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Total Investment in Research and Innovation (TWIN) 2016-2022

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This report by the Rathenau Institute presents statistics on the national government's direct financial and indirect tax-related support for Research & Development (R&D) and innovation in the 2016-2022 period. It also discusses investments in R&D and innovation by regional and European sources.

Content

Summary

Total Investment in Research and Innovation 2016-2022 (in Dutch: TWIN) surveys the Dutch national government's financial and tax-related support for R&D and innovation based on budgeted R&D and innovation appropriations and forecasts. The figures presented in this edition of TWIN are based on the 2018 budgets of various Ministries, in accordance with the OECD's Frascati Manual. They do not take into account the budgetary measures announced in the Dutch Government's Coalition Agreement for 2017-2021. We discuss the effects of the Coalition Agreement separately, in section 5.

The present report is based largely on the Ministries' budgets for 2018 and covers the 2016-2022 period. The figures for 2016 are actual outlays and those for 2017 concern provisional expenditure for that year in so far as known when the budgets for 2018 were published (Budget Day, September 2017). The figures for 2018 are taken from the budget proposal and those for 2019-2022 are multi-year budget forecasts.

This report covers three categories of government expenditure:[1]

- *Direct R&D expenditure*, meant to expand the knowledge base and develop new applications of the existing knowledge;[2]
- *Direct expenditure on non-R&D innovation*, meant to promote innovation but with no R&D component;
- *Indirect support for R&D and innovation*, specifically tax incentives.

In addition, we also consider international and regional funding of research and innovation.

The main findings of this report are:

a) In the 2016-2022 period, the national government will spend approximately € 6.5 billion a year on R&D and innovation. More than three quarters of this amount will consist of direct R&D expenditure, with some € 5.1 billion spent as of 2018. At € 1.2 billion, tax-related support for R&D represents 18 per cent of all government funding of R&D and innovation in 2018.

b) Based on the 2018 budget, direct R&D expenditure will increase between 2016 and 2022 by 2.6 per cent, largely owing to increases at three ministries (Education, Culture and Science; Economic Affairs; Social Affairs and Employment). Expenditure will decline at the ministries of Health, Welfare and Sport; Infrastructure and Environment; Security and Justice. Institutions that focus mainly on basic research will see an increase in (primarily institutional) government funding for R&D. Funding for institutes of applied research ('TO2 institutes') will decline.

c) Average revenue from the EU's Horizon 2020 Framework Programme comes to almost € 650 million per annum until 2016 and may increase further. Regional funding of research and innovation through the European Regional Development Fund (ERDF) comes to about € 100 million per annum. Regional funding of research and innovation amounted to € 190 million in 2016 and is expected to remain at about the same level between 2017 and 2020.

d) R&D is funded not only by government but also by the business enterprise sector, other national sources and sources abroad. In terms of gross domestic product, total expenditure on R&D in the Netherlands increased slightly between 2011 and 2016 from 1.9 per cent of GDP to 2.03 per cent. This increase is mainly due to a rise in R&D funding from foreign sources.

e) Direct government support for R&D will decline as a percentage of GDP starting in 2018, based on the 2018 Budget and the investment measures announced in the 2017 Coalition Agreement.[3] Given the current economic growth forecast, the Netherlands will need to make an additional total investment of € 5.8 billion compared with 2016, if it is to comply with international agreements regarding R&D intensity (i.e. 2.5 per cent[4] of GDP by 2020). This will require extra funding, most of it to be provided by the business enterprise sector, but some by government. If the existing ratio between public and private funding of R&D is maintained (1:1.5), government will be obliged to provide a larger share of the additional investment than if the ratio were closer to the international average (1:2). The necessary investment also depends on whether R&D funding from other national and foreign sources increases.

1 TWIN report, 2016-2022

Table 1 summarises the Dutch national government's expenditure on R&D and innovation in the 2016-2022 period, in absolute figures.

[1] For definitions, see Appendix 2.
[2] This means that the budget items are not always included in their entirety in the TWIN expenditure figures because the TWIN report is limited to the amounts designated as R&D spending.
[3] This decline does not yet reflect any potential effects of the efficiency budget cuts on research capacity.
[4] This does not include any indirect tax-related support for private-sector R&D because these figures have already been taken into account in the figures for R&D expenditure by the business enterprise sector. Government compensates businesses for their outlay on R&D staffing and other R&D-related expenditure by charging a lower tax rate on such spending. This reduces the amount in tax revenues that government collects.

Of the total amount provided in government support for R&D, 77 per cent consists of direct expenditure, including funding of university research within the first funding stream and research carried out by public research institutes, incentive funding for private-sector R&D, and research contracted out by government. About a quarter of expenditure is innovation-relevant. Indirect tax-related support amounts to 18 per cent of the total in 2018, while direct expenditure on non-R&D innovation stands at around 5 per cent. These percentages are fairly stable. Trends throughout the relevant period vary from one category to the next:

- The pattern in direct R&D spending resembles the overall pattern of total government support: a slight rise in 2017 followed by fluctuations at this higher level.
- Indirect tax-related support declines slightly in 2018 and then returns to the 2017 level.
- Direct expenditure on non-R&D innovation rises sharply in 2017 and is expected to fall back to the 2016 level. Since this is a small category, the relative changes are larger.

Table 1: Direct and indirect government financial support for R&D and innovation, 2016-2022, in millions of euros

	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Direct expenditure on R&D	4926.0	5107.4	5066.3	5048.4	5019.9	5060.3	5052.1
- *of which innovation-relevant*	*1079.0*	*1161.0*	*1121.1*	*1120.0*	*1123.5*	*1113.8*	*1097.6*
Direct expenditure on non-R&D innovation	254.0	325.3	295.9	300.1	296.0	255.8	238.5
Indirect tax-related support for R&D (including the WBSO tax scheme)	1216.8	1214.4	1172.4	1214.4	1214.4	1214.4	1214.4
Total	**6396.8**	**6647.0**	**6534.5**	**6562.8**	**6530.2**	**6530.4**	**6505.0**

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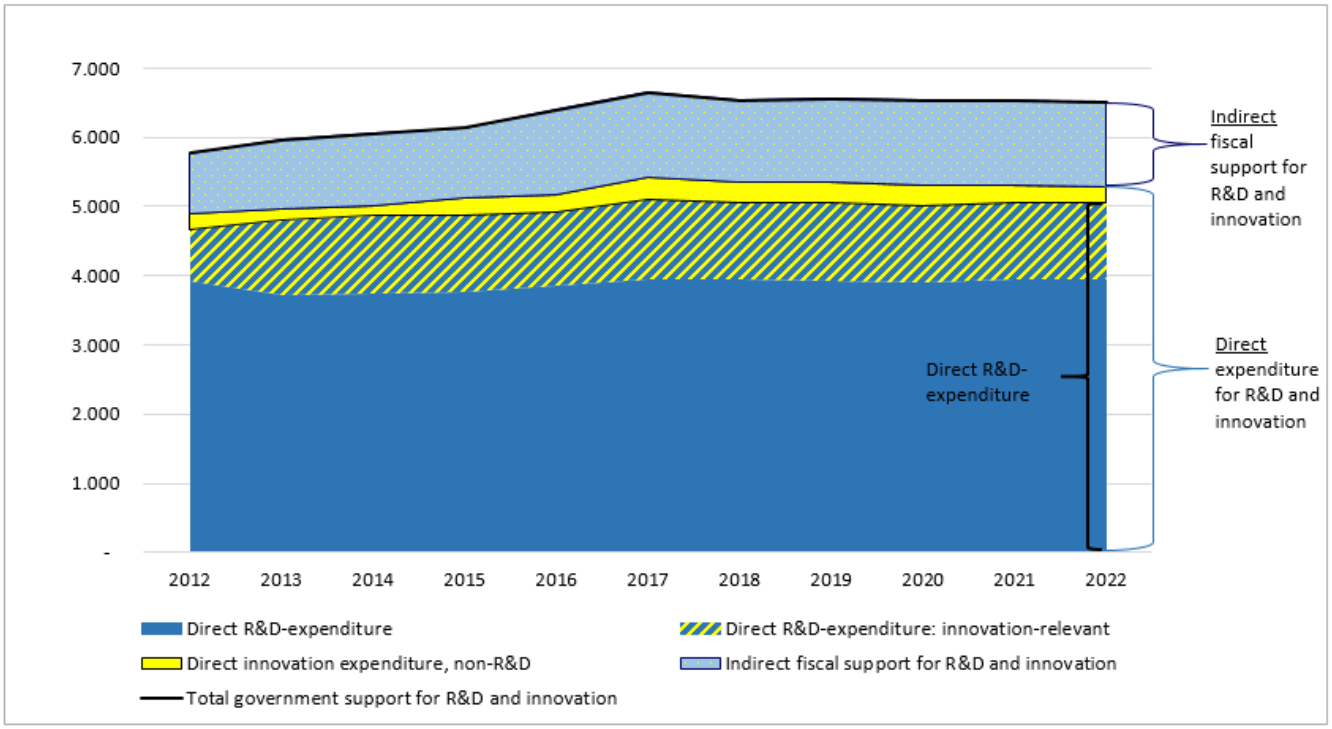
Source: TWIN budget report, 2018
Note: As in previous years, tax-related support does not include the 'Innovation Box' tax regime; see p. 7.

Figure 1 shows how the various categories of government expenditure compare over time: R&D expenditure (innovation-relevant or not); direct expenditure on non-R&D innovation; and indirect tax-related support.

Figure 1 Government financial support for R&D and innovation, by category, 2012-2022 (in millions of euros)



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Source: TWIN budget reports 2014-2018
Note: Data on innovation-related expenditure were collected from 2012 onwards.

2 Trends in government support for R&D and innovation

In this section, we look at trends in the national government's expenditure on R&D and innovation. We consider direct R&D expenditure (by Ministry and by recipient), tax-related support for R&D, and innovation-relevant expenditure.

2.1 Direct expenditure on R&D by Ministry

Initially, total direct government spending on R&D rises between 2016 and 2017 by 3.7 per cent, from € 4.9 billion to € 5.1 billion. It then fluctuates between € 5.0 and € 5.1 billion. Compared with earlier government R&D budget reports, which consistently show a decline across the entire relevant period, the most recent report shows a rise and then fluctuations at this higher level of spending. Whereas the previous TWIN report still showed spending fall by € 46 million across the entire period, the present report reveals an increase of € 126 million between 2016 and 2022 (+2.6 per cent).

Table 2 shows R&D expenditure by Ministry as specified in the 2018 Budget. The Ministries are listed by size of R&D expenditure in 2016.

The table shows that the Ministry of Education, Culture and Science is the most important source of direct R&D funding (accounting for 74 per cent of all expenditure), followed by the Ministry of Economic Affairs (17 per cent). The other Ministries account for 9 per cent of all expenditure as a group.

Table 2: Direct R&D expenditure by Ministry (cash basis), in millions of euros

Ministry	2016	2017	2018	2019	2020	2021	2022	*Trend 2016-2022*	
Education, Culture & Science	3677.8	3749.4	3758.3	3766.8	3743.2	3806.7	3829.5	*151.6*	*4.1%*
Economic Affairs	810.3	899.1	851.5	845.8	847.0	835.4	817.7	*7.4*	*0.9%*
Health, Welfare & Sport	226.5	235.6	235.3	228.9	221.6	207.5	196.8	*-29.8*	*-13.1%*
Infrastruc-ture & Environment	70.5	76.3	78.5	62.4	63.6	64.8	62.2	*-8.3*	*-11.8%*
Defence	61.1	62.5	61.2	61.2	61.2	61.2	61.2	*0.1*	*0.2%*
Foreign Affairs	37.0	40.0	40.0	40.0	40.0	40.0	40.0	*3.0*	*8.1%*
Security & Justice	24.3	22.0	22.0	21.9	21.9	21.9	21.9	*-2.4*	*-9.8%*
Interior & Kingdom Relations	10.1	10.6	10.3	8.8	8.6	10.0	10.0	*-0.05*	*-0.5%*
Social Affairs & Employ-ment	7.9	11.4	8.6	12.1	12.3	12.3	12.3	*4.4*	*55.1%*
General Affairs	0.5	0.6	0.6	0.6	0.6	0.6	0.6	*0.1*	*14.2 %*
Total	**4926.0**	**5107.4**	**5066.3**	**5048.4**	**5019.9**	**5060.3**	**5052.1**	***126.1***	***2.6 %***

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Source: TWIN budget summaries 2014-2018
Note 1: The figures for Education, Culture and Science include the general university funds (GUF) for research (research portion of the first funding stream). The Rathenau Instituut has estimated this amount based on Statistics Netherlands' coefficients. The Ministry's figures also include research funding made available to Wageningen University and Research Centre by Economic Affairs; that amount (estimated at approximately € 117 million in 2018) has been deducted from the figures pertaining to Economic Affairs.
Note 2: In accordance with the 2018 Budget, Economic Affairs' R&D expenditure includes the portion earmarked for agriculture, nature and food quality.

Education, Culture and Science increases its spending on R&D across the entire period by € 152 million (4 per cent), boosting its relative share.[5] Economic Affairs initially increases spending by 11 per cent in 2017 and then lowers it slightly to just above the 2016 level. Starting in 2019, extra spending by Social Affairs and Employment rises to € 4.4 million per annum, resulting in an increase of 55 per cent in 2022 compared with 2016. The largest decline between 2016 and 2022 is in Health, Welfare and Sport (-€ 29.8 million or -13 per cent) followed by Infrastructure and Environment (-€ 8.3 million or -12 per cent). This includes cuts in the amounts that Health, Welfare and Sport spends on research at public knowledge organisations (PKOs), such as the Netherlands Institute for Social Research (SCP), the National Institute for Public Health and the Environment (RIVM) and the Netherlands Institute for Health Services Research (NIVEL). It also includes cuts by Infrastructure and Environment on research budgets for PBL Netherlands Environmental Assessment Agency, Deltares, the Royal Netherlands Meteorological Society (KNMI) and the Energy Research Centre of the Netherlands (ECN).

[5] Budgeted funds freed up by the student loan system (*Studievoorschot*) have not been designated as R&D expenditure: see TWIN 2015-2021, p.15 and section 5 of the present TWIN report.

The factsheet on PKOs and related data publications on our website show trends in total revenues by type of PKO and by organisation.

In 2018, the Ministries placed 31 per cent of their research budgets in the market as project funding: commissioned research contracts which organisations acquire through competition.. Most of the budget (69 per cent) is appropriated for institutional funding, i.e. longerterm and programme funding by the national government. The share earmarked for project funding varies over time and differs considerably from one Ministry to the next, which is made clear in our online data publication on trends in project funding on our website. There is a separate data publication analysing government support for R&D by various socio-economic objectives.

PPP Allowance

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

In the 2013-2016 period, a total of more than 1000 PPP allowance projects were launched, involving almost 5000 participants and representing a total of € 1.2 billion in budgeted project costs. PPP allowance awards increased from € 27 million in 2013 to € 107 million in 2015 and then fell to € 78 million in 2016. Most of the TKI allowances awarded between 2013 and 2016 went to knowledge institutions (93 per cent). The multi-year forecast has the PPP allowance rising again after 2016 to € 103 million in 2018 and then to an annual € 116 million.

More data on the PPP allowance and a breakdown by type of organisation and type of research can be found in the relevant factsheet (Dutch only) on the Rathenau Instituut website.

2.2 Trends at specific institutions

Table 3 shows funding earmarked for specified institutions, broken down by:

a) basic research;
b) applied research at the TO2 institutes (institutional funding only)[6];
c) other spending by the Ministries (both institutional and project funding).

Basic research is carried out largely 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 foreign research institutes funded by Education, Culture and Science (CERN, ESA, ESO, EMBL and EMBC). The 'basic research' category implies that most, but not all, of the research carried out by or through these organisations is basic research.[7] For the TO2 institutes, the opposite is the case. Table 3 reveals two contradictory trends.

[6] Since 2010, TNO, DLO and the Large Technological Institutes (GTIs: NLR, ECN, MARIN and Deltares) have joined forces under the 'TO2 institutes' banner. The TO2 institutes focus on applying basic research.

[7] https://www.rathenau.nl/en/science-figures/investments/rd-expenditure-netherlands-funding-source-and-sector-performance 57 per cent of all research carried out in the higher education sector is basic research, and 25 per cent in the research institute sector. It should be noted that the 'research universities' tend to focus on basic research, whereas the 'universities of applied sciences' concentrate more on applied research. 63 per cent of all research carried out in the research institute sector is applied research.

On the one hand, the programme budgets (i.e. institutional funding) for applied research have declined at all TO2 institutes. On the other hand, funding for higher education and international organisations has increased. In the previous TWIN report (2015-2021) we revealed these contradictory trends, starting in 2010 and still ongoing. Despite an increase in 2017, other expenditure (mainly destined for applied research) by the Ministries – for example Foreign Affairs, Infrastructure and Environment, and Economic Affairs – remains well below spending levels in 2010, when it exceeded € 1.1 billion. The reason lies in the decision to terminate various funding schemes and to reduce institutional funding destined for public knowledge organisations, for example PBL Netherlands Environmental Assessment Agency and the Netherlands Forensic Institute (NFI).

Table 3: Direct R&D expenditure by national government, by funding recipient, 2016-2022, in millions of euros[8]

	2016	2017	2018	2019	2020	2021	2022	2022 based on Index 2016 = 100
HE, research budget	2768	2845	2836	2848	2870	2895	2917	105
- NWO, institutional funding	454	439	458	457	412	455	457	101
- NWO, other	280	277	280	276	275	270	270	96
- ZonMw	119	140	150	143	136	122	111	93
- Royal Academy	66	69	69	69	69	69	69	104
- International institutions, from Education, Culture & Science	91	97	97	97	97	97	97	107
Subtotal	**3778**	**3867**	**3890**	**3890**	**3859**	**3908**	**3921**	**104**
- TNO, programme funding	182	177	172	168	168	168	168	92
- GTI, programme funding	63	57	55	55	55	55	55	88
- DLO	147	142	127	123	122	122	123	83
TO2 institutes, subtotal	**392**	**376**	**354**	**345**	**345**	**345**	**345**	**88**
Other expenditure by Ministries	**756**	**865**	**822**	**813**	**816**	**807**	**786**	**104**
Total	**4926**	**5107**	**5066**	**5048**	**5020**	**5060**	**5052**	**103**

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Source: TWIN budget report, 2018

Note 1: 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 3 mainly concerns institutional funding, owing to the block grant paid to universities, but some of NWO's funding, for example, consists of project funding. 'Other expenditure by Ministries' is a combination of institutional funding and project funding.

Note 2: From the 2018 Budget onwards, the method used to calculate the Royal Academy's research percentage has been adjusted in accordance with the Frascati Manual (2015). As a result, the research capacity used in the calculation has increased whereas the Ministry's basic funding remains the same. As a result, the Academy's R&D resources are larger than in the previous TWIN report.

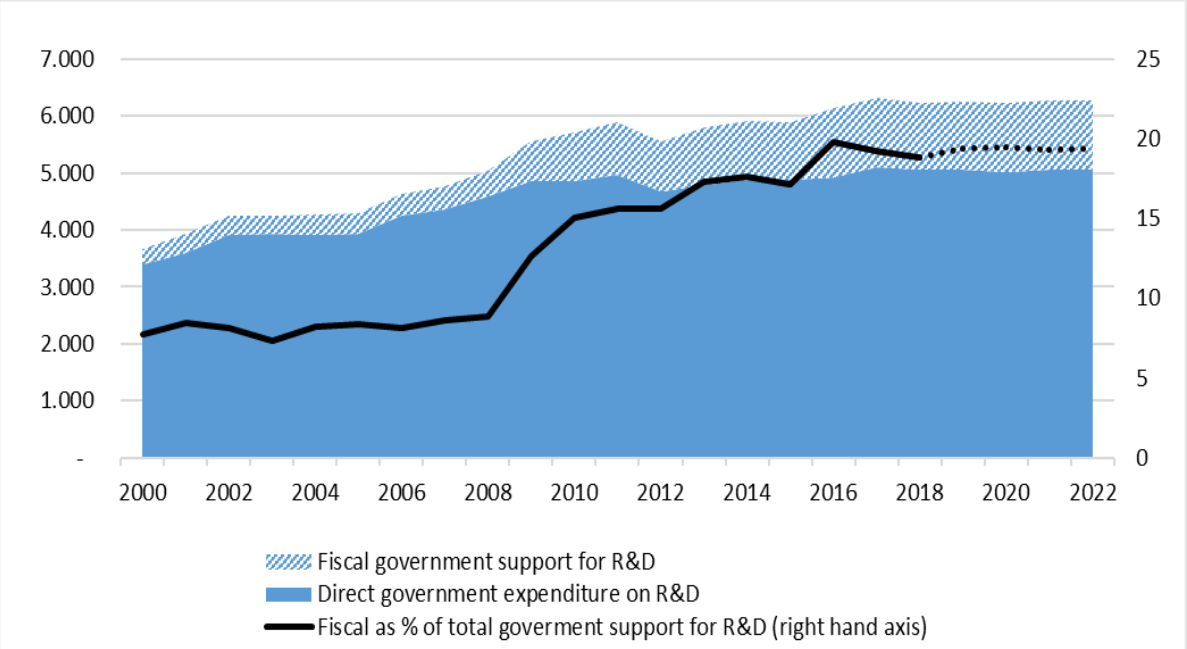
[8] The categories used in this table differ in some respects from the table presented in the National Reform Programme. For example, the subcategory 'targeted basic research' also includes the budgets for ZonMw and the international research organisations.

2.3 Tax-related support for R&D

In addition to direct forms of funding, government also fosters R&D by means of tax incentives. The Research and Development (Promotion) Act (WBSO) has been in effect since 1994.[9] The purpose of this tax incentive is to support R&D in the business enterprise sector (especially at SMEs) so as to drive innovation and economic growth. The WBSO reduces the amount of tax businesses pay on staffing costs associated with R&D. The Research & Development Allowance (RDA) was introduced in 2012 as a supplement to the WBSO. The RDA scheme provides 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.nl). Only businesses that conduct research themselves can make use of the WBSO tax facility. We do not provide further detail here on environmental tax incentives, in which R&D plays only a limited role. [10]

Figure 2 shows that tax-related support for R&D and innovation in the Netherlands has increased more in recent years than direct government expenditure on R&D. Tax-related support rises gradually from € 284 million in 2000 to € 445 million in 2008 before increasing steeply to € 1.22 billion in 2016. It drops slightly to € 1.17 billion in 2018 and then stabilises at € 1.21 billion. The black line in Figure 5 shows that the share accounted for by tax-related support more than doubles between 2000 and 2016, from 8 to almost 20 per cent of total support for R&D. It falls slightly thereafter and then remains stable at around 19 per cent.

Figure 2: Trends in direct and indirect (tax-related) government support for R&D and innovation, 2000-2022 (in millions of euros)



Source: TWIN reports, Ministry of Economic Affairs.
Note: Figures 2019-2022: Multi-year forecasts

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.

[9] For more information on the R&D tax credit, see (in Dutch): http://wetten.overheid.nl/BWBR0007746/2018-01-01#HoofdstukVIII. For more information on the R&D tax deduction, see (in Dutch): http://wetten.overheid.nl/BWBR0011353/2018-01-01#Hoofdstuk3_Afdeling3.2_Paragraaf3.2.4

[10] This refers to the Environmental Investment Rebate (MIA) and the Arbitrary Depreciation of Environmental Investments (Vamil). For 2018, the innovation component has been estimated at € 3.35 million.

The WBSO is a tax benefit on R&D and innovation spending; the Innovation Box provides a lower tax rate on profits generated by past R&D or innovation activities. In international statistics, 'patent boxes', which are comparable to the Innovation Box, are also not included in statistics concerning tax-related support for R&D and innovation.[11]

2.4 Expenditure on innovation

The TWIN report also aims to investigate government support that is clearly meant to stimulate innovation. Table 4 shows the three types of government support aimed at innovation and their share of total government support for R&D and innovation.

Table 4: Government support for innovation, including innovation-relevant R&D expenditure, in millions of euros, 2016-2022

	2016	2017	2018	2019	2020	2021	2022
Direct innovation-relevant R&D expenditure	1079.0	1161.0	1121.1	1120.0	1123.5	1113.8	1097.6
Direct expenditure on non-R&D innovation	254.0	325.3	295.9	300.1	296.0	255.8	238.5
Tax-related instruments for R&D and innovation	1216.8	1214.4	1172.4	1214.4	1214.4	1214.4	1214.4
Total government support for innovation	**2549.8**	**2700.6**	**2589.3**	**2634.4**	**2633.8**	**2583.9**	**2550.5**
As % of total support for R&D and innovation	*39.9 %*	*40.6 %*	*39.6 %*	*40.1 %*	*40.3 %*	*39.6 %*	*39.2 %*

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Source: TWIN budget report, 2018
Note: For detailed figures, see http://www.rathenau.nl/nl/TWIN2016-2022.xlsx

Government support for innovation accounts for about 40 per cent of all direct and indirect government support for R&D and innovation. Nearly half of this amount consists of R&D- and innovation-specific tax incentives. Two Ministries are responsible for the lion's share of direct innovation-related expenditure. Economic Affairs spends the largest amount on innovation-relevant R&D and other non-R&D innovation activities (64 and 59 per cent respectively in 2018). Education, Culture and Science also makes a relatively large contribution to innovation spending: more than a quarter of all expenditure on innovation-relevant R&D and almost a third of all expenditure on other innovation activities. Ministries appear to be cautious about linking expenditure to innovation and it remains difficult to establish that link.

3 European and regional funding of R&D and innovation

If this TWIN report looked only at expenditure by Ministries, it could not cover total public investment in research and innovation in the Netherlands.[12] In addition to the Dutch government, foreign and regional public sources also fund research in the Netherlands.

[11] For more details, see TWIN 2015-2021, pp. 11-12 and the OECD's Frascati Manual 2015, p. 346. Note that the Innovation Box is not a budgeted scheme. In other words, there are no restrictions on the budgetary share that it will account for going forward or its associated use. The Innovation Box's budgetary share almost tripled between 2011 and 2016, from € 605 million to € 1.7 billion. As from 2018, its share is expected to drop by € 113 million owing to the increase in the effective tax rate from 5% to 7%, as announced in the 2017 Coalition Agreement.

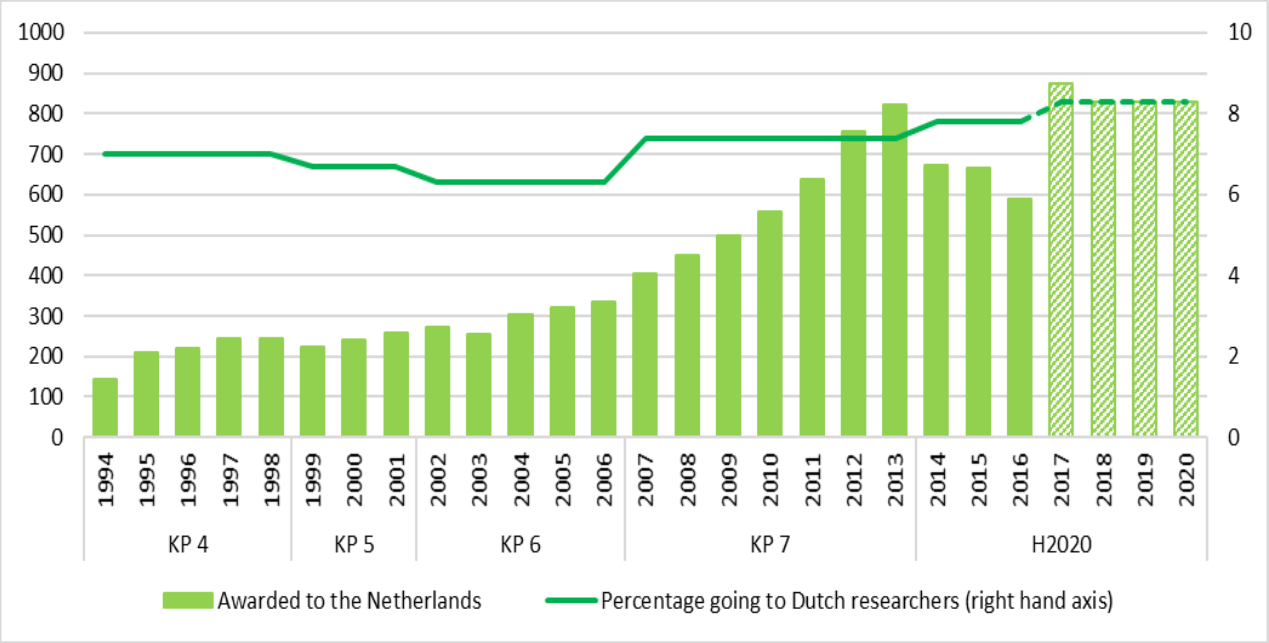
[12] The OECD Frascati Manual, the basis for R&D data collection in EU and OECD countries, also recommends that, where significant, funds provided by the provinces should be included in data collection on government budgets.

The European Union is becoming increasingly important as a source of funding for Dutch R&D. The Framework Programmes (FPs) are the European Union's main instrument for stimulating research and innovation. Provincial authorities, EU funds, regional economic development agencies (REDAs), local authorities and several new semi-public organisations are responsible for regional interest in and funding of research and innovation.

3.1 European funding at national level: Horizon 2020

There have been seven framework programmes with successively larger budgets. Figure 3 shows Dutch revenues obtained from recent framework programmes. Horizon 2020 is the eighth framework programme. It began in 2014, runs until 2020, and has a total budget of more than € 70 billion.[13] Of this amount, more than € 29 billion has been appropriated to projects.[14] An interim evaluation by the European Commission shows that Dutch researchers received between € 600 and € 700 million annually from the Horizon 2020 programme between 2014 and 2016.[15]

Figure 3: Trends in funding awarded to Dutch researchers from framework programmes (in millions of euros)



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Sources: European Commission, Development of Community research – commitments 1984 – 2013: 1984-2013 figures. Interim Evaluation H2020: 2014-2016 figures. 2017 figures: EC Draft EU budget 2017 and EC News Alert 5 April 2017. 2018-2020 figures: Fact Sheet Horizon 2020 Work Programme from 2018 to 2020. Share of FP allocated to the Netherlands FP4-FP6: Evaluations of 5th and 6th FP by Senter (2003) and SenterNovem (2006). Share of H2020 budget allocated to the Netherlands in 2017-2020 based on appropriations up to January 2018 in European Commission, Country Profiles based on Corda proposals database, data from 2014- Feb. 2018. The estimated amounts are based on the percentage allocated to the Netherlands and total annual EU expenditure on Horizon 2020. Figures pertaining to the 2017-2020 period are preliminary estimates.

[13] http://www.neth-er.eu/en/dossiers/research-and-innovation/horizon-2020
[14] Source: Participant portal for H2020 projects (data up to 25 January 2018): https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889fb83c4e21d33e/sheet/erUXRa/state/analysis
[15] Based on 2014-2016 figures. Source: European Commission, Internet tables all revised (Expenditure H2020 by country).

The Netherlands acquired 7.8 per cent of the Horizon 2020 budget in this period, more than during the FP7 programme. [16] The rate of return is approximately one and a half times the Dutch contribution to the total budget, i.e. 5.3 per cent.[17] As Table 5 shows, this means that the Netherlands has the highest rate of return among the top ten Horizon 2020 countries. More recent data, based on proposals awarded funding up to the end of January 2018, show an even higher Dutch share of 8.3 per cent.[18] The Netherlands is in sixth place on the list of EU countries with respect to the overall scale of funding awarded. The acceptance rate for Dutch applicants is also above average: 16.4 per cent of proposals compared with 13.6 per cent on average for all EU countries.

Table 5: Funding awarded under Horizon 2020, as share of total awarded and share contributed to total budget

Country	Awarded under H2020 (€ millions)	% of total H2020 budget	% contribution to EU budget	Rate of return	Acceptance rate (%)
Germany	4150	16.7	20.5	0.81	16.3
United Kingdom	3769	15.2	12.9	1.18	14.8
France	2565	10.3	15.8	0.65	17.2
Spain	2181	8.8	8.1	1.09	14.0
Italy	1996	8.0	12.0	0.67	12.2
Netherlands	1927	7.8	5.3	1.47	16.4
Belgium	1192	4.8	4.2	1.14	17.5
Sweden	853	3.4	2.9	1.17	15.6
Austria	682	2.7	2.2	1.23	16.9
Denmark	582	2.3	1.8	1.28	14.7

Sources: Funding awarded 2014-2016: Interim Evaluation H2020. Contributions to total EU budget based on total own resources (revised) 2014-2016: http://ec.europa.eu/budget/figures/interactive/index_en.cfm.
Acceptance ratesbased on European Commission, Country Profiles based on Corda proposals database, 2014-Feb. 2018.
Note: There is no information available on each country's actual contribution to Horizon 2020. We therefore assume that each country's contribution to Horizon 2020 is comparable to its contribution to the EU budget.

Our data publication on H2020 revenues shows that institutes for higher education receive a relatively large proportion (49 per cent) of the Netherlands' Horizon 2020 revenues, followed by businesses (27 per cent), research institutes (18 per cent) and other organisations (including government, 6 per cent). If we look at the total Horizon 2020 funding for all countries, these figures are 38 per cent, 29 per cent, 26 per cent and 7 per cent respectively. Revenues obtained under Horizon 2020 represent about 12 per cent of all R&D expenditure in the Netherlands funded directly by government. National co-financing is required for part of the projects granted under Horizon 2020, giving the EU even more influence on research funding in the Netherlands.

[16] For more information, see H. Dorst, J. Deuten and E. Horlings, The Dutch science system in the European Research Area, The Hague, Rathenau Instituut, 2016, and TWIN 2015-2021.
[17] The rate of return is calculated as follows: share of funding awarded under Horizon 2020 / share of contributions (based on contributions to EU).
[18] European Commission, Country Profiles based on Corda proposals database, 2014-Feb. 2018.

Moreover, the EU affects the research agenda and how research is organised and implemented.[19]

3.2 EU regional funds

The main EU research and innovation fund is the European Regional Development Fund (ERDF), a structural fund which aims to strengthen economic and social cohesion in the Union. The current ERDF programme began in 2014 and will continue until 2020. ERDF funding accounts for about a third of total regional expenditure on research and innovation in the Netherlands. The ERDF consist of two programmes: (1) regional programmes (2) European Territorial Cooperation or INTERREG. The regional programmes are distributed between the northern, eastern, southern and western regions of the Netherlands. In the 2014-2020 programme period, research and innovation funding is concentrated mainly in the priority areas 'research and innovation' and 'low-carbon economy'. ERDF funding is only awarded if at least 50 per cent of the relevant budget is provided through public or private national co-financing. The total ERDF budget available for the Netherlands for 2014-2020 amounts to € 507 million, of which € 454 million is earmarked for research and innovation. The annual ERDF budget for research and innovation in the Netherlands therefore amounts to an average of € 65 million, excluding public and private co-financing.[20] Table 6 provides an overview of the 2014-2020 ERDF budget for research and innovation and the contracted amounts, excluding co-financing.[21] By the end of 2016, 28 per cent of the budget reserved for research and innovation had been committed.

Table 6: ERDF budget for research & innovation in the Netherlands and contracted amounts per region in millions of euros

	Research and Innovation		Low-carbon economy		Total ERDF for priorities related to research & innovation		
	Budget 2014-2020	Allocated to year-end 2016	Budget 2014-2020	Allocated to year-end 2016	Budget 2014-2020	Allocated to year-end 2016	% allocated
North	78.7	13.7	20.7	3.9	99.4	17.6	18%
East	66.0	22.0	30.0	6.1	96.0	28.1	29%
South	75.0	28.5	34.1	9.6	109.1	38.1	35%
West	113.0	42.1	36.0	2.8	149.0	44.9	30%
Total	**332.7**	**106.3**	**120.8**	**22.4**	**453.5**	**128.7**	**28%**

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

INTERREG consists of programmes for cross-border cooperation (INTERREG A), transnational cooperation (INTERREG B), and interregional programmes (INTERREG C). The current INTERREG programme period runs from 2014 to 2020. The Netherlands will receive a total of € 390 million under the programme, 94 per cent of which is meant for project implementation. Estimates show that approximately € 30 million of this amount is destined for Dutch 'research and innovation' projects each year.[22]

[19] H. Dorst, J. Deuten and E. Horlings, The Dutch science system in the European Research Area, The Hague, Rathenau Instituut, 2016.
[20] Comparable to the research and innovation component of ERDF 2007-2013, amounting to € 62 million per annum.
[21] Table 10 shows co-financing covered by provincial budgets. Co-financing by the national government falls under the budget of Economic Affairs, shown in Table 3.

In early 2018, about two-thirds of the available budget for research and innovation (for the participating countries, 2014-2020) under INTERRG A was allocated to projects.[23] Of the innovation-related priorities under INTERREG B and C, half of the budget was allocated to projects by the end of 2017.[24] A breakdown of the INTERREG allocations by participating countries is expected at the end of the programme period.

3.3 Provincial resources

Regarding provincial data, our aim is to identify expenditure on research and innovation in the year prior to data collection. Because the financial basis and system underpinning the regional figures differ from those for the national budgets, it is not possible to simply add the two sets of figures together. As indicated in TWIN 2014-2020, the regional landscape is complex, with different types of organisations (provincial authorities, regional economic development agencies, management authorities and other regional and municipal organisations) and overlapping funding streams. Table 7 shows expenditure in 2016 and, as far as possible, planned investment in research and innovation in the current policy or programme period (2017-2020). The table only reports public funds actually recorded in the province's own budget and for which the province is authorised to spend on research and innovation projects and schemes. These are funds drawn from the general provincial budget, provinces' own resources and decentralised targeted grants. [25]

Table 7: Provincial expenditure on research and innovation, in millions of euros

Province	2016						2017-2020
	Schemes	Projects	REDAs	Innova-tion Funds	Other	Total commit-ments in 2016	Budgeted
Limburg	4.6	12.6	1.2	5.5	17.5	**41.4**	81.0
Fryslân	1.5	19.9	0.5	1.5	-	**23.3**	PM
Gelderland	6.0	5.0	2.7	8.0	-	**21.7**	82.6
Drenthe	-	0.5	0.3	3.3	15.8	**19.9**	37.5
Groningen	5.0	10.0	0.5	2.7	-	**18.2**	77.3
N-Brabant	3.5	7.1			7.4	**18.0**	88.1
Flevoland	11.2	-	-	-	1.0	**12.2**	PM
N-Holland	9.1	1.4	-	-	-	**10.5**	60.0
Overijssel	7.1	-	1.4	-	-	**8.5**	70.1
Utrecht	4.8	0.3	-	-	-	**5.1**	9.0
Z-Holland	3.4	-	1.2	-	-	**4.6**	113.6
Zeeland	-	3.4	1.1	-	-	**4.5**	12.1
Total	**56.2**	**60.2**	**8.9**	**21.0**	**41.7**	**188.0**	**631.2**

[22] Source: Factsheet on cross-border cooperation programmes (Economic Affairs) and survey of INTERREG B and C (31-12-2016).
[23] INTERREG A Budget update January 2018 (Economic Affairs).
[24] Source: RVO.nl
[25] Does not include projected public or private co-financing where the funds are budgeted to other organisations (MAs, national, EU, municipal or private). Figures do include projected co-financing by the province itself for schemes and projects under regional or INTERREG programmes.

Source: TWIN survey among provinces, 2016-2020. Figures are rounded off, possibly leading to discrepancies between the totals and sums in the table.
Note 1: The amounts are underestimated because expenditure on research and innovation is categorised under several budget items, not all of which have yet been identified for all of the provinces. See the points above.
Note 2: Flevoland: expenses for 2015 are included in the figures for 2016. Noord-Brabant: expenditure is for 2017 and the budget for 2017-2020 includes investment in (partly) revolving funds of € 60 million and € 10 million. Drenthe: € 3.3 million payment into the Innovation Fund is a loan. Overijssel: 2016 is a transitional year; clusters and board contributions allocated in 2017 cover several years and are budgeted in 2017; estimated ERDF co-financing based on 2015, broadband infrastructure yet to be approved.

The provincial data raises some points to be taken into account. For example, it is difficult to identify data on research and innovation. It is particularly hard to trace research and innovation expenditure within policy domains other than 'economic'. It is also difficult to identify the research and innovation component in other categories of provincial expenditure: spending on schemes, projects, contributions to the operating costs of REDAs,[26] and deposits into reserves and funds. In any given year, a province may issue one-off subsidies or loans for a longer period. Finally, not all the amounts have already been appropriated; the figures shown in the table may still change.

Given these reservations, we can assume that in 2016, the provinces spent a minimum of € 188 million on research and innovation. We expect at least the same level of annual expenditure in the coming years, as some amounts have yet to be allocated.

4 TWIN in a broader perspective

Government is not the only source of R&D funding. To put government R&D spending into perspective, we compare it with expenditure by other important sources of R&D funding, such as businesses, private non-profits and foreign sources. We show which proportion of R&D is performed in the various sectors. We also look at trends in R&D expenditure set off against the size of the economy and compare Dutch R&D intensity to that of other countries.

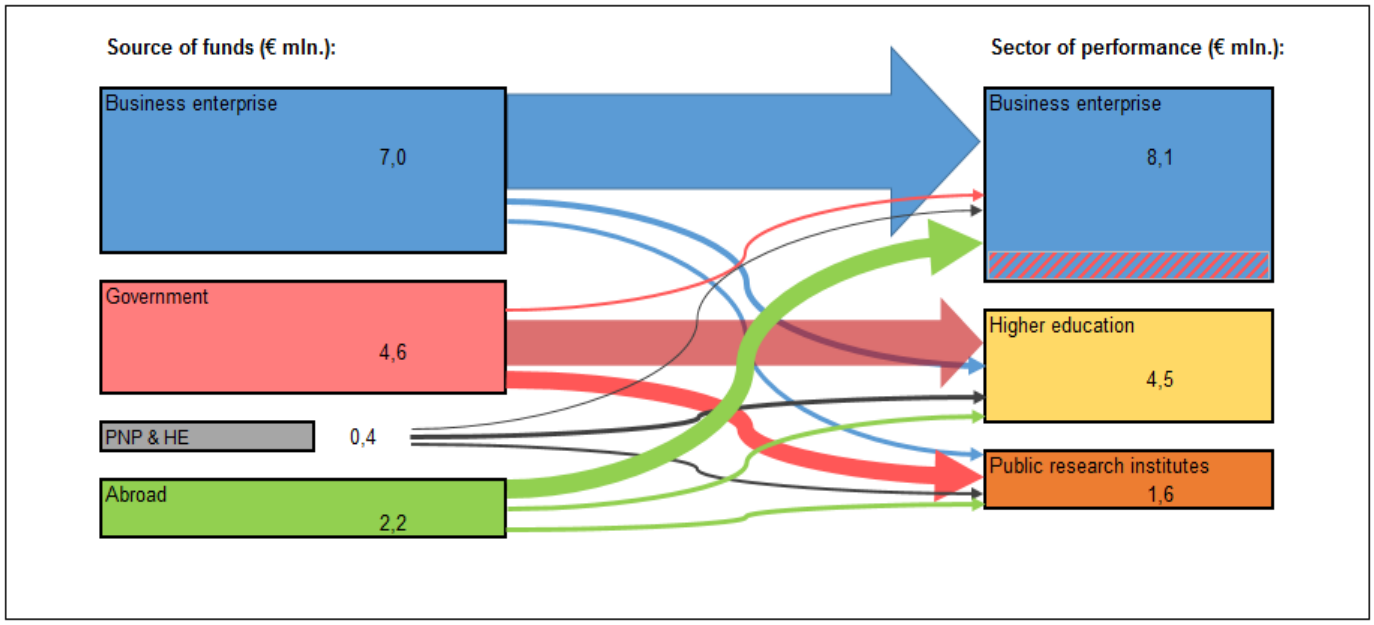
4.1 Total R&D expenditure in the Netherlands, by funding source and sector of performance

Figure 4 shows R&D expenditure by funding source and sector of performance. Total expenditure on R&D in the Netherlands came to € 14.3 billion in 2016.[27] A third of this is financed by government and almost half by businesses. Foreign businesses and organisations provided 16 per cent of funding and the private non-profit sector (PNP) and higher education (HE) together accounted for 3 per cent.

More than half of all R&D expenditure in the Netherlands is performed in the business sector. The majority of R&D financed by businesses is also performed within the business enterprise sector. Almost a third of R&D performed in the Netherlands is carried out in the higher education sector (HE), most of this being funded by government. Government is also the main source of funding for research performed by public research institutes.

[26] Regional economic development agencies
[27] Indirect tax-related support for R&D is not listed separately because it lowers the tax burden on businesses' actual R&D expenditure, and 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 4: R&D performed in the Netherlands by funding source and sector of performance (2016)



Source: CBS StatLine, and Economic Affairs; adapted by the Rathenau Instituut. [28]
Note 1: Under businesses, the shaded portion indicates that businesses that perform their own R&D receive tax relief compensating them for €1.2 billion of their R&D expenditure.
Note 2: We have combined private non-profit organisations (PNP) and higher education (HE) into a single funding source.

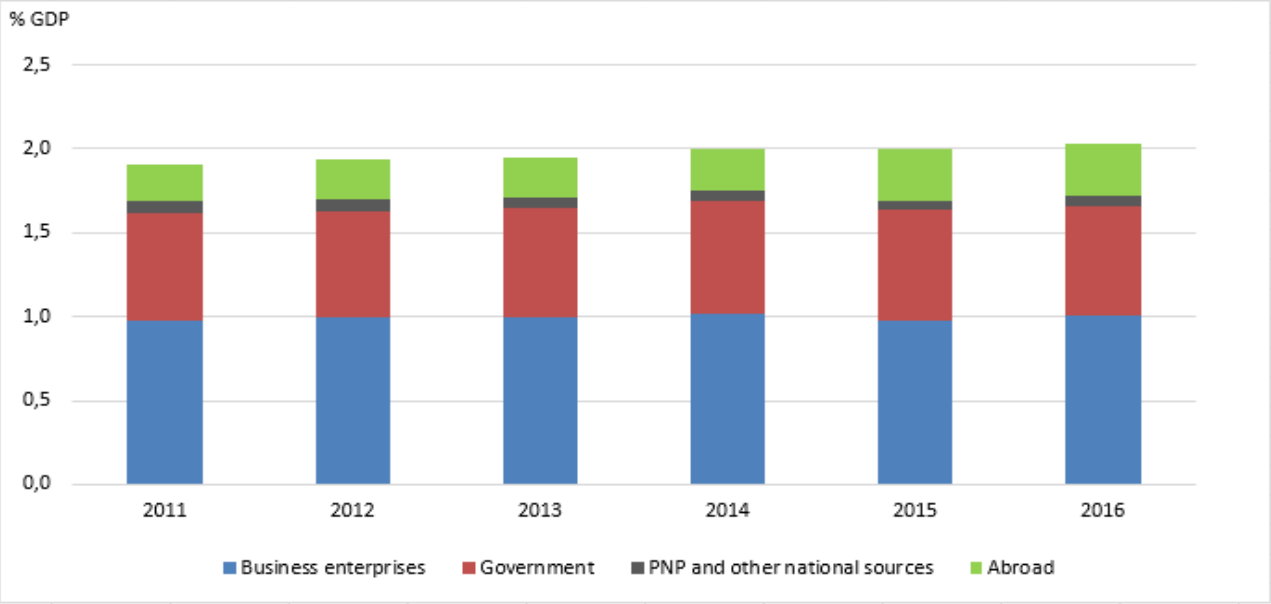
4.2 Trends in R&D expenditure from an economic perspective

To gain a picture of the relative size of R&D investment, we measure it against the size of the economy (gross domestic product). This is known as 'R&D intensity'. Figure 5 shows that R&D intensity in the Netherlands has increased slightly in recent years, from 1.9 per cent of GDP in 2011 to 2.03 per cent of GDP in 2016. This increase is due largely to a 0.1 percentage point increase in R&D expenditure from abroad, from 0.22 to 0.32 per cent of GDP.[29] As a share of GDP, R&D funding by businesses increased by 0.03 percentage points across this period and government funding by 0.01 percentage points.

[28] R&D funding by government in TWIN is slightly higher than the figure that Statistics Netherlands gives for government. That figure is based on data related to sector of performance, whereas TWIN is based on data related to government as a funding body. TWIN also includes public expenditure on international organisations.

[29] Two-thirds of R&D funding from abroad comes from businesses and one-third from the EU and other sources. Financing by foreign businesses and funding by other international sources increased at approximately the same rate between 2011 and 2016 (60% and 62% respectively). The ratio between these foreign sources has therefore remained the same.

Figure 5: R&D expenditure in the Netherlands as percentage of GDP by funding source



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Source: CBS Statline, adapted by Rathenau Instituut

4.3 2.5% by 2020

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 direct expenditure on R&D performed by institutes of higher education, public research institutes and businesses in the Netherlands. The funds come from the Dutch government, businesses, private non-profits and foreign sources, as described in the previous sections. Expenditure on non-R&D innovation is not included. [30]

According to the latest economic forecasts for GDP, on top of the current € 14.3 billion for R&D in 2016, an additional investment of € 5.8 billion per annum will be required to comply with the 2.5 per cent of GDP to be spent on R&D by 2020. If the ratio between government, business and other funding sources remains the same (1:1.5:0.6), then government will have to invest an additional € 1.9 billion per year, the business enterprise sector an additional € 2.9 billion, and foreign sources an additional € 1 billion (at 2018 price levels). If the ratio between government, business enterprise and other sources moves towards the international average of approximately 1:2:0.5, an additional investment will be needed of € 1.1 billion per year from government, € 4.4 billion from business enterprise, and € 0.4 billion from abroad. In other words, both business enterprise and government would still have to make an extra investment in R&D.

The 2018 budget, however, shows that direct R&D expenditure budgeted by government – which falls under the international agreement of 2.5 per cent of GDP for R&D – is declining, from 0.70 percent of GDP in 2016 to 0.61 percent in 2022. This is shown in Table 8. The decline can also be seen across all government support for R&D and innovation. In section 5 we show that the additional investments announced in the Coalition Agreement will not reverse the expected decline in government R&D expenditure as a percentage of GDP.

30 Indirect tax-related support for R&D is not listed separately; see footnote 27.

Table 8: Direct and indirect financial support for R&D and innovation, 2016-2022, in percentage of GDP

	2016	2017	2018	2019	2020	2021	2022
Direct expenditure on R&D	0.70	0.70	0.66	0.64	0.62	0.62	0.61
Direct expenditure on innovation	0.04	0.04	0.04	0.04	0.04	0.03	0.03
Indirect tax-related support for R&D	0.17	0.17	0.15	0.15	0.15	0.15	0.15
Total government support for R&D and innovation	**0.91**	**0.91**	**0.85**	**0.83**	**0.81**	**0.80**	**0.79**
GDP (in billions of euros)	*702.6*	*734.0*	*771.5*	*792.3*	*804.2*	*816.3*	*826.1*

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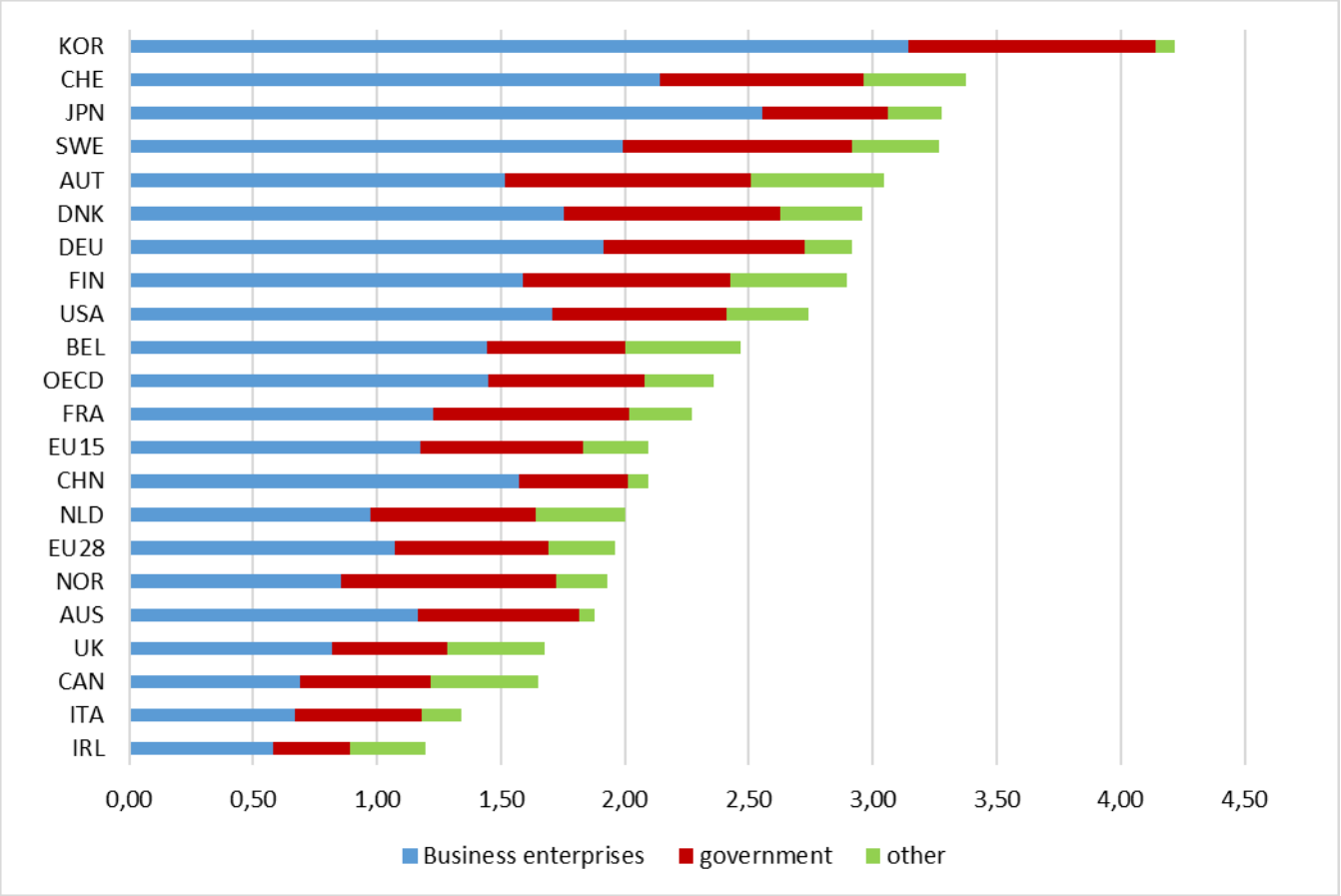
Source: TWIN report, 2018 budget. GDP figures for 2016-2018 taken from nominal figures produced by the Netherlands Bureau for Economic Policy Analysis (CPB) based on 'Short-term forecasts March 2018, additional main economic indicators'.
Note: The Netherlands' GDP for 2019-2022 is based on volume growth percentages from 'Collected appendices CEP 2018' (Central Economic Plan 2018).

4.4 R&D expenditure from an international perspective

Figure 6 compares R&D expenditure in the Netherlands with that of other countries by funding source. Total R&D intensity in the Netherlands is 0.36 percentage points below the OECD average and positioned in between the EU-15[31] and EU-28 averages. Dutch government expenditure on R&D is on par with the EU-15 average but falls short of government spending by several countries with which the Netherlands often compares itself. R&D financing by the Dutch business enterprise sector not only falls short of the EU-28 and EU-15 average but is also below the level of funding by businesses in most of the reference countries. Details can be found in our international data publication on R&D expenditure funded by the government and business enterprises.

[31] A succession of new countries acceded to the EU after 2004, increasing the number of member states from 15 to 28 today.

Figure 6: International comparison of R&D expenditure as a percentage of GDP, by funding source (2015)



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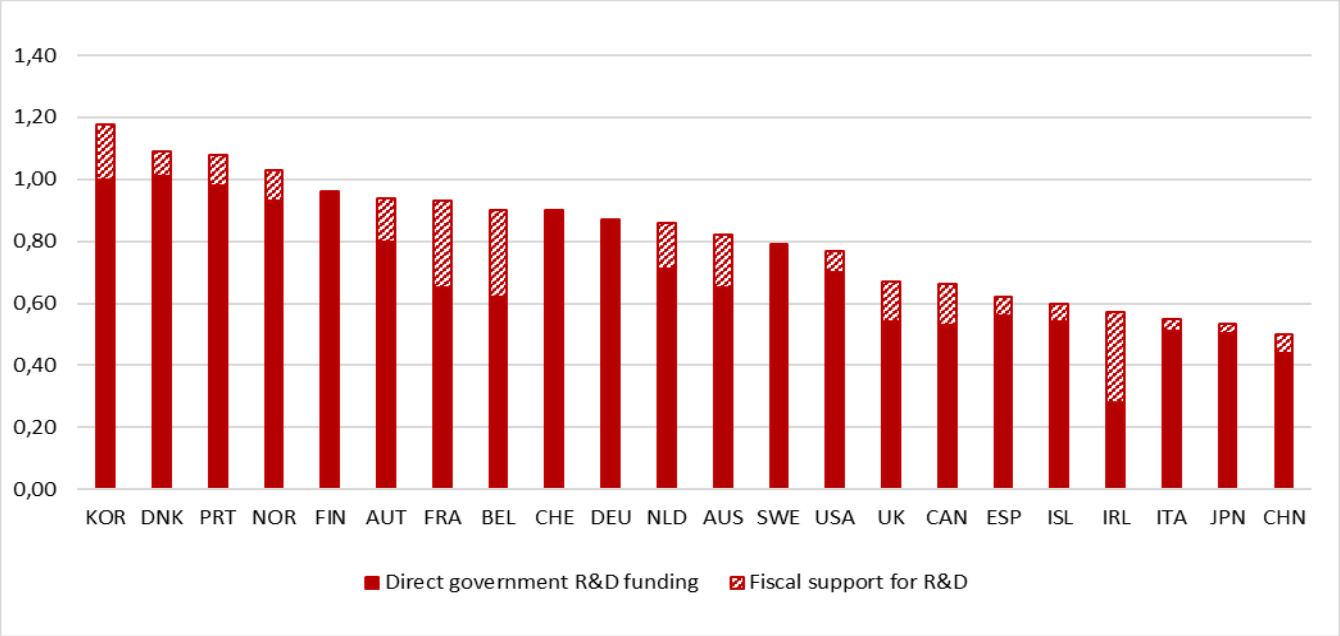
Source: OECD/MSTI database. 2015 data. International data from 2016 on R&D expenditure by funding source were not yet available at the time of publication. Note: Based on data provided by organisations that perform R&D. b) Australia: 2008; Sweden: 2013. c) The 'other' category consists of other national sources and foreign financing (businesses, EU and other organisations).

Indirect tax-related support is not separated out in the above figure. If we consider only the scale of tax-related government support, we see that it is larger in the Netherlands than in most other countries. Of the reference countries listed in Figure 7, the Netherlands would be in sixth place, after Ireland, France, Belgium, South Korea and Australia. However, if we look at total direct *and* tax-related government support for R&D, then the Netherlands moves to the middle, in eleventh place in the figure below. The diagram also shows that there are major differences between countries when it comes to the scale of their tax facilities.[32] Countries such as Germany, Switzerland, Sweden and Finland offer no tax-related support for R&D. At 0.29 per cent, Ireland provides the highest level of tax-related support as a percentage of GDP. For the Netherlands, that is 0.15. The Netherlands has the highest percentage of tax-related R&D support as a percentage of total government R&D support for businesses (88 per cent). [33]

[32] For more information on tax instruments in an international context, see the OECD's Innovation Policy Platform: www.innovationpolicyplatform.org/document/rd-tax-incentives-rationale-design-evaluation.
[33] See our international data publication on government support for R&D for business enterprises.

Figure 7: Direct and tax-related government support for R&D as percentage of GDP, 2015



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Note: Tax-related support in Belgium, France, Germany, Iceland, Ireland, Sweden and the United Kingdom: 2014. Australia, China, United States: 2013.

5 Dutch Government Coalition Agreement, 2017

The data for the TWIN report are compiled in accordance with relevant international agreements and based on figures from the draft budget for the forthcoming year.[34] Investments and austerity measures announced in the 2017 Coalition Agreement have therefore not been included. In this section, we look at the potential impact of the Coalition Agreement.

5.1 Extra funding for research in the Coalition Agreement

Compared with the 2018 Budget, the 2017 Coalition Agreement provides for an additional investment in research and innovation of up to € 400 million in 2020 and beyond (see Table 9). The Ministries of Education, Culture and Science and Economic Affairs and Climate have identified the targets, programmes and organisations that will receive these funds.[35] The extra funding mitigates, but does not reverse, the decline in government expenditure as a percentage of GDP. The economy is still expected to grow at a faster rate than government investment in R&D.

Investments in other policy domains announced in the 2017 Coalition Agreement may also result in extra money being channelled to research and innovation. It is not yet clear how these funds will be allocated to budget items involving research and innovation. That can only be covered in subsequent TWIN editions, based on the 2019 budget and beyond.

[34] See the chapter on Government Budget Allocations for R&D (GBARD) in the 2015 Frascati Manual.
[35] See: Min. Education, Culture and Science, *Kamerbrief Uitwerking investeringen wetenschap en onderzoek*, 9 March 2018 and Min. Economic Affairs, *Kamerbrief Investeringen voor toegepast onderzoek en innovatie in 2018*, 26 February 2018.

Table 9: Extra funding for research and innovation under the 2017 Coalition Agreement, in millions of euros

	2016	2017	2018	2019	2020	2021	2022
Basic research	-	-	100	150	200	200	200
Applied research and innovation (Min. of Science & Min. of Economic Affairs)	-	-	100	150	200	200	200
Research infrastructure	-	-	50	50			
Extra research funding in Coalition Agreement			**250**	**350**	**400**	**400**	**400**
Development phase (2018-2019)	-	-	*240*	*360*	*400*	*400*	*400*
Gov't R&D expenditure, incl. Coalition Agreement	4926	5107	5306	5408	5420	5460	5452
Gov't R&D expenditure incl. Coalition Agreement as % GDP	**0.70**	**0.70**	**0.69**	**0.68**	**0.67**	**0.67**	**0.66**

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Sources: Third Rutte Government Coalition Agreement; Min. Education, Culture and Science, *Kamerbrief Uitwerking investeringen wetenschap en onderzoek*, 9 March 2018 and Min. Economic Affairs, *Kamerbrief Investeringen voor toegepast onderzoek en innovatie in 2018*, 26 February 2018. GDP figures, see note to Table 8.

5.2 Austerity measures: more efficiency in education

The table above does not yet include the austerity measures meant to improve efficiency in education. The efficiency budget cuts at the universities will increase from € 2.9 million in 2018 to € 26.1 million in 2021. In research and science policy, they will rise from € 0.6 million in 2018 to € 5.9 million in 2021.[36] While these measures are not meant to impact the primary process of education and research, it is difficult to say in advance how they will affect research.

6 Conclusion and robustness

This final section summarises the most important findings in this TWIN report. It also discusses the robustness of the figures by providing a description of our data set and how we applied the R&D coefficient.

6.1 Findings

Between 2016 and 2017, the national government's total support for R&D and innovation rises from € 6.4 billion to € 6.6 billion per year, and fluctuates between € 6.5 and € 6.6 billion as from 2018. Initially, direct government spending on R&D rises between 2016 and 2017 by 3.7 per cent, i.e. from € 4.9 billion to € 5.1 billion. This amount then fluctuates between € 5.0 and € 5.1 billion. It does not include any financial measures announced in the 2017 Government Coalition Agreement. Compared with earlier TWIN reports, which consistently show a decline across the multi-year forecast, this report shows a rise and then fluctuations at this higher level of spending.

[36] Source: Dutch House of Representatives: *Tweede nota van wijziging op de begrotingsstaat van het Ministerie van Onderwijs, Cultuur en Wetenschap (VIII) voor het jaar 2018.* We do not include the budget cuts at universities of applied sciences because their research share is based on two specific budget items intended solely for research, and not on the general university funds (GUF) allocated by Education, Culture and Science.

Tax-related support for R&D has increased significantly over the past decade, to € 1.2 billion or 18 per cent of all support for R&D and innovation in 2018.

Dutch revenues from Horizon 2020 have so far averaged almost € 650 million annually and are expected to increase going forward. Provincial funding of research and innovation came to € 190 million in 2016 and is likely to remain at about the same level between 2017 and 2020. Regional EU funding of research and innovation stands at an estimated € 100 million per annum.

Between 2011 and 2016, total R&D expenditure in the Netherlands (public, private and foreign) increased slightly as a percentage of GDP, rising from 1.90 to 2.03 per cent of GDP, mainly owing to a rise in foreign funding. The Netherlands' total R&D expenditure lies between the averages for the EU-15 and the EU-28 and below the OECD average. The Netherlands is on par with the EU-15 average in terms of direct government support for R&D. Despite its relatively high proportion of tax-related support, it is also midway in the rankings when it comes to total government support (direct and tax-related) for R&D. R&D financing by Dutch business enterprises falls short of the EU and OECD averages, however, and also trails behind private-sector R&D financing in most of the reference countries.

To comply with international agreements specifying an R&D intensity of 2.5 per cent of GDP by 2020, the Netherlands must invest € 5.8 billion more than it did in 2016 under the current economic growth scenario. If it maintains its current ratio of public-private R&D investment, this will amount to an additional investment of € 1.9 billion from government, € 2.9 billion from business enterprises, and approximately € 1 billion from abroad. If the ratio between public and private investment moves closer to the international average, an additional annual investment will be required of € 1.1 billion from government, € 4.4 billion from business enterprises, and € 0.4 billion from abroad. Both the business enterprise sector and government would therefore be required to make an extra investment in R&D. The necessary investment by government and businesses further depends on how much R&D funding from other national and foreign sources increases.

However, the 2018 budget shows direct government support for R&D declining as a percentage of GDP from 0.70% to 0.61% in 2022. Despite additional investment, government support for R&D and innovation is still not keeping pace with economic growth. Even if we add the € 400 million investment announced in the Coalition Agreement, direct R&D expenditure will fall to 0.66 per cent of GDP in 2022, and this figure does not yet take the proposed efficiency budget cuts into account.

6.2 About the data

The annual TWIN data set is based on a questionnaire that is sent to the Ministries.
The questionnaire surveys the following categories of government expenditure:

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

Regarding expenditure, the questionnaire also asks what proportion of the budget item involves R&D, where the expenditure ends up (to the extent possible) and what its purpose is (based on a classification of government objectives).

A further question is what proportion of each budget item concerns innovation.

The OECD's Frascati Manual sets out international agreements governing the definition and scope of the term 'R&D'.[37] As the national TWIN data collection has a long-standing tradition, the Ministries have acquired considerable experience and expertise in drawing up their R&D reports, all of which contributes to the robustness of the data.

So far, no such agreements have been reached or expertise accrued with respect to government budgets for innovation. We have therefore made use of the OECD terminology for collecting innovation data in the business enterprise sector (see Appendix 1). It is difficult to apply this terminology in practice, however, because the definitions are general in nature but must be applied to specific budget items. Hence, the national government's data set on expenditure on non-R&D innovation is still 'under construction'. 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 R&D, starts with the 2014 budget. This data set is likely to improve, but it is difficult to say how this will affect the overall picture.

6.3 Method: university research expenditure

The Rathenau Instituut uses an R&D coefficient to calculate the proportion of the general university funds (GUF) used to finance research activities. Statistics Netherlands calculates this coefficient using data provided by the universities and university hospitals on total staff numbers, research capacity, and financial data. For a more detailed description of this calculation method, see: J. van Steen, 2013.[38] To avoid the excessive fluctuations that variable coefficients could unleash on TWIN data concerning the first funding stream for universities, the Rathenau Institute has based the amounts for that stream on a three-year average, starting with the 2017 budget. This means that the coefficient used for the 2016-2022 period is based on the average for 2014, 2015 and 2016. The coefficient was 0.62 in 2014 and 2015 and 0.57 in 2016, amounting to a three-year average of 0.60 for this TWIN period. The coefficient, which is based on data regarding actual research capacity, is also applied to budget and multi-year figures, in accordance with the Frascati Manual.

The new student loan system may impact the research share of the GUF. Replacing the basic student grant with a loan system puts more resources at the government's disposal. The extra money is meant to improve the quality of education.[39] For the universities, this will amount to € 77 million in 2018 rising to € 194 million in 2022.[40] As described in the foregoing paragraph, the R&D coefficient is based on data concerning the actual proportion of the entire GUF (block grant) spent on research. The funds freed up by the student loan system are 'new budgeted funds' for education that are not yet included in the actual performance figures and therefore do not play a role in the research coefficient. We have therefore separated out these funds when calculating the universities' research expenditure for the 2018-2022 budget period and not allocated any of these amounts to research.

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[37] The first version of the OECD manual dates from 1964. The most recent (seventh) version of the Frascati Manual was published on 8 October 2015.
[38] Totale Onderzoek Financiering 2011-2017. Rathenau Instituut, March 2013, p. 12.
[39] See the 2018 Budget of the Ministry of Education, Culture and Science
[40] Reported by the Ministry of Education, Culture and Science

For more details, see TWIN 2015-2021, pp. 15-16. Starting in 2019, any changes in the actual research capacity arising from the student loan system will influence the R&D coefficient. At that point, we can no longer separate out the funds freed up by the student loan system.

Starting in 2008, we have been able to collect data on the universities' research capacity by occupational level. Having access to data on occupational level 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 estimate is that refinement based on occupational level will produce a slightly smaller R&D coefficient, given the current data. This would mean that the universities' research share would be several percentages smaller. We will decide whether or not to apply this refinement for the next TWIN report.

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 relevant parties are consulting about these aspects. There is no coefficient to determine the research capacity at universities of applied sciences. To determine government funded research expenditure at the universities of applied sciences, we use two identifiable budget items in the Ministry of Education, Culture and Science's budget that specifically target applied research.

Appendix 1 Data collection at the Ministries

Like the previous four TWIN reports, this *Facts & Figures* publication contains figures on both R&D expenditure and what the national government spends on innovation. The OECD Frascati Manual sets out international agreements concerning the definition and scope of the term 'R&D'. So far, no such agreements have been reached with respect to government budgets for innovation. We made an initial attempt to define the term 'innovation' in the 2012-2018 TWIN report using the terminology applied by the OECD in its *Oslo Manual: Guidelines for collecting innovation data*.[41] It is difficult to apply this terminology in practice, however, because the definitions are general in nature but must be applied to specific budget items. We will therefore be cooperating with the Ministries to refine the way in which we apply the term 'innovation' to budget outlays in the years ahead.

The two most important principles guiding the collection of R&D and innovation data are as follows:

a) International agreements (based on an EU-EUROSTAT Regulation concerning the delivery of data on government R&D expenditure) require that it remains possible to distinguish between R&D expenditure on the one hand and innovation expenditure that does not involve R&D on the other;
b) The definition of innovation expenditure must match any existing, internationally accepted definitions as closely as possible (the same goes for the definition of R&D expenditure).

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 are imposed on the collection of innovation 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 Economic Affairs. The second situation tends to apply to expenditure by the various 'specialist' ministries. One example is medical innovation as a means to improve healthcare. The definition thus excludes any expenditure that is not clearly related to innovation or that will only contribute to innovation in the longer term. Examples include expenditure on education and funding provided directly to the universities.

[41] *The Oslo Manual: Guidelines for collecting and interpreting innovation data* is currently being revised. The revised manual will be published in the third quarter of 2018: https://www.oecd-ilibrary.org/science-and-technology/oslo-manual_9789264013100-en

Appendix 2 Definitions

The TWIN report uses certain terms that cannot always be precisely defined or delineated. Some of these terms overlap or are used interchangeably. We therefore explain the most important terms in this appendix: Research and Development (R&D), science, (scientific) research, and innovation. To the extent possible, the TWIN report adheres to the terminology applied by Statistics Netherlands (CBS) and derived from the OECD's Frascati Manual. The most recent version of the manual dates from 2015. Regarding innovation-related concepts and terminology, we adhere as much as possible to the OECD's *Oslo Manual: Guidelines for collecting and interpreting innovation data*. This manual is currently being revised.

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 and is mainly associated with basic research. Such 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.

Innovation consists of activities that (should or can) 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. Statistics Netherlands uses R&D as one of the categories for charting innovation in the private sector.

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

Previous editions of Facts and Figures:

F&C 1	Steen, J. van (2008) *Facts and Figures: Universities in the Netherlands.* The Hague: Rathenau Instituut.
F&C 2	Steen, J. van (2009) *Facts and Figures 2: Public research institutes on the Netherlands.* The Hague, Rathenau Instituut.
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Note

This is the twenty-fourth publication in the Rathenau Instituut's *Facts & Figures* series. This edition surveys the Dutch national government's expenditure on R&D and innovation in the 2016-2022 period as well as regional and European funding of R&D and innovation. Data on the national government were collected from the various Dutch Ministries and are based on their 2018 budgets.

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