	1.1	-	-	**4.9**	*26.4
Utrecht	3.8	0.3	-	-	-	**4.1**	unknown
Flevoland	0.1	-	0.9	-	-	**1.0**	10.5
Totaal	**58.5**	**46.4**	**13.8**	**10.4**	**25.0**	**154.0**	**571.4**

Source: TWIN survey of provinces 2017-2021.
* Data covering 2020 and 2021 are missing or incomplete.
** Data on Noord-Brabant are the same as in the previous TWIN report, as they were already based on 2017.
*** Noord-Holland: schemes in 2017 include provincial co-financing under the rural development programme (POP3).

35 Does not include projected public or private co-financing where the funds are budgeted to other organisations (management authorities, national, EU, municipal or private). The figures do include projected co-financing by the province itself for schemes and projects under regional or INTERREG programmes.

Figure 6 shows trends over the 2015-2017 period and planned investments for the 2018-2021 period. Most of the provinces are stepping up their research and innovation budgets for the coming period compared with 2017. Exceptions are Limburg, Noord-Brabant and Drenthe, which already spent more on research and innovation in 2017 than the other provinces.[36] There are major differences between provinces.

Figure 6 Provincial expenditure on research and innovation 2015-2017 and 2018-2021 budget (in millions of €, per annum)



Source: TWIN reports on provinces 2015, 2016 and 2017-2021.
Note: Annual budget based on information covering 2018-2019 for: Gelderland, Overijssel and Zeeland. Annual average based on information covering 2018-2020 for: Groningen. No data available on 2018-2021 budget for Utrecht and Fryslân. Listed in order of actual expenditure in 2017.

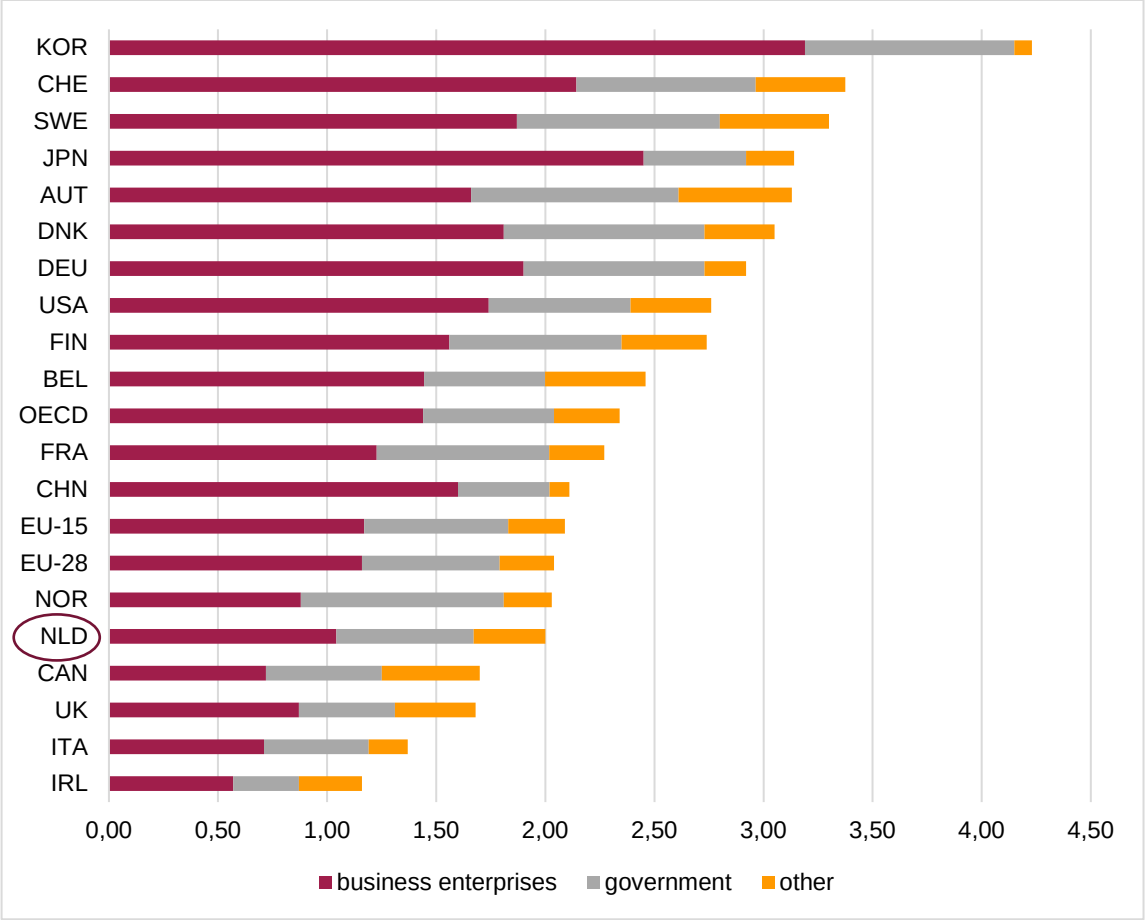
4. Dutch R&D expenditure from an international perspective

Figure 7 compares R&D expenditure in the Netherlands with that of other countries. We see that R&D intensity in the Netherlands is 0.35 percentage points below the OECD average and slightly lower than the EU-15 and EU-28 averages. R&D expenditure by the Dutch government is somewhat higher than the OECD average and virtually equal to the EU-28 average. But it falls short of government spending in the EU-15 and in several countries that serve as reference countries for the Netherlands, such as Germany, Switzerland and the Scandinavian countries. R&D financing by the Dutch business enterprise sector falls short of the EU-15, EU-28, and OECD averages as well as corporate R&D spending in most of the reference countries. More information is

36 There are no data available for the provinces of Utrecht and Friesland concerning the multi-year budget for 2018 and beyond.

available in our fact sheets and data publications on Dutch R&D investments compared internationally. [37]

Figure 7 International comparison of R&D expenditure as a percentage of GDP, by funding source (2016)



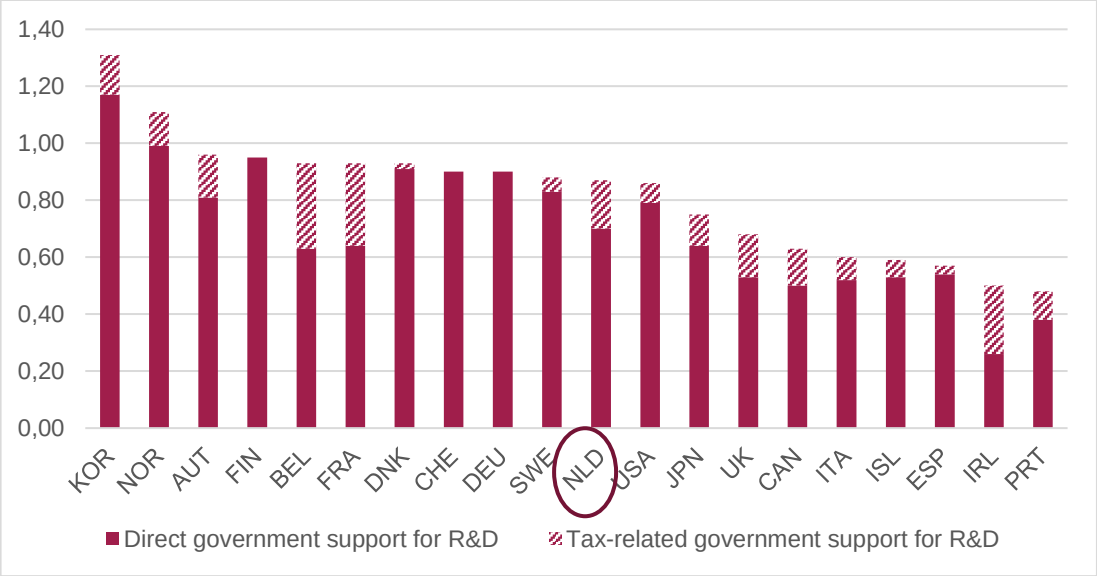
Source: OECD, MSTI database, 2016 data. EU-28: Eurostat
Note 1: Sweden: 2013. France, Belgium, Switzerland, Denmark and EU-15: 2015.
Note 2: Based on data provided by organisations that perform R&D.
Note 3: The 'Other' category consists of other national sources and foreign financing (business enterprises, EU and other organisations).

In addition to direct spending on R&D, government also offers indirect tax-related support. We show this in Figure 8. Compared with other countries, the Dutch government makes a relatively large proportion of R&D funding available in the form of tax instruments, i.e. 19.5 per cent. The Netherlands spends 0.17 per cent of GDP on tax-related support for R&D. Only Belgium, France and Ireland spend a higher percentage of their GDP in this way (0.30, 0.29 and 0.24 per cent respectively). Finland, Switzerland and Germany offer no tax-related government support for R&D. If we

37 https://www.rathenau.nl/en/science-figures/investments/international-perspective-rd-investments

consider overall government support for R&D in business enterprises, we see that 89 per cent of such support in the Netherlands consists of tax instruments.[38]

Figure 8 Direct and tax-related government support for R&D as percentage of GDP, 2016



Source: EUROSTAT (direct government support); OECD (tax-related government support)
Note: United States: 2013, Iceland and Sweden: 2014, Finland, France and the United Kingdom: 2015.

38 See: https://www.rathenau.nl/en/science-figures/investments/international-perspective-rd-investments/government-support-rd-gdp

Appendix: Methodology

Data collection at the Ministries

The Rathenau Institute collects data from the Dutch Ministries every year for its TWIN publication. We do this by sending the Ministries a questionnaire surveying the following categories of government expenditure:

1. institutional funding of R&D (fixed amounts allocated to institutes), with the Ministries being asked to indicate the innovation-relevant portion;
2. project funding of R&D (both projects and programmes), with the Ministries being asked to indicate the innovation-relevant portion;
3. other expenditure on non-R&D innovation;
4. tax schemes involving both R&D and innovation.

The questionnaire also asks where the expenditure ends up (insofar as possible) and the purpose of the expenditure (based on a classification of government objectives). It also asks what proportion of the budget item concerns R&D and/or innovation.

The Rathenau Instituut collects these data based on international agreements governing the definition and scope of the term 'R&D' as set out in the OECD's *Frascati Manual*.[39] Use of this manual is a long-standing practice, and in the course of time the Ministries have accumulated considerable experience and expertise in drawing up their data reports on R&D. As a result, we are able to present robust and internationally comparable data on the national government's R&D expenditure.

So far, no such agreements have been reached or expertise accrued with respect to government budgets for innovation. We therefore make use of the OECD terminology for collecting innovation data in the business enterprise sector. It is difficult to apply this terminology in practice, however, because the definitions are general in nature but must be applied to specific government budget lines. That means that the national government's data set on expenditure on non-R&D innovation is still 'under construction', as it were. Caution should be exercised when interpreting these data. There are no comparable examples of data sets abroad.

The data set concerning regional funding, which focuses more on innovation than on research, starts with the 2014 budget. Once again, this is a data set 'under construction', and some caution is advised when interpreting these data. It is difficult to say how an improved data set will impact the overall picture.

39 The first version of this manual dates from 1964. The most recent, 7th edition of the *Frascati Manual* was published on 8 October 2015.

Data set on R&D and innovation: international agreements and principles

The collection of data on R&D and innovation is subject to international agreements. The two most important principles unpinning the R&D and innovation data set are the following:

a) It must (in accordance with a EUROSTAT Regulation concerning the provision of data on government R&D expenditure) remain possible to distinguish between R&D expenditure on the one hand and non-R&D innovation expenditure on the other;
b) The definition of innovation expenditure must match the existing, internationally accepted definitions as closely as possible (the same goes for the definition of R&D expenditure).

We defined the term 'innovation' for the first time in the TWIN report for 2012-2018, using the nomenclature applied by the OECD in its *Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation*.[40] We will be cooperating with the Ministries to refine the way in which we apply the term 'innovation' to budget appropriations in the years ahead.

We define government budgets for innovation as expenditure directed at funding activities (scientific, technological, organisational, commercial) that focus primarily on innovation and are intended to generate innovation in both the private and public sectors, leading to the introduction of:

- new or vastly improved products
- new or vastly improved processes/methods
- new or vastly improved services
- administrative, organisational or marketing innovation.

To ensure that the scope of this definition remains manageable, certain constraints have been imposed on the collection of innovation-related budget data. The data must concern specified government initiatives, measures or interventions that a) have innovation in the relevant government sector as their target (enhancing Dutch innovativeness); b) have innovation as a means to an end, for example to achieve a specific policy objective; c) combine a) and b).

The first and third situation apply mainly to expenditure by the Ministry of Economic Affairs. The second situation tends to apply to expenditure by the various 'specialist' Ministries. The definition excludes any expenditure that is not clearly related to generating innovation or that will only contribute to innovation in the longer term. Examples include expenditure on education and the first funding stream, which goes directly to the universities.

40 The *Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation* was recently updated. The new edition was published in October 2018; see http://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm

Definitions

Below, we define the key terms used in this publication: research & development (R&D), scientific research, science, and innovation. We adhere as much as possible to the terminology applied by Statistics Netherlands and derived from international agreements on nomenclature, such as those laid down in the OECD's *Frascati Manual* (for R&D) and its *Oslo Manual* (for innovation). The most recent *Frascati Manual* dates from 2015 and an updated edition of the *Oslo Manual* was published in 2018.

R&D is used as a collective term in the Frascati Manual for three types of activity:

- Basic research. This consists of experimental or theoretical work undertaken primarily to acquire new knowledge, without any particular application or use in view.
- Applied research. This is also original investigation undertaken to acquire new knowledge, but directed primarily towards a specific practical aim or objective.
- Experimental development. This is systematic work, drawing on existing knowledge gained from research or practical experience, which is directed towards producing new materials, products or devices or towards improving those already produced.

Science encompasses objective human knowledge that has been systematically acquired (through scientific research) and organised, the process of knowledge acquisition, and the community in which this knowledge is acquired. That scientific community has its own set of principles, methods and conventions on which it bases its research.

Scientific research consists of the activities of the scientific community. It is mainly associated with basic research but the definition also covers applied research. Basic research is conducted in the higher education sector, at non-academic research institutes and, to a lesser extent, at research organisations and businesses. In addition, universities also undertake applied research and experimental development, albeit to a lesser extent. Conversely, businesses and research institutes also carry out basic research.

Innovation consists of activities that (should or is intended to) lead to new or vastly improved products, processes and services, or to administrative, organisational innovation within organisations or broader social alliances. R&D may be part of an innovative activity and is then referred to as innovation-relevant R&D. Examples of innovative activities that cannot be classified as R&D include the purchasing of products (e.g. software or equipment) or external expertise and activities such as industrial design. Innovation can thus be based on R&D activities but it can also take other forms.

All things considered, it is not always possible to draw a strict distinction between R&D activities and innovation. That distinction depends in part on the purpose of the activity or whether an R&D activity can be called innovation-relevant.

Method used for research expenditure in higher education

Universities receive their annual block grant or GUF from the Ministry of Education, Culture and Science. The GUF is meant to support both research and teaching. The Rathenau Instituut uses an R&D coefficient to calculate how much of the GUF is used to finance research activities. Statistics Netherlands calculates this coefficient based on data concerning staff research capacity at universities, i.e. the percentage of time that university staff spend on research.[41] There is no coefficient to determine the research capacity at universities of applied sciences. We therefore use two identifiable budget items in the Ministry of Education, Culture and Science's budget that specifically target applied research.

The university R&D coefficient differs from year to year. To avoid excessive fluctuations in TWIN data concerning the first funding stream for universities, the Rathenau Instituut has based the amounts for that funding stream on a three-year average. This means that the coefficient used for the 2017-2023 period is based on the average for 2015, 2016 and 2017. The coefficient was 0.62 in 2015, 0.57 in 2016 and 0.58 in 2017, bringing the three-year average for this TWIN period to 0.59. The coefficient, which is based on data regarding actual research capacity, is also applied to budgeted and multi-year figures, in accordance with the *Frascati Manual*.

One development that could impact the R&D coefficient is the student loan system. It is the government's intention to use all the funds freed up by replacing the basic student grant with a loan system to improve the quality of education. [42] That is why these funds have not been taken into account in our calculations concerning research funding in the 2018-2023 budget years. It is possible to exclude them because they are 'new budget appropriations' for education that are not yet included in the actual research performance figures.[43] They amounted to € 77.1 million in 2018 and will rise to € 208.8 million in 2023. As soon as we report on 2018 actual expenditure, we will no longer be able to separate out the funds freed up by the student loan system. From then on, any changes in actual research capacity due to the loan system will be reflected in the R&D coefficient.

Refining the R&D coefficient

The Rathenau Instituut is working with Statistics Netherlands and the Association of Universities in the Netherlands (VSNU) to refine the R&D coefficient. To obtain a reliable R&D coefficient, it is important that the universities' data on staff numbers and research capacity are as comparable and consistent as possible across the universities and over time. The data should preferably be verified from time to time with a time-use survey. The parties concerned are consulting about these aspects.

41 For a more detailed description of this calculation method, see: J. van Steen, 2013, *Totale Onderzoek Financiering 2011-2017*, p. 12.

42 See the 2018 Budget of the Ministry of Education, Culture and Science.

43 For more details, see Vennekens, A. and J. van Steen, 2017. *Totale investeringen in wetenschap en innovatie (TWIN) 2015-2021*. Den Haag: Rathenau Instituut.

Starting in 2008, we have been able to collect data on the universities' research capacity by job category. Having access to data on job category has allowed us to refine the method used to calculate the R&D coefficient. Statistics Netherlands and the Rathenau Instituut are discussing the practical feasibility and implications of this. An initial overall assessment reveals that, using the current data, a refinement based on job category will produce a slightly smaller R&D coefficient. This would mean that the proportion of the GUF used by universities to fund research activities would be smaller by several per cent. This refinement was not yet available for application in this edition of the TWIN report.

Authors
Alexandra Vennekens, Lionne Koens and Jos de Jonge

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Rathenau Instituut
2509 CJ The Hague
+31 (0)70-342 15 42
info@rathenau.nl
www.rathenau.nl

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