Chapter 3

Innovation performance in the Netherlands

This chapter reviews aggregate innovation performance in the Netherlands relative to other OECD countries, especially those with advanced innovation systems. It begins with an examination of the levels and flows of expenditure across institutional sectors (business, higher education and government) and of human resources for innovation. It then examines a number of indicators of innovation output (drawn from bibliometrics, patents and trademarks) and uses them to ascertain some salient qualitative characteristics of the Dutch innovation system.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

3.1. Innovation inputs

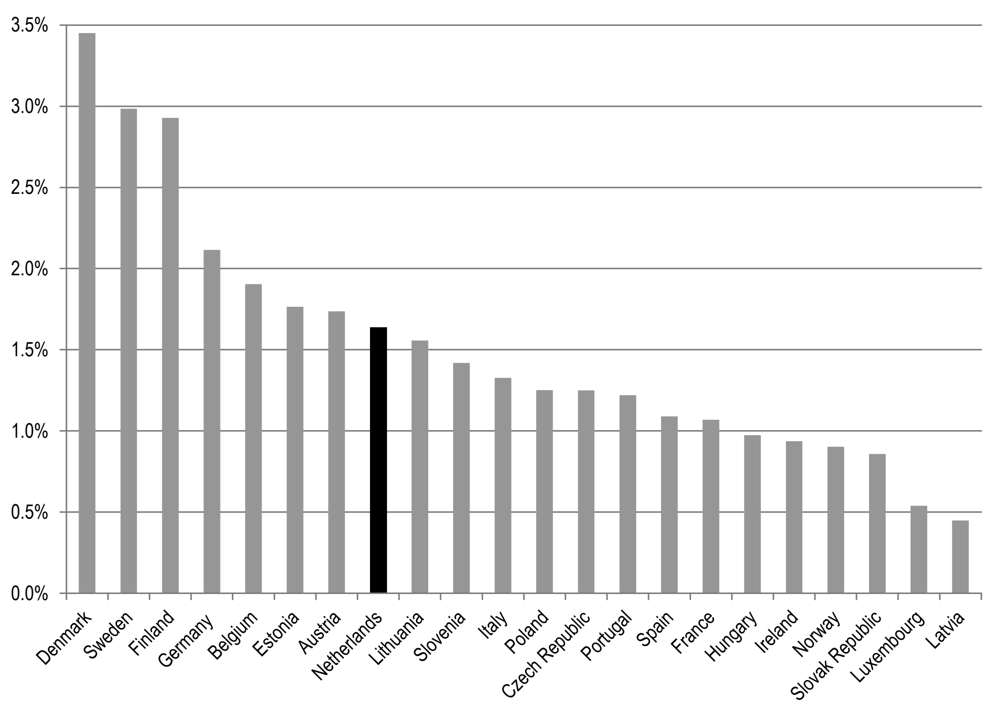
The ability to mobilise resources for innovation differs markedly across countries. In advanced innovation systems with good framework conditions, businesses find innovation profitable and devote considerable financial and human resources to it. In doing so they articulate social demands for innovation and leverage the system's innovation capabilities to meet them. Well-governed public research systems achieve social impact, recognition and trust, allowing governments to legitimise making substantial shares of their budgets available for research and innovation. A holistic assessment of the amount of financial and human resources devoted to innovation needs to take into account the diverse forms of innovation in various institutional sub-contexts. As a result various measures need to be employed.

Innovation and R&D expenditure

Systematically gathered aggregate indicators on innovation expenditure are not widely available. The EU's Community Innovation Survey (CIS) collects information on a broad range of innovation expenditures, not only for R&D, but also for acquisition of machinery, equipment and software and other external knowledge. The ratio of total innovation expenditure to firm turnover is a potentially revealing proxy of the prominence of innovation in firms' activities (Figure 3.1). The Netherlands is positioned at the upper end of countries considered, ahead of France and Norway but behind most other countries with advanced innovation systems.

Figure 3.1. Business innovation expenditure, 2008-10 CIS

Share of total firm turnover (irrespective of innovation)



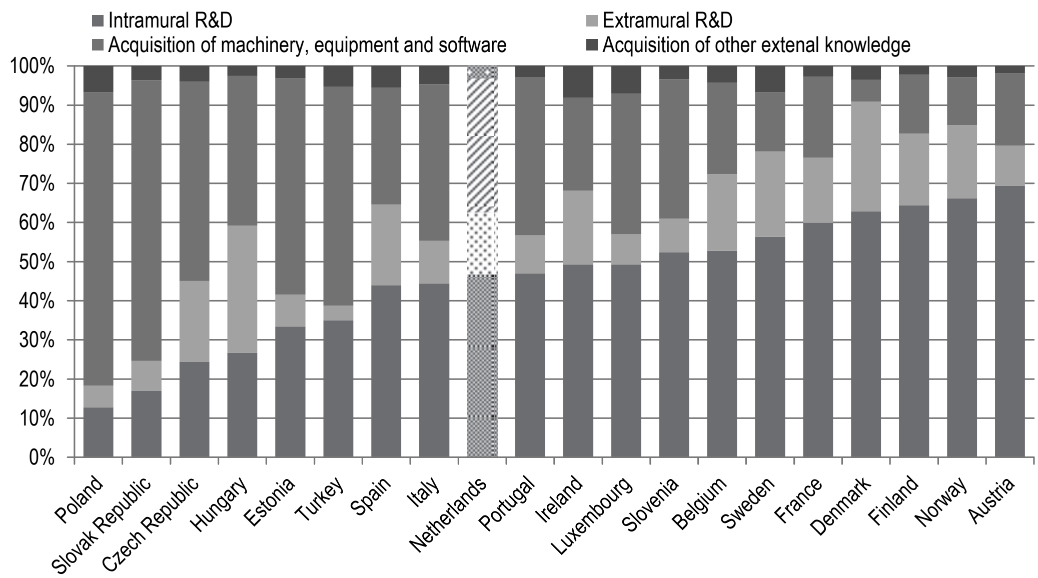
Note: International comparability may be limited as both sides of the fraction can be affected by the characteristics of national samples. For this reason more emphasis should be placed on the general position in the group than on the precise ratio values or country ranks.

Source: Eurostat (2014), Statistics Database, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database.

Figure 3.2 shows a breakdown by type of expenditure, including intramural R&D, extramural R&D, acquisition of machinery, equipment and software and other external knowledge. Austria, Norway and Finland lead with respect to the share of innovation expenditure devoted to intramural R&D. The Netherlands' share of intramural R&D is smaller than that of the other advanced innovation systems. Its share of innovation expenditures in machinery, equipment and software is closer to that of Spain than to that of other advanced systems. This likely partly reflects the diversity of the Dutch economy and the prominence of the services sector relative to manufacturing.

Figure 3.2. Innovation expenditures by type

Percentage of total, 2010



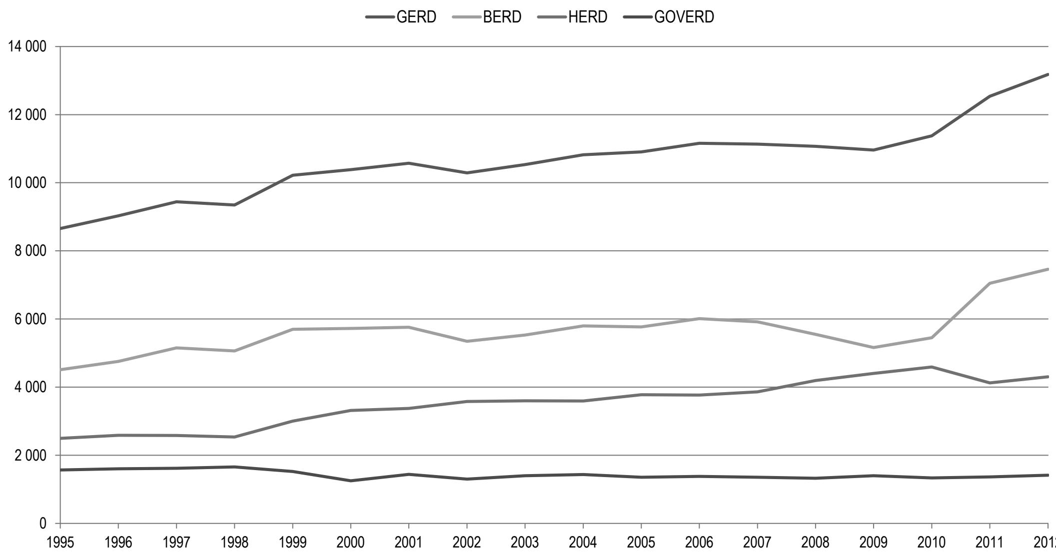
Source: Eurostat (2014), Statistics Database, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database.

In absolute terms, gross domestic expenditure on R&D (GERD) in 2011 totalled USD 14.6 billion (PPP, current prices). The Netherlands spends more on R&D than Belgium or Austria (about USD 10 billion each) and spends roughly the same order of magnitude as Sweden (USD 13.4 billion) (OECD, 2014a).

Real GERD has risen steadily from just over USD 8.6 billion (constant 2005 prices) in 1995 to USD 12.5 billion in 2011 (Figure 3.3), mainly owing to the increase in higher education expenditures on R&D (HERD). Government R&D expenditures display a steady trend since 1995. The sharp increase in business sector expenditure on R&D (BERD) in 2011 and the decline in HERD are mostly due to a break in series that complicates comparisons with previous years. This is because of changes aimed at improving the statistical measurement of R&D activity. According to Statistics Netherlands (2014) the changes included widening the definition of R&D conducted by companies[1], the inclusion for the first time of R&D spending by companies with fewer than ten persons employed and adjustments in the calculation basis for R&D spending in higher education[2]. According to Statistics Netherlands (2014) the changes in measurement resulted in an increase on BERD by 26%. This implies that over 80% of the increase in BERD in 2011 was due to changes in measurement.

Figure 3.3. Netherlands GERD and its components

Business, higher education and government expenditure on R&D, USD millions, constant 2005 prices PPP



Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

As in other advanced innovation systems, the business sector occupies a dominant position in funding research, accounting for 51%, against 34% for government institutions (Table 3.1). Business funds 82% of R&D performed by businesses (USD 6.7 billion PPP), 13% is funded from abroad and 4% by government. The business sector funds 8% of R&D performed by higher education, above the OECD average of around 6% (OECD, 2014a). Business also funds 17% of R&D performed by government, considerably above the OECD average of around 3-4%.

Table 3.1. GERD by sector of performance and source of funds, 2011

EUR millions (percentages of performance in italics)

Sector of performance	Business enterprise	Government	Higher education	Total (performance)
Source of funds				
Business enterprise	5 692	221	326	6 239
	82%	*17%*	*8%*	*51%*
Government	264	792	3 111	4 167
	4%	*60%*	*78%*	*34%*
Higher education	5	33	0	38
	0%	*3%*	*0%*	*0%*
Private non-profit	48	55	302	405
	1%	*4%*	*8%*	*3%*
Funds from abroad	913	218	255	1385
	13%	*17%*	*6%*	*11%*
Total (funding sector)	6 922	1 319	3 994	12 235
	100%	*100%*	*100%*	*100%*

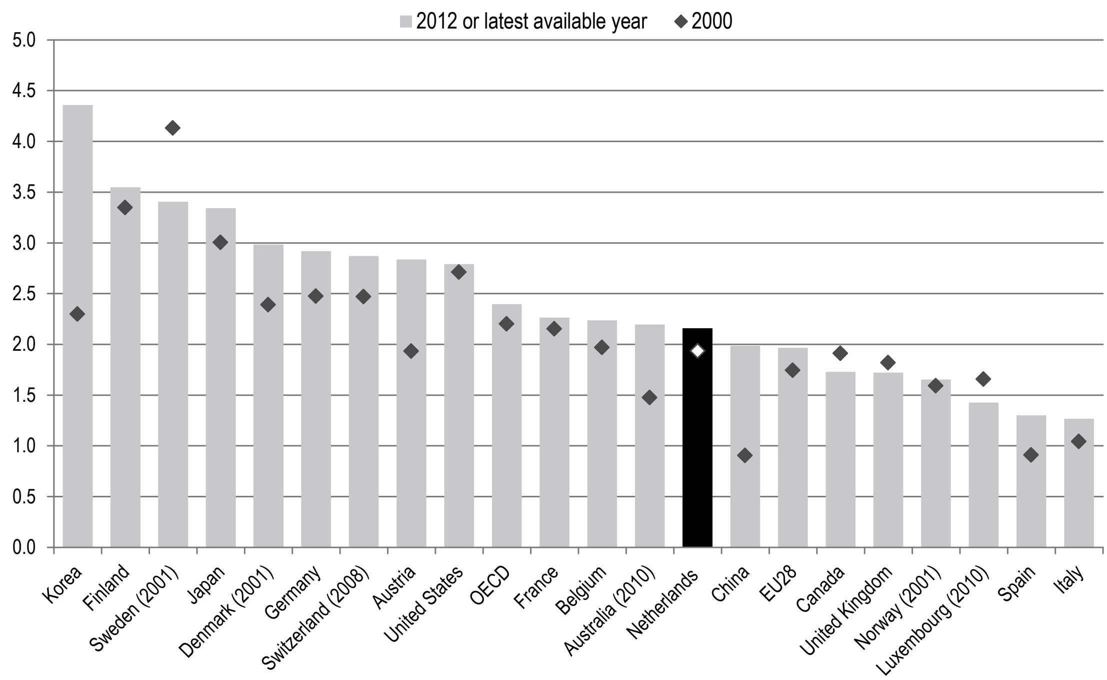
Note: These are revised figures for 2011 published in December 2013 by Statistics Netherlands which are not reflected in internationally comparable OECD statistics. The relative shares of funding and performance are in broad agreement with previously published figures, with the exception of the share of business funding in government performed R&D [11% according to figures in OECD (2014a)] and correspondingly the share of government funding in government performed R&D [71% according to figures in OECD (2014a)].

Source: Statistics Netherlands.

The Netherlands' GERD as share of GDP (commonly referred to as national R&D intensity) is quite stable (rising from 1.97% in 1995 to 2.16% in 2012) (Figure 3.4). The share is below the Lisbon Stategy EU objective of 3% and just above the EU27 average. R&D intensity in the Netherlands is significantly lower than in most other OECD countries with developed innovation systems, such as Korea (4.4%), Finland (3.6%), Sweden (3.4%) and Japan (3.3%). In the Netherlands, BERD intensity as well as HERD and GOVERD intensity have also been quite stable for a long time. GERD and particularly BERD increased in 2011, but this is mostly due to a change in the statistical measurement of research activities in enteprises (see discussion accompanying Figure 3.3 above).

Figure 3.4. Gross domestic expenditure on R&D

As a percentage of GDP, 2000 and 2012 or latest available year

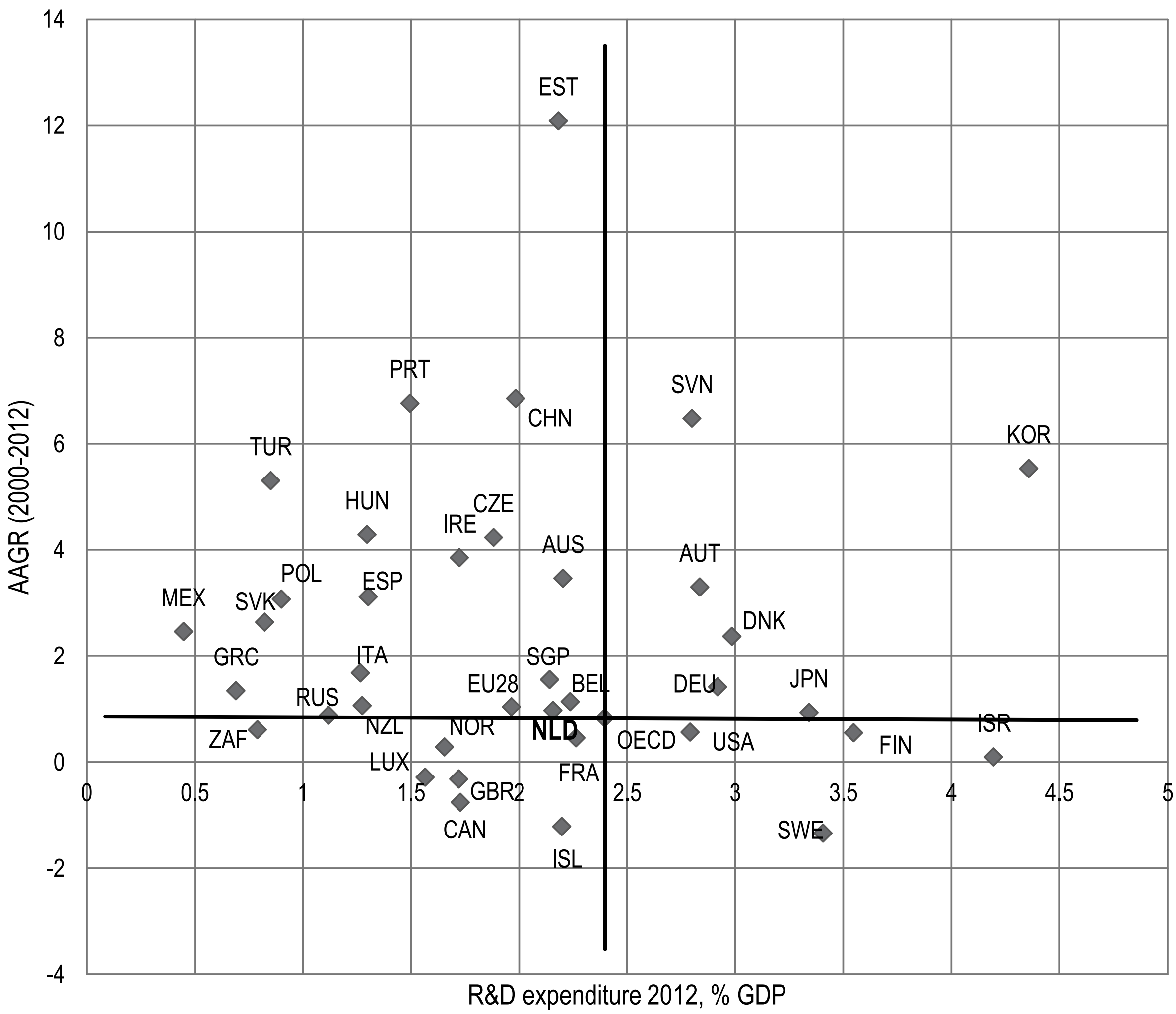


Note: 2012 figures are provisional except for Finland, Norway and Spain. Year of nearest available figures to 2012 or 2000 in brackets.

Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Figure 3.5 shows selected countries' R&D intensity on the horizontal axis and the corresponding average annual increase in R&D intensity over the period 2000-12 on the vertical axis. In 2012, the OECD average R&D intensity was 2.4%, and the OECD average annual increase in R&D intensity between 2000 and 2012 was 0.8%. The Netherlands lagged the OECD average for R&D intensity in 2012. After stagnation over most of the past decade and negative growth between 2007 and 2009, the country's R&D intensity has begun to rise since 2010. For 2000-12, the Netherlands' average annual rise in R&D intensity over 2000-12 stood at 0.9%, a figure that is however heavily influenced by the 2011 break in series.[3] In any case, the average annual increase in R&D intensity is below that of advanced systems such as Korea, Austria, Denmark and Germany.

Figure 3.5. R&D intensity, 2012 (or latest year available) and average annual growth rate of R&D intensity, 2000-12

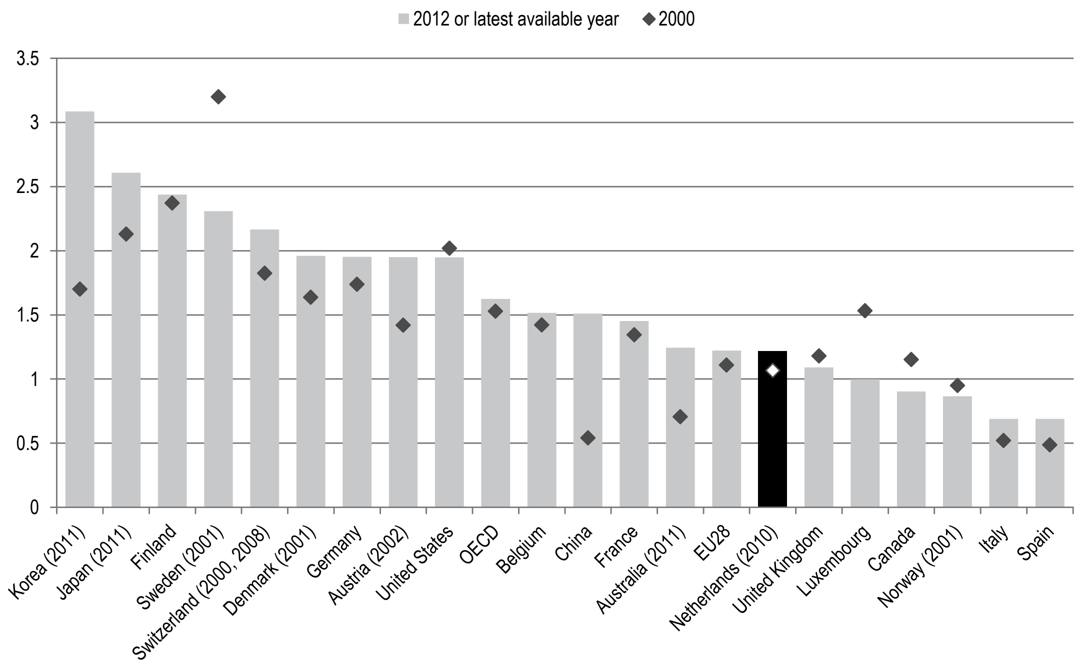


Source: OECD (2014a), *Main Science and Technology Indicatiors*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Figure 3.6 presents BERD intensity in the Netherlands and a selection of other countries. At 1.2%, the Netherlands' BERD intensity is below that of countries with advanced innovation systems such as Korea (3.1%), Japan (2.6%) and Sweden (2.3%), but also below the OECD average of 1.6%. BERD intensity in the Netherlands only increased from 1.06% in 2000 to 1.22% in 2012. Again, the increase is largely explained by a break in series in 2011.

Figure 3.6. Business expenditure on R&D

As a percentage of GDP, 2000 and 2012 or latest available year



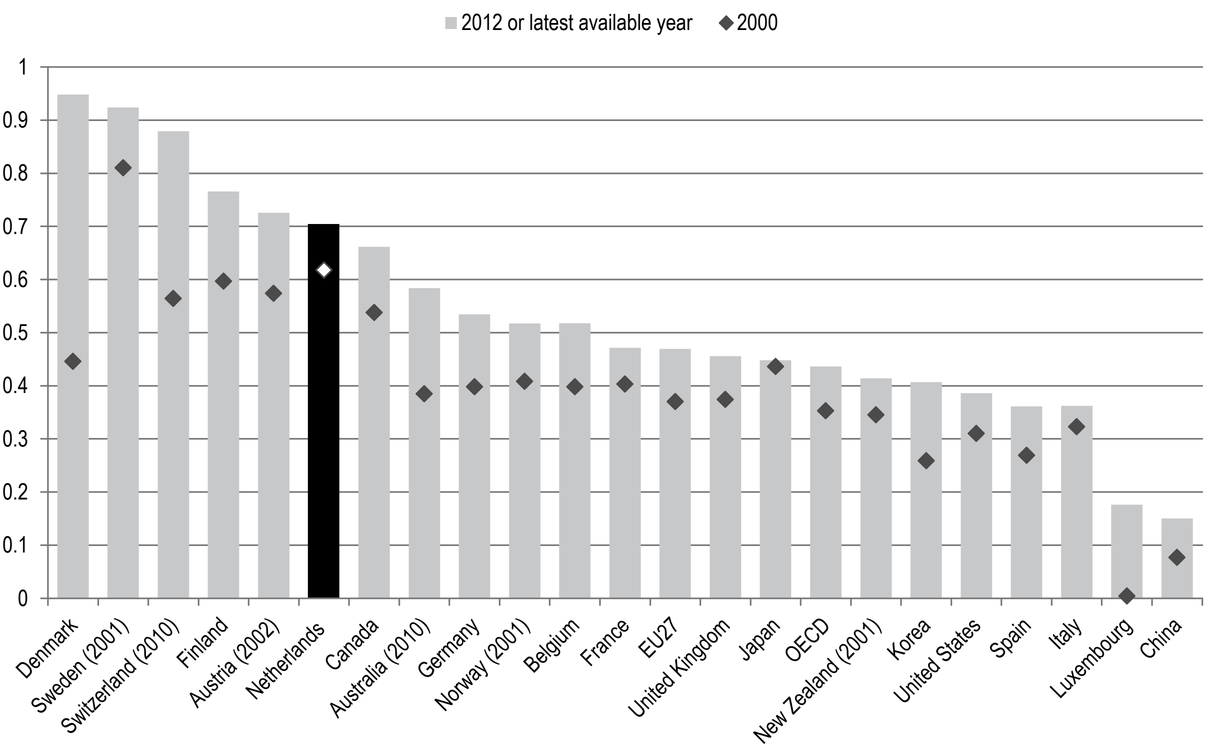
Note: 2012 figures are provisional except for Finland, China, Luxembourg, Norway, Spain and Switzerland.

Source: OECD (2014a), *Main Science and Technology Indicatiors*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Figure 3.7 displays HERD intensity. Like other advanced systems, the Netherlands (0.70%) has a HERD intensity above the OECD average (0.44%). Only Denmark (0.95%), Sweden (0.92%), Switzerland (0.88%), Finland (0.77%), and Austria (0.72%) have higher HERD intensities. As in most OECD countries, HERD intensity in the Netherlands increased since 2000 from 0.62%[4] to 0.70% in 2012. However, the increase was less pronounced than in other advanced systems, especially Denmark, but also Switzerland, Finland and Austria. The Netherlands' high HERD intensity has supported the strong position of its higher education institutions (HEIs) in international rankings, and their successful participation in European instruments.

Figure 3.7. HERD as a percentage of GDP in selected countries

2000 and 2012 or latest available year



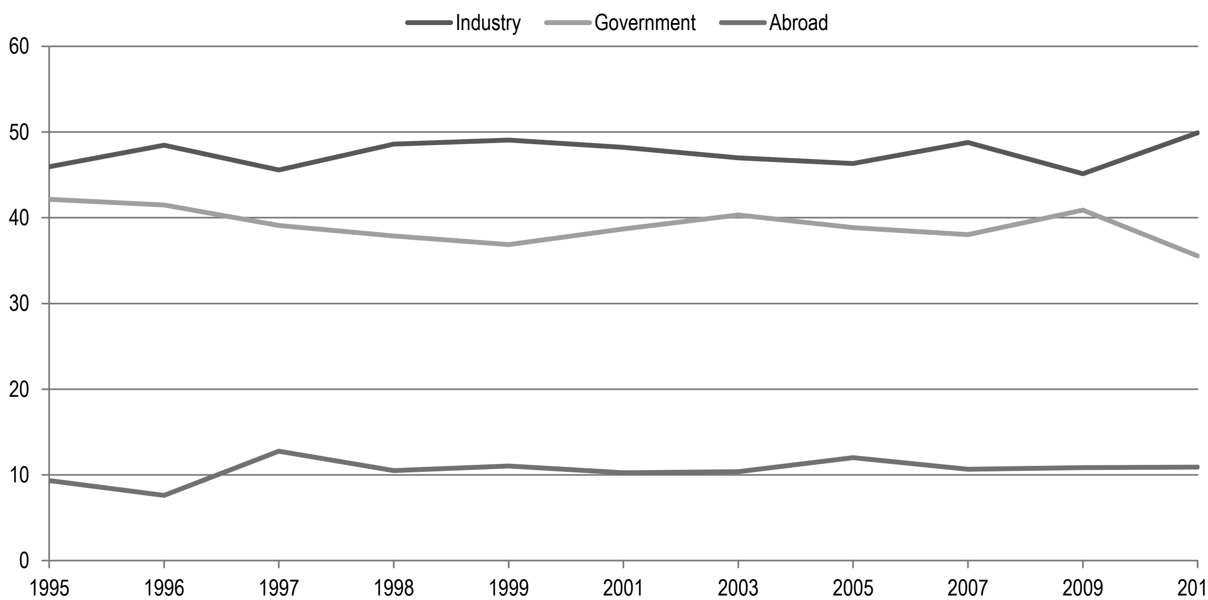
Note: The latest available year was 2011 for Japan, Korea, Luxembourg and New Zealand,. 2010 for Australia.

Source: OECD (2014a), *Main Science and Technology Indicatiors*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Looking at the evolution of R&D funding sources across time, the share of R&D financed by industry increased from around 46% of total R&D financing in 1995 to 50% in 2011 (Figure 3.8). The share of government financing decreased over the period from 42% to approximately 35%. The share of GERD funded from abroad has been stable around 10%. Despite the increases, compared to other countries with advanced innovation systems, the Netherlands still has a relatively small share of business R&D funding (50%), below both the EU28 (54%) and the OECD average (59%) and significantly behind countries such as Japan, Korea, Finland, Germany or Denmark (Figure 3.9).

Figure 3.8. Share of gross domestic expenditure on R&D financing by sectors

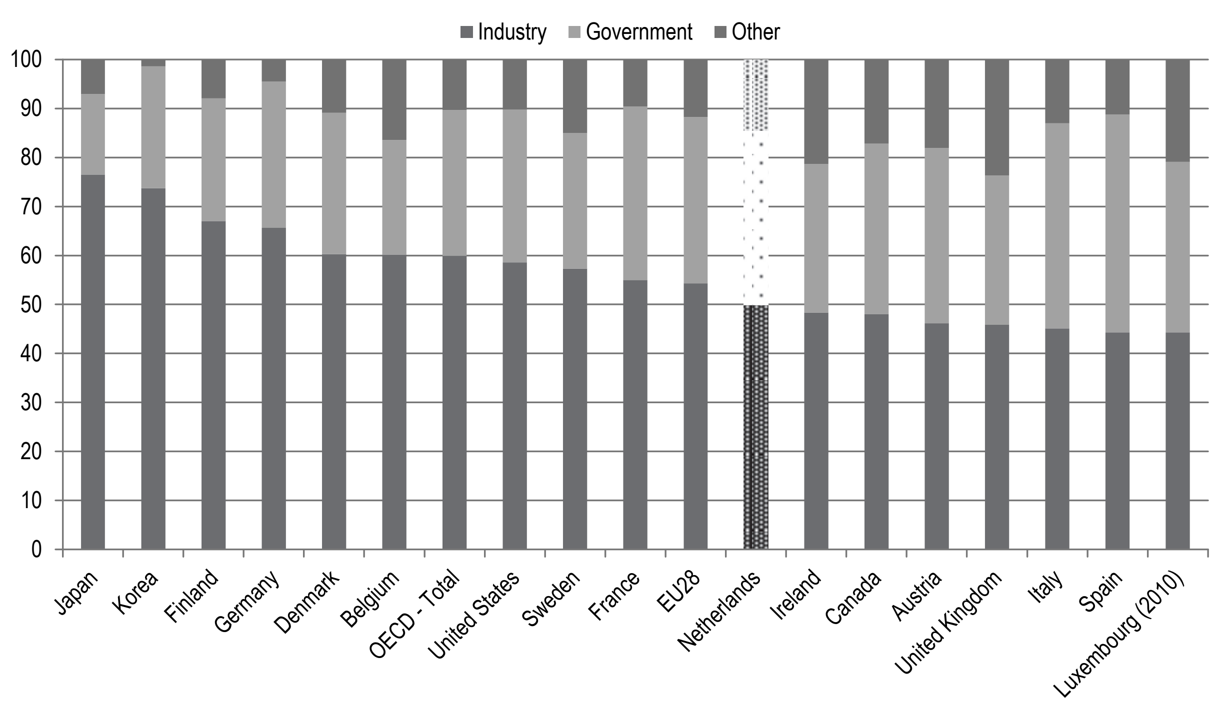
Percentage



Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Figure 3.9. Gross domestic expenditure on R&D by source of funding, selected countries

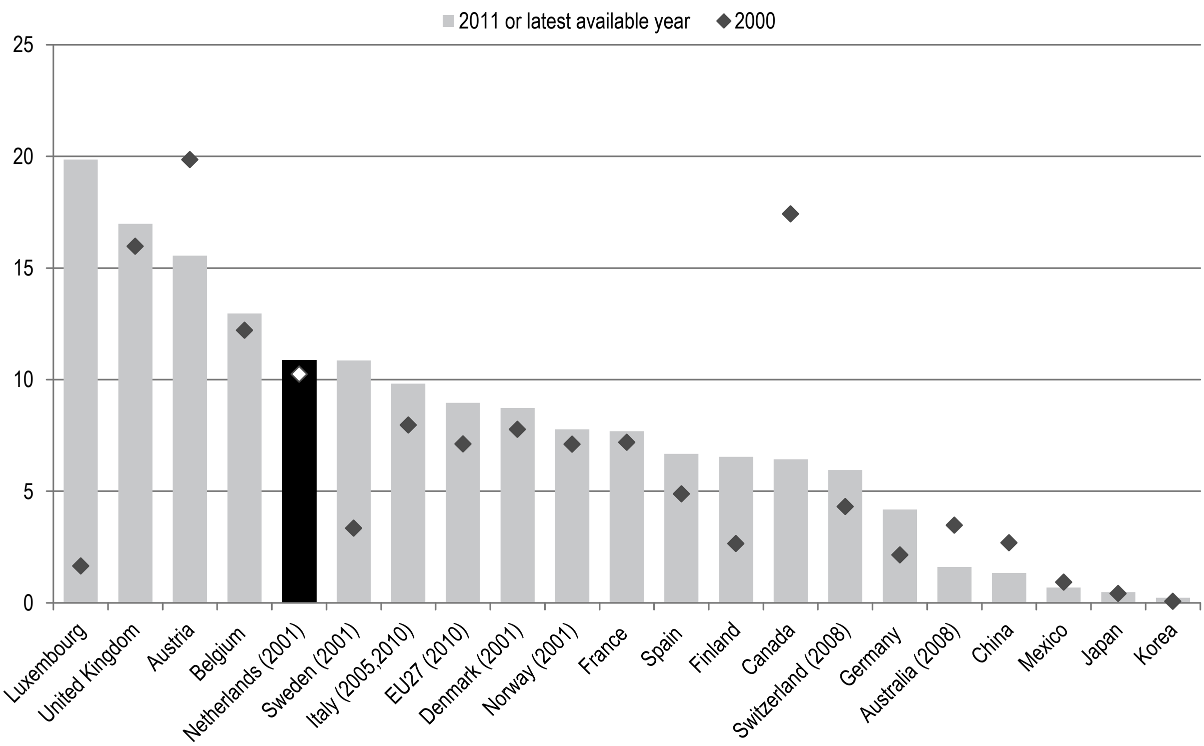
Percentage, 2011 or latest available year



Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

The share of GERD financed from abroad is relatively high in the Netherlands (in 2011 around 11%) and has been relatively stable (10.2 % in 1995) (Figure 3.10). The Netherlands is at the same level as Sweden (11), but below the levels of the United Kingdom (17%), Austria (16%) and Belgium (13%).

Figure 3.10. Percentage of GERD financed from abroad in selected countries



Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Human resources for science, technology and innovation

Human resources are the foundation of knowledge-based economies and thus a key issue for innovation policy. The many ways in which human resources relate to innovation are described in Box 3.1, which lists the wide array of knowledge and skills beyond science and engineering that are relevant for innovation. There are many ways individuals can build and accumulate human capital, such as education and training, work-place experience and international migration. The way countries leverage their human resources for research and innovation can often be improved.

Box 3.1. How do human resources spur innovation?

Generating new knowledge

Skilled people generate knowledge that can be used to create and introduce an innovation. Carlino and Hunt (2009) found that an educated workforce is the decisive factor in the inventive output of American cities; a 10% increase in the share of the workforce with at least a college degree raises quality-adjusted patenting per capita by about 10%. Data on Spanish regions also found a positive relationship between human capital and number of patent applications (Gumbau-Albert and Maudos, 2009). Lin (2009), using “new work” (i.e. new statistical occupational categories) as an indicator of innovation, found that locations with a high share of college graduates have more jobs requiring new combinations of activities or techniques. Such jobs appeared in the labour market along with application of new technologies and knowledge.

Adopting and adapting existing ideas

In many countries, incremental innovations involving modifications and improvements to existing products, processes and systems represent the bulk of innovation activity and can have great significance for productivity and the quality of goods or services. Higher skill levels raise economies’ absorptive capacity and ability to perform incremental innovation by enabling people to understand how things work and how ideas or technologies can be improved or applied to other areas. Importantly, skills for adoption and adaptation are beneficial not just in R&D teams but across the wider workforce and population. Toner (2007) argued that the production workforce plays a strong role in incremental innovation when management encourages and acts on suggestions for improvement. Skills and absorptive capacity are also required in functions and activities such as marketing. For their part, skilled users and consumers of products and services can contribute to the adaptation of existing offerings by providing suppliers with ideas for improvement.

Enabling innovation through capacity to learn

Skilled people are better able to learn new skills, adapt to changing circumstances and do things differently. In the workplace, educated workers have a better set of tools and a more solid base for further “learning”. This enhances their ability to contribute to innovation. Leiponen (2000) found that, in contrast to non-innovating firms, innovators’ profitability was significantly influenced by the amount of higher education and higher technical and research skills possessed by employees.

Complementing other inputs to innovation

By interacting with other inputs to the innovation process, such as capital investment, people with better skills can spur innovation. Australian research has shown that human capital complements investment in information and communication technologies (ICTs), with the uptake and productive use of ICTs significantly influenced by management and employee skills (Gretton et al., 2004). A Canadian study found that a firm’s human resource strategy, as well as its innovation strategy and business practices, influenced the extent to which it adopted new advanced technologies (Baldwin et al., 2004). Equally, a firm’s lack of human capital is likely to exacerbate other constraints on innovation. Mohnen and Röller (2001) concluded that measures to remove barriers to innovation may be more effective if also explicitly directed at increasing levels of internal human capital.

Generating spillovers

Human capital can contribute indirectly to innovation through the “spillovers” generated by skilled people. Not only does skilled workers’ knowledge diffuse throughout their workplace and the wider environment, they may also, through their interactions and their explicit or implicit actions as role models, spur accumulation of human capital by other workers. The resulting spread of ideas and upgrading of competencies can spur innovation. It has also been suggested that entrepreneurs “spill” knowledge by commercialising ideas that would otherwise not be pursued within the organisational structure of an existing firm (Acs *et al*., 2009).

…/…

Box 3.1. How do human resources spur innovation? *(continued)*

Contributing to social capital

Higher levels of human capital enhance social capital, and social capital can support innovation in several ways, predominantly through its effect on trust, shared norms and networking, which improve the efficiency and exchange of knowledge. Some studies suggest that higher levels of trust can promote venture capital financing of risky projects, owing to factors such as reduced monitoring costs (Akçomak and ter Weel, 2009). Closer relationships among actors can lead to the exchange of proprietary information and underpin more formal ties (Powell and Grodal, 2005), while social networks may also enable firms to work through problems and get feedback more easily, thereby increasing learning and the discovery of new combinations (Uzzi, 1997). Firms with higher levels of social capital are more likely to engage specialist knowledge providers, such as the public science base, to complement their internal innovation activities (Tether and Tajar, 2008). Social capital is also a feature of the "invisible colleges" that link researchers across geographic space in pursuit of common research interests.

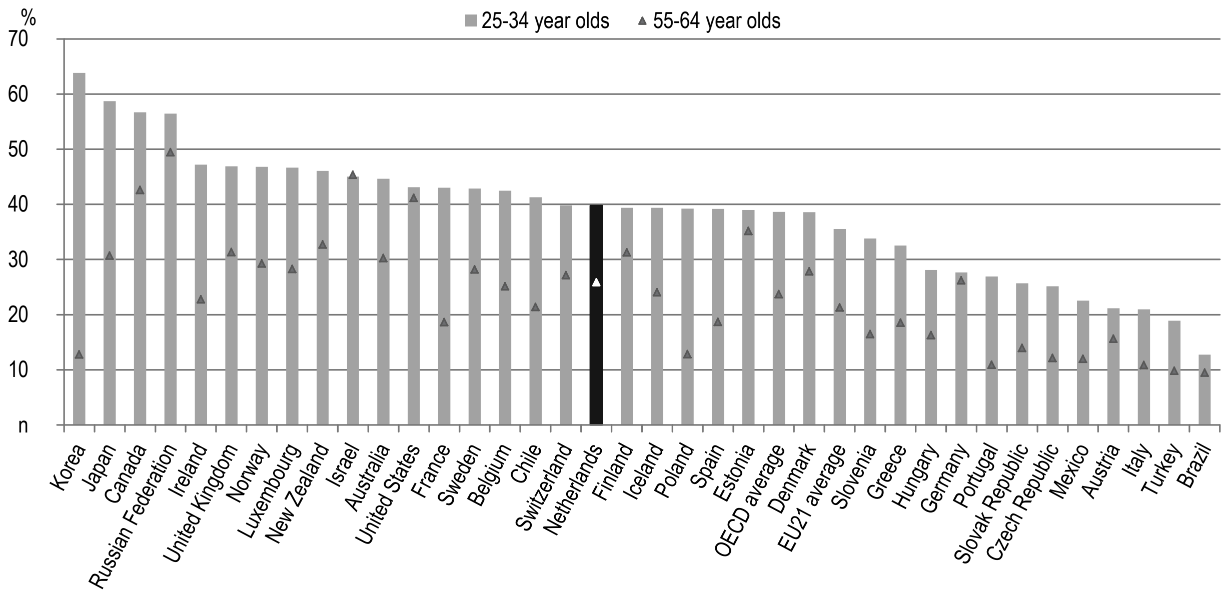
Source: OECD (2011), *Skills for Innovation and Research*, OECD Publishing, doi: 10.1787/9789264097490-en.

Education and training

In 2010, the Netherlands invested about 6% of GDP in education, a share equivalent to the OECD average. It spent USD 11 800 PPP per student in secondary education, close to USD 3 000 PPP more than the average OECD country (OECD, 2013a). The Netherlands spent about USD 17 200 PPP per student in tertiary education, around USD 3 600 PPP more than the average OECD country. The shares of private expenditures in tertiary education, however, amounted only to 28.2% whereas for OECD countries the average was 31.6%. This difference may reflect the fact that public tertiary education funding is sufficient, but may also reflect low private spending on adult education. Dutch private investments focus on primary, lower secondary and upper secondary education, with 13.1% of expenditures, while the OECD average is 8.5%.

Tertiary educational attainment can be used as a broad measure of a country's ability to accumulate human capital of potential relevance to innovation. In 2011, the Netherlands reported tertiary attainment rates of 32% in adults, matching the OECD average (32%) and exceeding that of the EU (29%). Figure 3.11 breaks down attainment rates between younger (25-34 years old) and older (55-64 years old) age groups. For the Netherlands, these levels correspond to 40% and 26% of the respective age groups. The Netherlands has a highly educated workforce overall, as its indicators match or exceed OECD and EU averages. The Netherlands surpasses Finland and Denmark in the young adult age group, but Norway and Sweden perform better in both age groups. At 72%, the share of the population 25-64 years of age having completed upper secondary education lags slightly behind the OECD and EU averages of 75% and 76%, respectively (OECD, 2013a). The relatively lower ranking of the older age group in the Netherlands is probably due to the fact that until a few years ago there were hardly any short-duration tertiary education programmes.

Figure 3.11. Percentage of the population with tertiary education by age group, 2011



Source: OECD (2013d), *Education at a Glance*, OECD Publishing, doi: 10.1787/eag-2013-en.

The Netherlands stands out as having one of the lowest percentages of young people not in employment, education or training (NEET) among all OECD countries. However, this proportion has risen significantly since the start of the global financial crisis. The 15-29 year olds with tertiary education have been particularly affected; the proportion of NEETs rose from 2% in 2008 to 5% in 2011 (OECD, 2013a). Nevertheless, this indicator remains well below the OECD average of 13% in 2011.

Dutch tertiary education institutions are producing more graduates (Table 3.2). In 2011, 38.9% of the 20-29 year age group participated, considerably above the EU27 average of 31.9%. Between 2006 and 2011 the average annual increase was also one of the highest at 5.7%. Tertiary students in science and engineering (S&E) fields account for 13.9% of students, around half of the EU27 average of 25.3%. The Netherlands is not closing this gap, as the growth rate in S&E is the same as that of EU27 (3.8%). The lag is particularly pronounced with respect to countries with advanced innovation systems, such as Austria, Sweden, Denmark and Germany, as well as Ireland. The lag is quite even in terms of the shares of tertiary students across broad subjects ("science, mathematics and computing" and "engineering, manufacturing and construction").

Table 3.2. Students participating in tertiary education, total and selected fields of study

Share of the population aged 20–29 and of all tertiary students, EU27 and selected countries, 2011

	All fields			S&E[1]			Science, mathematics and computing	Engineering, manufacturing and construction
	Total number in 1000s	As a % of population aged 20-29	AAGR 2006-11	As a % of population aged 20-29	As a % of all tertiary students	AAGR 2006-11	As a % of all tertiary students	As a % of all tertiary students
Austria	362	34.1	6.8	8.7	25.4	7.8	11.0	14.5
Belgium	462	33.6	2.9	5.3	15.6	2.1	5.2	10.4
Denmark	259	39.6	1.9	7.6	19.1	2.5	8.5	10.6
Germany	2 763	28.1	3.4	9.0	32.1	4.2	14.3	17.8
Hungary	382	29.4	-2.2	6.5	22.1	1.4	7.2	14.9
Ireland	196	29.9	1.0	7.8	26.2	3.5	14.4	11.8
Italy	1 968	29.9	-0.4	7.7	25.8	1.1	8.1	17.7
Netherlands	780	38.9	5.7	5.4	13.9	3.8	6.2	7.7
Norway	230	36.0	1.2	6.0	16.6	1.6	8.5	8.1
Poland	2 080	35.8	-0.3	7.8	21.9	1.4	8.0	14.0
Portugal	396	30.4	0.7	8.8	28.9	0.4	7.2	2.2
Spain	1 950	36.5	1.3	10.0	27.5	0.0	9.8	17.7
Sweden	464	37.8	1.4	9.8	25.9	1.5	9.2	16.7
Switzerland	258	26.0	4.3	6.1	23.6	3.8	9.8	13.8
United Kingdom	2 492	29.3	1.5	6.4	22.0	1.3	13.5	8.5
EU27	20 128	31.9	3.7	8.1	25.3	3.9	10.3	15.0

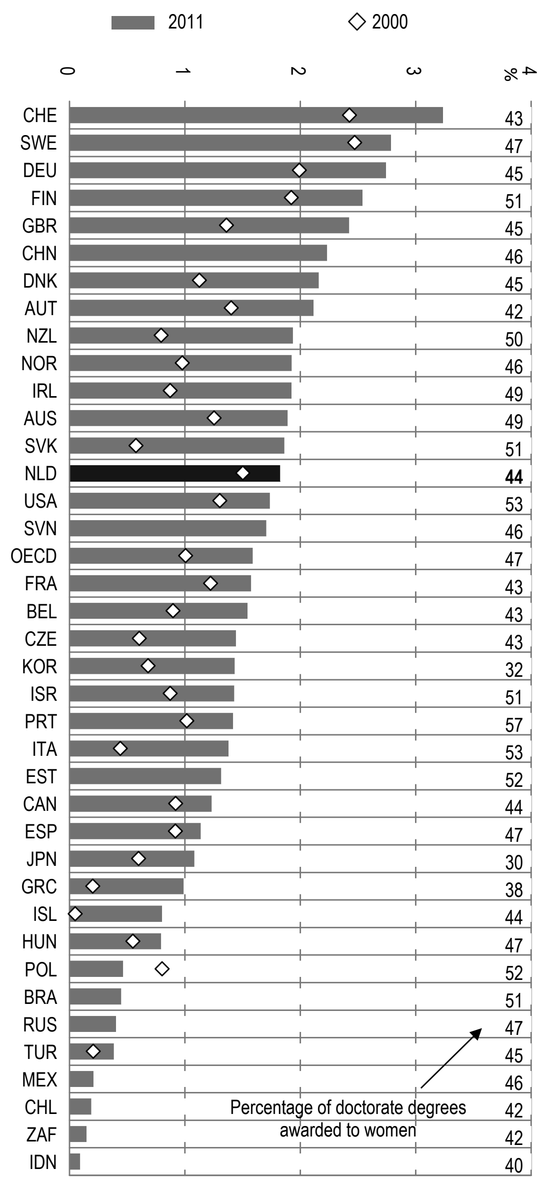
Note: 1. S&E = science, mathematics, computing + engineering, manufacturing and construction. AAGR = average annual growth rate.

Sources: Eurostat (2014), Statistics Database, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database.

The Netherlands produces fewer doctoral graduates than many other OECD countries (Figure 3.12). Still, at 1.8%, the share of doctoral graduates in the reference age cohort is above the OECD average (1.6%) and higher than the United States (1.7%), France (1.6%) and Belgium (1.5%). Between 2000 and 2011, the Dutch share of doctoral graduates grew by only 0.3 percentage points; growth was higher in Denmark (1%), the United Kingdom (1%) and Norway (0.9%).

Figure 3.12. Graduation rates at the doctoral level, 2000 and 2011

As a percentage of the population in the reference age cohort

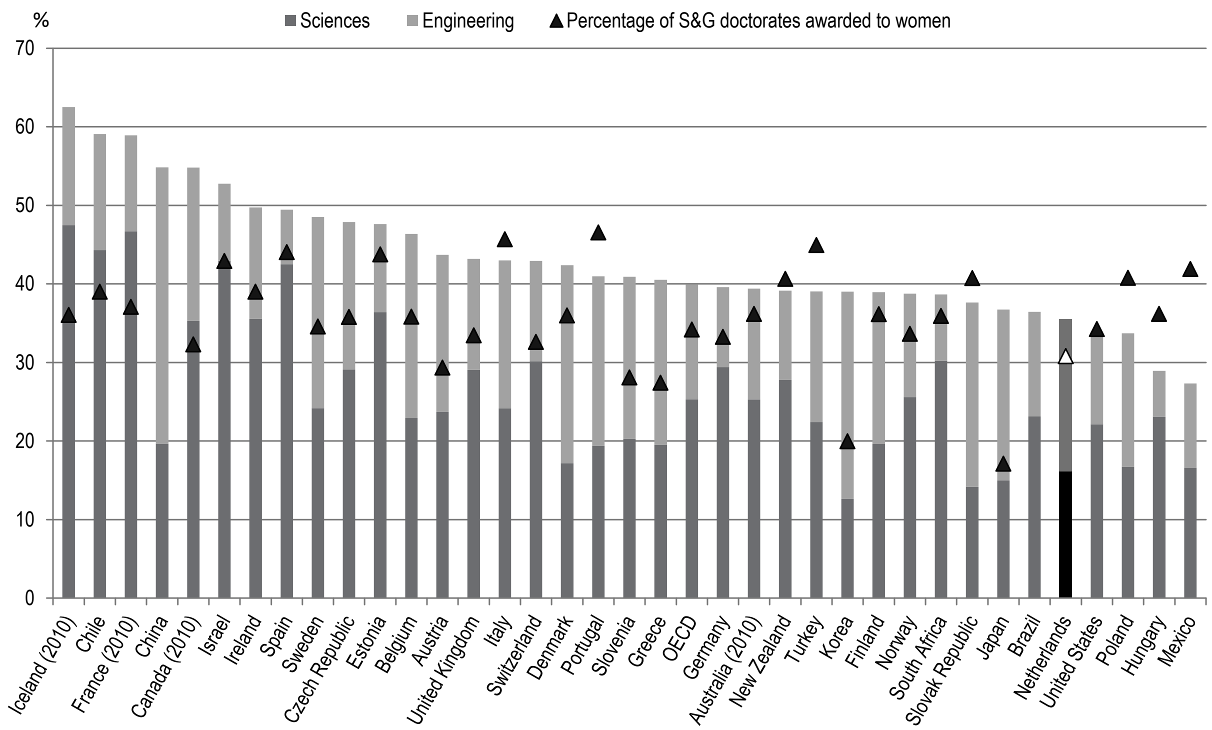


Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing, doi: 10.1787/sti_scoreboard-2013-en.

In keeping with the pattern observed in Table 3.2 for general tertiary education, the share of S&E doctorates awarded in the Netherlands in 2011 (35%) is below the OECD average (40%). Figure 3.13 puts the Netherlands behind countries with advanced innovation systems such as Sweden (49%), Belgium (46%), Germany (40%) and Norway (39%). This is mainly due to the low share of doctoral degrees in science fields (16% in the Netherlands against the OECD average of 25%). At the same time, engineering graduates at the doctoral level (19%) surpass the OECD mean (15%) as well as the British (14%), Norwegian (13%) and German (10%) levels.

Figure 3.13. Science and engineering graduates at the doctoral level, 2011

As a percentage of all new degrees awarded at the doctoral level



Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing, doi: 10.1787/sti_scoreboard-2013-en, p. 95.

The Programme for International Student Assessment (PISA) is a triennial international survey to assess education systems by testing the skills and knowledge of 15-year-old students. Table 3.3 shows countries' mean PISA scores for 2012 in mathematics, reading and science. In 2012, the Netherlands scored considerably higher than the OECD average in all three areas, i.e., mathematics: 523 against 494; reading: 511 against 496; and science: 522 against 501. These scores are suggestive of the high quality of the Dutch education system up to the secondary level and place it among the world leaders.

Table 3.3. Mean PISA scores, 2012

	Mathematics	Reading	Science
OECD average	**494**	**496**	**501**
Korea	554	536	538
Japan	536	538	547
Switzerland	531	509	515
Netherlands	523	511	522
Estonia	521	516	541
Finland	519	524	545
Canada	518	523	525
Poland	518	518	526
Belgium	515	509	505
Germany	514	508	524
Austria	506	490	506
Australia	504	512	521
Slovenia	501	481	514
Denmark	500	496	498
France	495	505	499
United Kingdom	494	499	514
Norway	489	504	495
Portugal	487	488	489
Italy	485	490	494
Spain	484	488	496
Russian Federation	482	475	486
Sweden	478	483	485
Romania	445	438	439
Thailand	427	441	444
Chile	423	441	445
Malaysia	421	398	420
Mexico	413	424	415
Uruguay	409	411	416
Costa Rica	407	441	429
Brazil	391	410	405
Argentina	388	396	406
Tunisia	388	404	398
Colombia	376	403	399
Indonesia	375	396	382
Peru	368	384	373

Significantly above the average

Not significantly different from the average

Significantly below the average

Source: OECD (2014b), *PISA 2012 Results: What Students Know and Can Do (Volume I, revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, OECD Publishing, doi: 10.1787/9789264208780-en.

Table 3.4 contains three skill indicators for adult populations gathered by the OECD's Programme for the International Assessment of Adult Competencies (PIAAC). In particular, the table shows the 2012 mean proficiency scores of 16-65 year olds in literacy and numeracy, and the percentage of 16-65 year olds scoring at Level 2 or 3 in problem solving in technology-rich environments. Results in the Netherlands exceed by a wide margin the average of most participating countries. It is only outperformed by Finland in literacy and by Japan and Finland in numeracy. Its performance in problem solving in technology-rich environments is only surpassed by that of Sweden and matched by Finland. The Netherlands is one of the few countries, along with Norway and Sweden, to have less than 7% of the adult population lacking the basic skills needed to use ICTs. Around 16% of 25-64 year olds in the Netherlands participated in education and training in 2012 (Eurostat, 2014). Though this share is above the EU28 average of 9%, it is considerably smaller than the 30% share of the leaders, Denmark and Switzerland, and is also lower than that of Sweden, Finland and Norway.

Table 3.4. Summary of proficiency in key information-processing skills, 2012

Countries	Literacy (mean score)	Numeracy (mean score)	Problem solving in technology-rich environments (% at level 2 or 3)
OECD			
National entities			
Australia	280	268	38
Austria	269	275	32
Canada	273	265	37
Czech Republic	274	276	33
Denmark	271	278	39
Estonia	276	273	28
Finland	288	282	42
France	262	254	m
Germany	270	272	36
Ireland	267	256	25
Italy	250	247	m
Japan	296	288	35
Korea	273	263	30
Netherlands	**284**	**280**	**42**
Norway	278	278	41
Poland	267	260	19
Slovak Republic	274	276	26
Spain	252	246	m
Sweden	279	279	44
United States	270	253	31

Significantly above the average

Not significantly different from the average

Significantly below the average

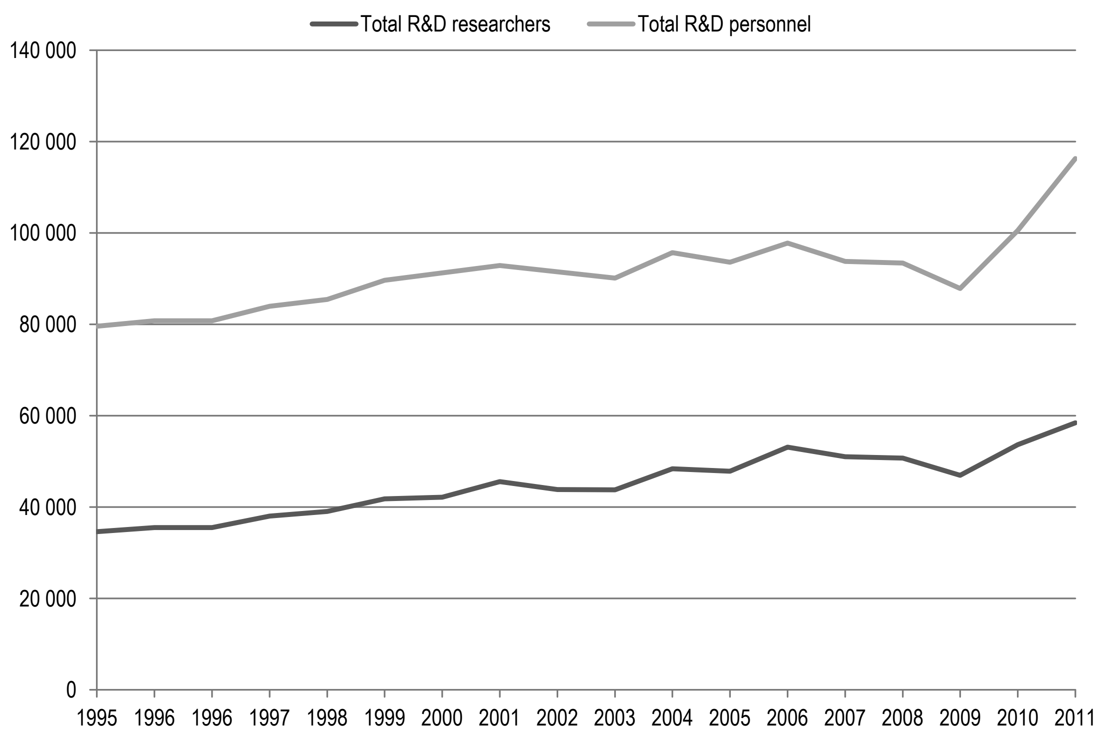
Source: OECD (2013c), *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing. doi: 10.1787/9789264204256-en.

R&D personnel

R&D personnel includes researchers and other support staff such as technicians and managers. The number of R&D personnel over time provides a perspective on the changing nature of countries' R&D activities. As a large portion of R&D investment goes to the salaries of research personnel, headcounts correlate strongly (albeit imperfectly) with GERD. Shifts in the relation between GERD and R&D personnel may indicate a change in policy focus, either towards the improvement of human resource capabilities or towards the development of infrastructures (e.g. laboratories and research centres). While the number of R&D personnel provides valuable information about the supply of human resources, it does not allow for evaluating the quality of their skills and how these are deployed.

Figure 3.14 shows that, with the exception of minor fluctuations in recent years, the number of R&D personnel and of researchers (full-time equivalent, FTE) has increased in the Netherlands over the last 15 years. R&D personnel rose from around 80 000 in 1995 to more than 116 000 in 2011. While a decline was observed between 2006 and 2009, growth seems to have resumed. The gap between the number of total R&D personnel and the total number of researchers was quite stable over 1995-2010 but widened considerably in 2011 owing to changes in the measurement of R&D activities in the business sector.[5]

Figure 3.14. R&D personnel and researchers (full-time equivalent) in the Netherlands, 1995-2011

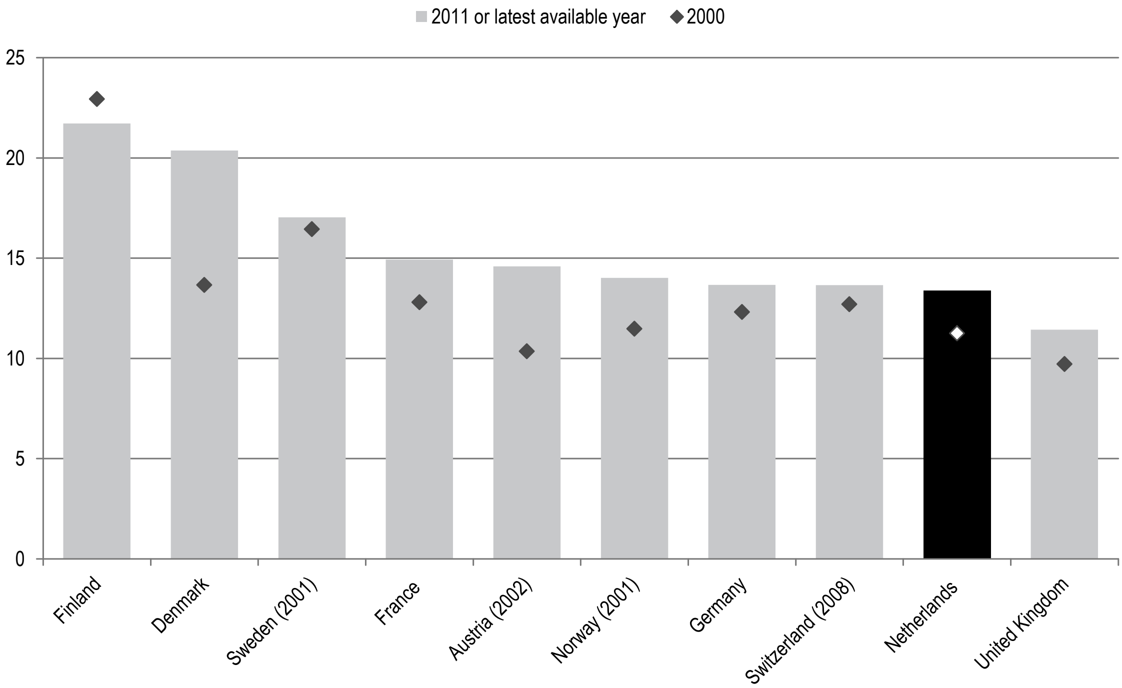


Note: A break in series occurred in 2011.

Source: OECD (2014a), *Main Science and Technology Indicatiors*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

In an international perspective, total R&D personnel (FTE) per thousand total employment in the Netherlands (13.4%) is on the lower end of the group of comparator countries with advanced innovation systems (Figure 3.15). Moreover, the Netherlands' 2.1 percentage point growth between 2000 and 2011 was weaker than in Austria (4.5%) and Denmark (6.5%).

Figure 3.15. Total R&D personnel (FTE) per thousand total employment in selected countries, 2000 and 2011



Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

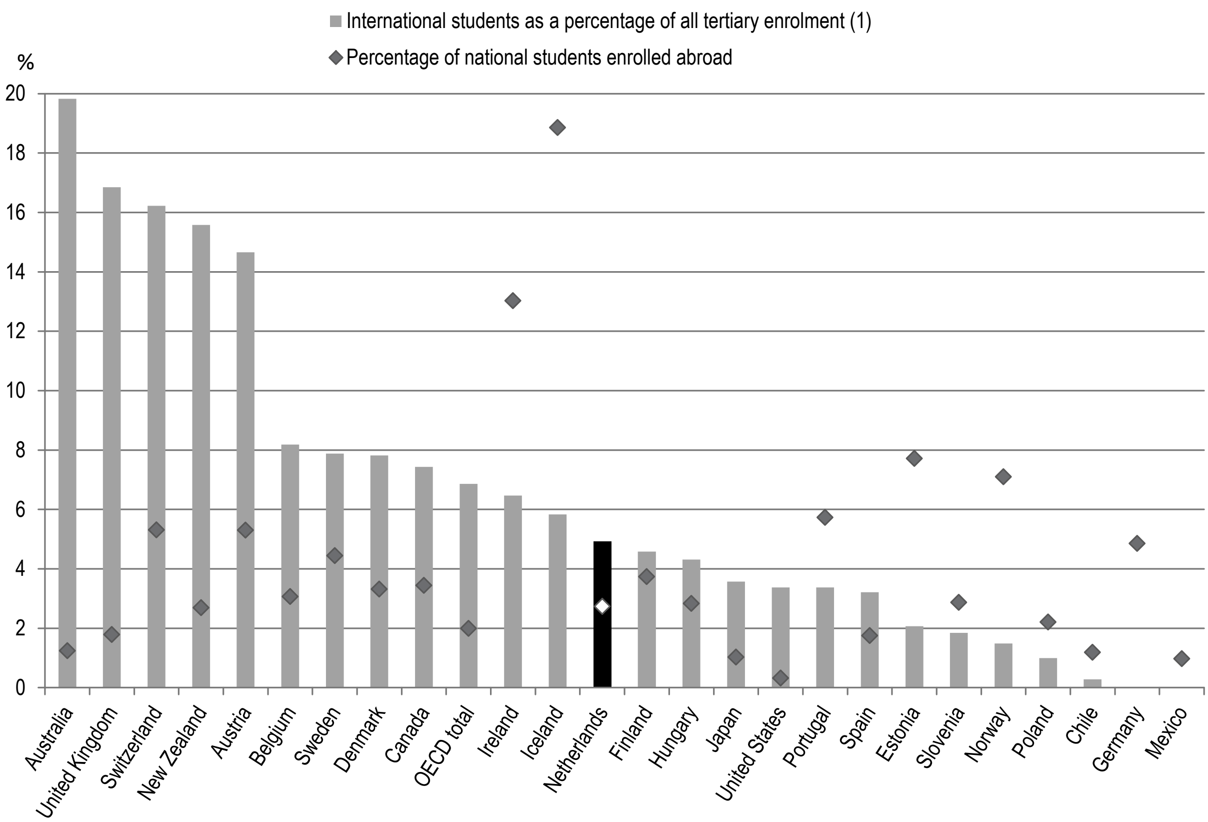
International migration of human resources for S&T and innovation

The migration of highly skilled human resources contributes to the creation and circulation of knowledge. Migrating individuals bring with them skills, knowledge and talent. Obtaining international experience can be important for many researchers and for their home systems, particularly if they return. Internationally mobile human resources can help research systems grow, improve knowledge flows and collaboration across countries, and lead to entrepreneurship and employment creation. Besides economic incentives, many other factors may contribute to the international migration of highly skilled people, such as a high-quality research infrastructure and opportunities to work with renowned scientists. In addition, language and quality of life also make certain countries more attractive for immigration than others (OECD, 2008).

The percentage of nationals enrolled abroad provides a view of outward mobility. Similarly, inward mobility can be proxied by the number of international students.[6] Figure 3.16 shows the performance of OECD countries on these two indicators for 2011. The Netherlands has 2.7% of its national students enrolled abroad, somewhat above the OECD average (2.0%). Conversely, at 4.9%, the country has a smaller share of international students among its tertiary education institutions than the OECD average (6.9%). In great part, this is due to the Dutch higher education's binary system, split between universities of applied sciences (UAS) and academic universities (WO). The latter are more likely to attract foreign students, while the former are large by international standards. In 2011, 44% of all international students in the Netherlands were enrolled in social science, business and law programmes (OECD, 2013b). Data from the

Association of Dutch Universities (VSNU) suggests that the share of foreign scientific personnel in universities has increased consistently in the past decade, from 20% in 2003 to 33% in 2012 (Rathenau Institute, 2013).

Figure 3.16. Mobility patterns of tertiary students, 2011



Note: 1. Data for Switzerland excludes tertiary-type B programmes.

Source: OECD (2013d), *Education at a Glance 2013: OECD Indicators*, OECD Publishing. doi: 10.1787/eag-2013-en.

The status of women in Dutch research

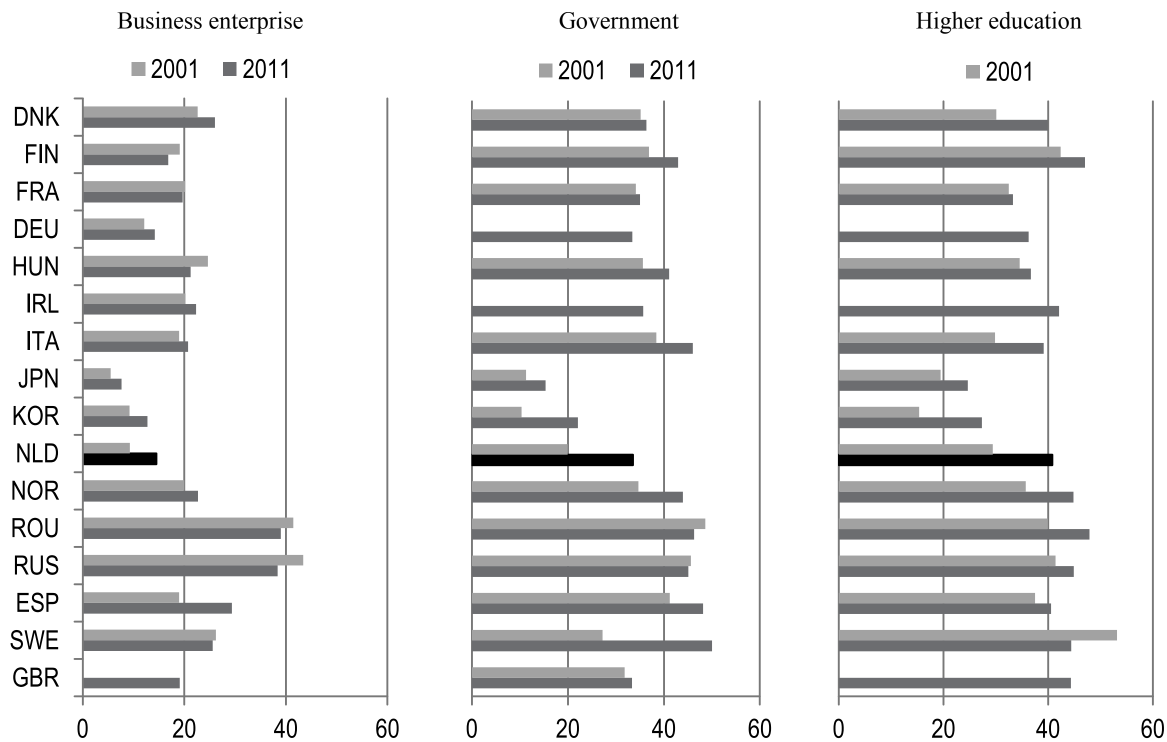
Even though women are the majority in the university student population, their share decreases progressively for higher qualifications and positions in universities' professional hierarchy. At the professor level, women have a smaller share in the Netherlands than in EU27, though their growth rate in 2002-10 was more rapid than in the EU27 (OCW, 2013). While progress has been made over the past decade, only 24% of researchers are women compared to over 35% in the United Kingdom, Norway and Sweden (OECD, 2014a).

With respect to research positions, most European countries are gradually closing the gender gap in research positions in higher education and the public sector (Figure 3.17). In Dutch higher education institutions, the share of women in research increased from 29% in 2001 to 41% in 2011. The Netherlands is thus approaching gender parity, but is still behind countries like Finland (47%), Norway and Sweden (45% each). The share of Dutch female researchers in government research institutes increased from 20% in 2001 to 34% in 2011. Despite this increase, recent shares lag behind countries such as Italy

(46%), Spain (48%) and Hungary (41%). All countries considered seem to have difficulties balancing male-female ratios in business-sector research positions. The Netherlands has made considerable progress from 9% in 2001 to 14% in 2011. Recent values remain, however, among the lowest and exceed only those of Korea (13%) and Japan (8%). In parallel to lower participation rates, there is a wage gap between male and female doctorate holders: the differential exceeds 20% in the business enterprise sector and the government sector (Auriol et al., 2013).

Figure 3.17. Female researchers by sector

Females as a percentage of total, 2001 and 2011

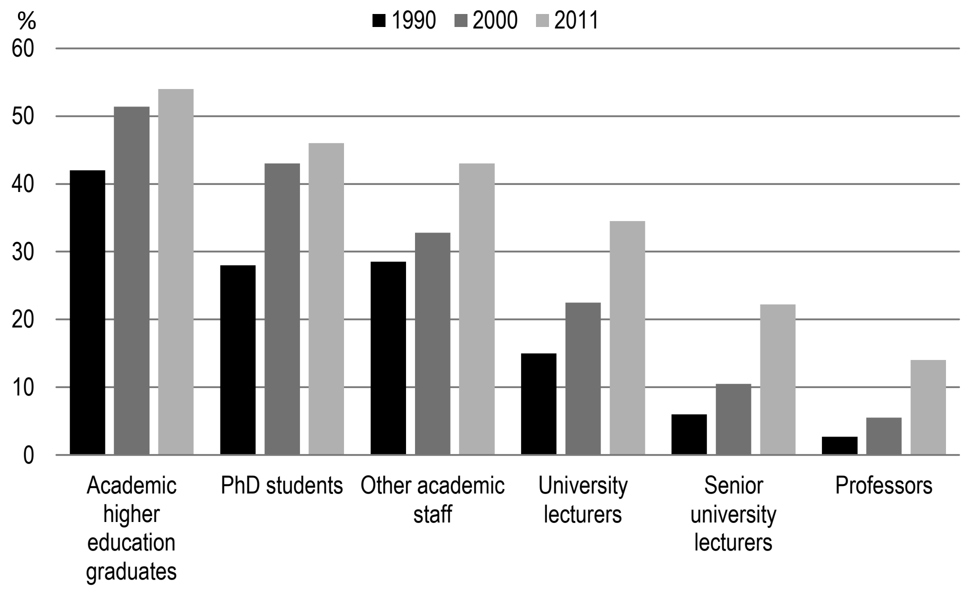


Source: OECD (2014a), *Main Science and Technology Indicators*, Vol. 2013/2, OECD Publishing, doi: 10.1787/msti-v2013-2-en.

Figure 3.12 shows that slightly fewer women obtain PhD degrees in the Netherlands (44%) than in the OECD area (47%). As is generally the case, Scandinavian countries have more evenly balanced gender parity in terms of the share of doctoral degrees awarded to women: Finland (51%), Sweden (47%) and Norway (46%). In all countries, women account for a lower share of S&E doctorates (Figure 3.13): on average across OECD countries, only 34% of S&E PhD graduates are female. The Netherlands had a somewhat lower share of 31%.

Figure 3.18 shows female participation at the different stages of academic careers between 1990 and 2011. As is generally the case, there is less gender parity higher up the hierarchical ladder. While women accounted for around 35% of university lecturer positions in 2011, they accounted for less than 15% of professors. However, the Netherlands has made significant progress during the last 20 years. At all stages shown in Figure 3.18, female participation has grown by 10 percentage points or more.

Figure 3.18. Female participation in academic careers, 1990-2011



Source: OCW (2013), "Key Figures 2008-2012 Education, Culture and Science", Ministry of Education, Culture and Science, www.government.nl/documents-and-publications/reports/2013/07/31/key-figures-2008-2012.html, p. 172.

3.2. Innovation outputs

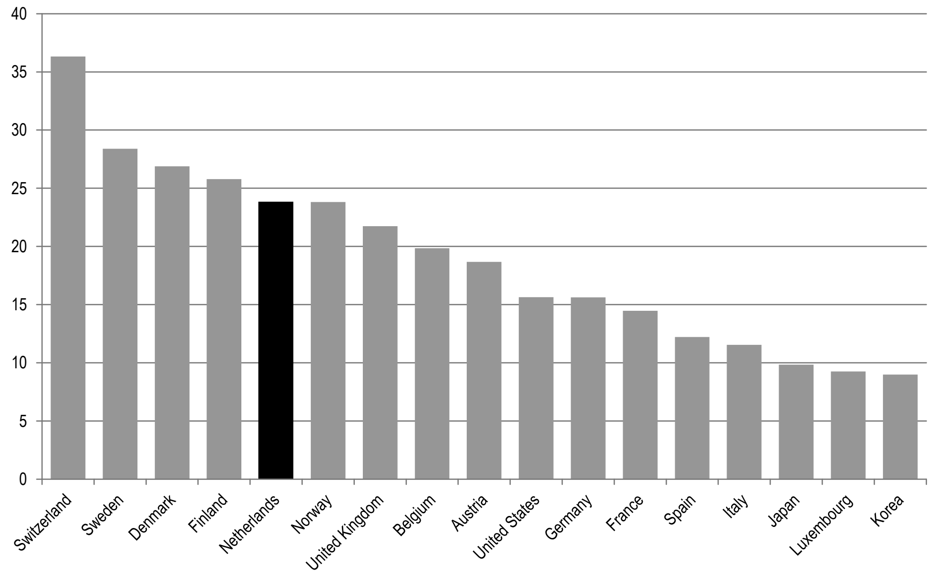
Innovation outputs are difficult to measure for a number of reasons. Available indicators only partially cover the various forms of innovation. Measures of technological innovation and scientific outputs are easily obtained and available. However, it is difficult to capture the level and qualities of process, organisational and marketing innovations, which are especially important for the services sector. In addition, with the exception of indicators derived from innovation surveys, traditionally used innovation output indicators are derived from data, such as patents and bibliometrics, originally collected for different purposes. Finally, as no two innovations are alike, the impact of innovations may differ greatly for every increment of measurement. Such limitations make the picture obtained from aggregate indicators inevitably partial and show the need for long temporal and country coverage as well as independent further validation. Nevertheless, taken together, the various available indicators of innovation present an opportunity to evaluate output systematically in a way that is consistent across countries and over time.

Scientific publications

The Netherlands is a leading OECD country in terms of the intensity of scientific output (Figure 3.19) and even more so in terms of visibility and impact (as measure by scientific citations, Figure 3.20). Over 2000-11, the Netherlands produced 23.9 scientific publication per million inhabitants, behind Switzerland (36.3), Sweden (28.4), Denmark (26.9) and Finland (25.8), but considerably ahead of other advanced systems such as the United Kingdom (21.7), the United States (15.6) and Germany (15.6). In terms of number of citations per published scientific article and of the share of publications among the top 10% cited, the Netherlands ranks second after Switzerland and before countries such as Sweden, the United Kingdom and Germany.

Figure 3.19. Intensity of scientific output

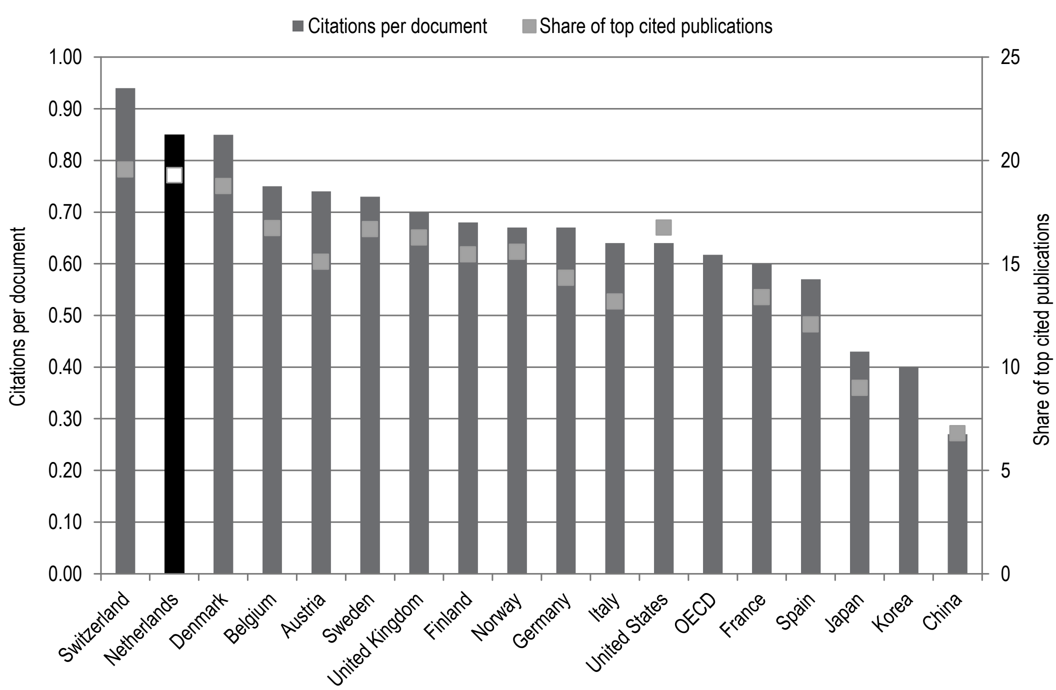
Publications per million population, 2000-11



Source: SCImago Journal and Country Rank.

Figure 3.20. Citations per published paper

Average number of citations, 2012 and share of top cited, 2003-11



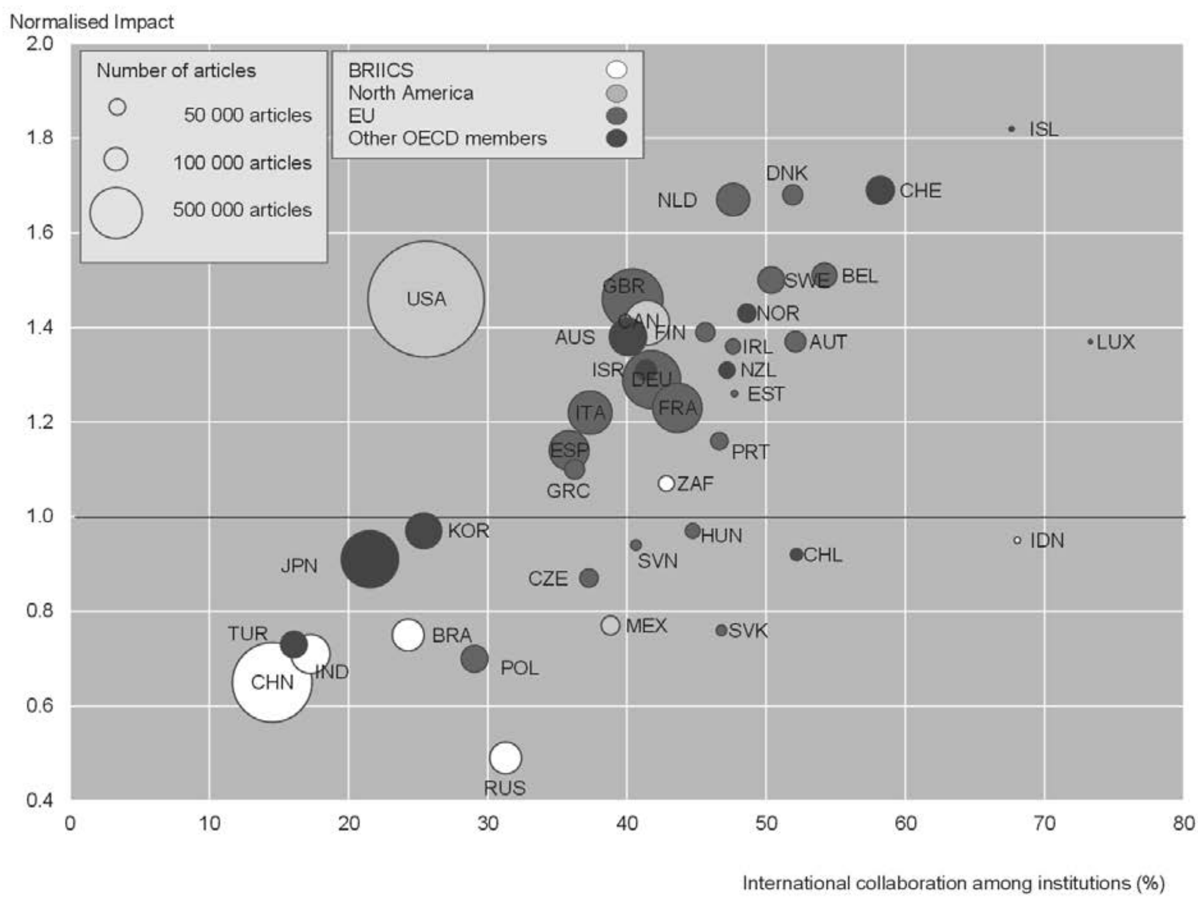
Note: An indicator of research excellence, the "top-cited publications" are the 10% most cited papers in each scientific field. Estimates are based on whole counts of documents by authors affiliated to institutions in each economy.

Source: SCImago Journal and Country Rank; OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en.

Collaboration and impact are interdependent: increased international collaboration exposes national scientific production to a wider audience and enhances its impact, while greater impact enhances attractiveness as a collaboration partner. Figure 3.21 shows this positive relationship. The Netherlands scores considerably above average on both counts. With respect to international scientific collaboration, the Netherlands ranks after Switzerland and Sweden (Figure 3.22). In an analysis of international collaboration patterns emerging from bibliometric output, den Hertog et al. (2012, p. 71) find that the Netherlands collaborates most intensively with its neighbours, above what would be expected by the relative size of the systems concerned. However, it collaborates considerably less than expected with emerging economies such as India, China, Brazil and Turkey. Collaboration bias towards proximate countries (either in space or culturally) is common, so this is not necessarily a shortcoming of the Netherlands relative to other countries, though the issue may be worth closer investigation.

Figure 3.21. The impact of scientific production and the extent of international scientific collaboration

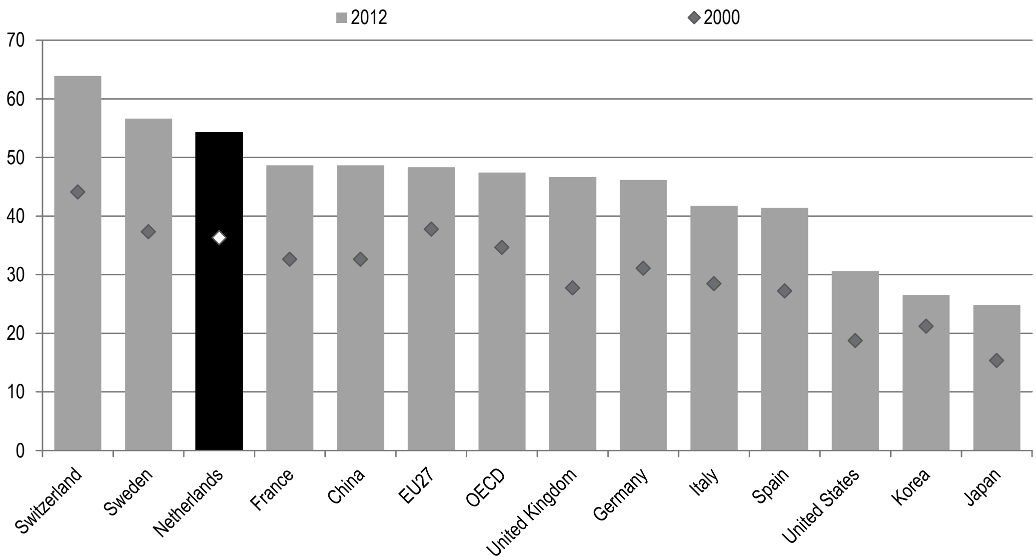
2003-11



Source: OECD (2013b) *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing, doi: 10.1787/sti_scoreboard-2013-en.

Figure 3.22. International copublication

Percentage of publications with more than one country of author affiliation, 2000 and 2012



Source: SCImago Journal and Country Rank.

Patents

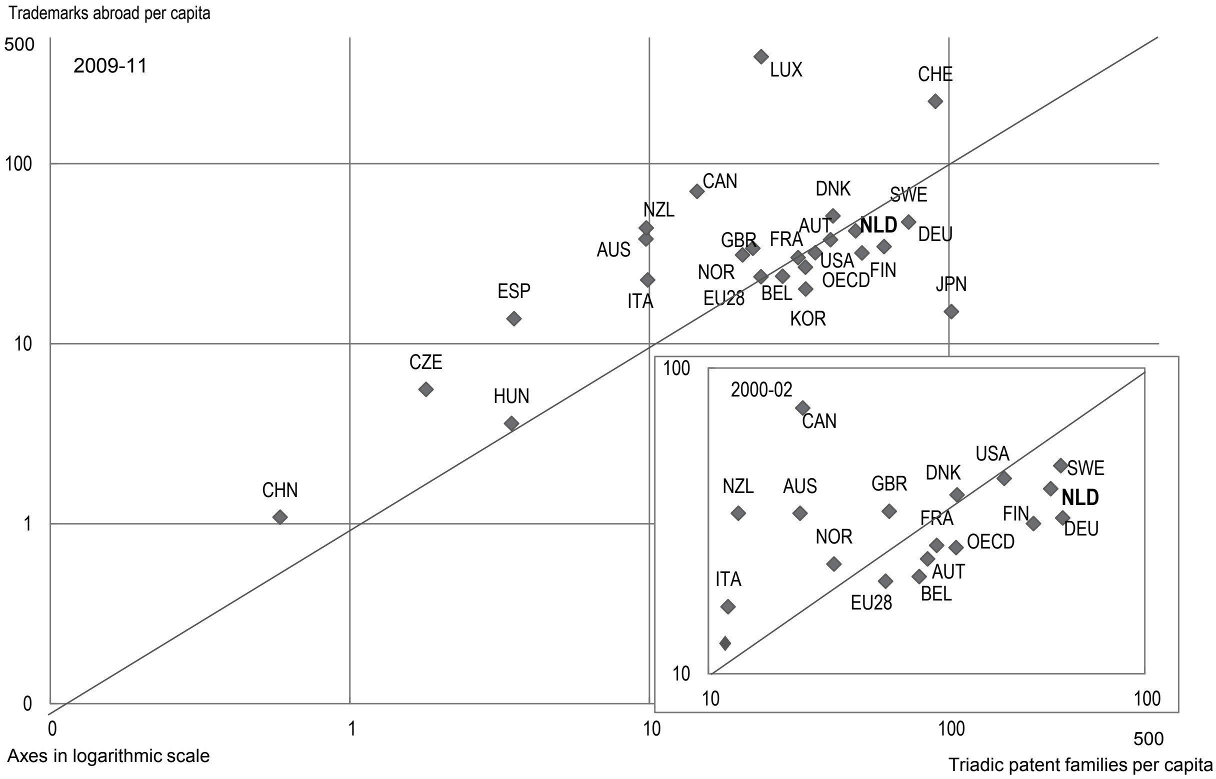
International patenting is considered a measure of the production of economically valuable technological inventions. This indicator is particularly relevant for developed innovation systems with a strong manufacturing sector. One measure of international patenting is the number of triadic patent families, defined as patents applied for at the European Patent Office (EPO), the Japan Patent Office (JPO) and the US Patent and Trademark Office (USPTO) referring to the same invention. Triadic patents are typically of higher value and lessen biases introduced by the geographical coverage of individual patenting offices. The indicator of trademarks abroad is similar in construction, corresponding to the number of applications filed at the USPTO, the Office for Harmonization in the Internal Market (OHIM) [for EU] and the JPO.

Figure 3.23 plots national scores on the two indicators, converted to logarithms to permit comparisons across systems of vastly different magnitudes. The Netherlands is well placed with respect to both triadic patents and international trademarks: it ranks sixth in terms of production of tradic patent families and seventh in terms of trademarks abroad, when compared to OECD and G20 countries. Nevertheless, it ranks behind some other countries with advanced innovation systems on both counts, particularly Switzerland and Denmark.

Companies in countries positioned exactly on the diagonal can be said to have an equal propensity to file for a trademark or to apply for a patent. Countries positioned in the lower half of the figure tend to have a higher trademark intensity than patenting intensity, whereas the opposite is true for countries below the diagonal. The Netherlands is relatively balanced in this regard, reflecting its strengths in both manufacturing and services.

Figure 3.23. Patents and trademarks per capita, 2000-02 and 2009-11

Average number per million population, OECD and G20 countries



Source: OECD Patent Database, June 2013; US Patent and Trademark Office Bulk Downloads: Trademark Application Text hosted by Google, May 2013; OHIM Community Trademark Database CTM Download, May 2013; JPO Annual Reports 2001-12, June 2013.

In terms of patent applications to the EPO, the Netherlands is near the top of the comparator group, at a similar level to Finland and Denmark (Table 3.5). It is markedly less patent-intenstive than only Sweden and, especially, Switzerland, a country with exceptionally high patenting activity. As in most European countries, patent intensity peaked around 2006 and then decreased chiefly as a consequence of the economic crisis (the administrative lag also plays a role in the declining trend over time). In the Netherlands, however, contrary to other leading European countries, patenting intensity had not yet recovered by 2013.

Table 3.5. European patent applications to the EPO per million population, 2004-13

Ranked by 2013 patents in 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Switzerland	643	695	745	782	777	760	874	822	845	841
Sweden	276	277	279	298	342	338	386	388	371	385
Finland	300	283	320	379	330	265	303	288	342	350
Netherlands	430	478	452	432	445	405	360	337	302	348
Denmark	179	214	225	252	284	267	327	320	287	345
Germany	278	287	301	306	325	307	334	321	333	325
Austria	122	129	139	163	178	179	208	206	222	237
Belgium	144	162	173	178	177	151	187	181	170	169
France	133	131	131	135	146	143	152	152	156	154
United States	111	110	116	117	122	107	127	112	112	108
Norway	79	70	78	88	100	98	104	93	111	101
United Kingdom	80	77	79	82	82	79	88	75	74	72

Notes: Latest population figures were for 2012 for all countries except Switzerland, where it was 2011. These years were used to calculate the ratio for 2013 (and 2012 for Switzerland).

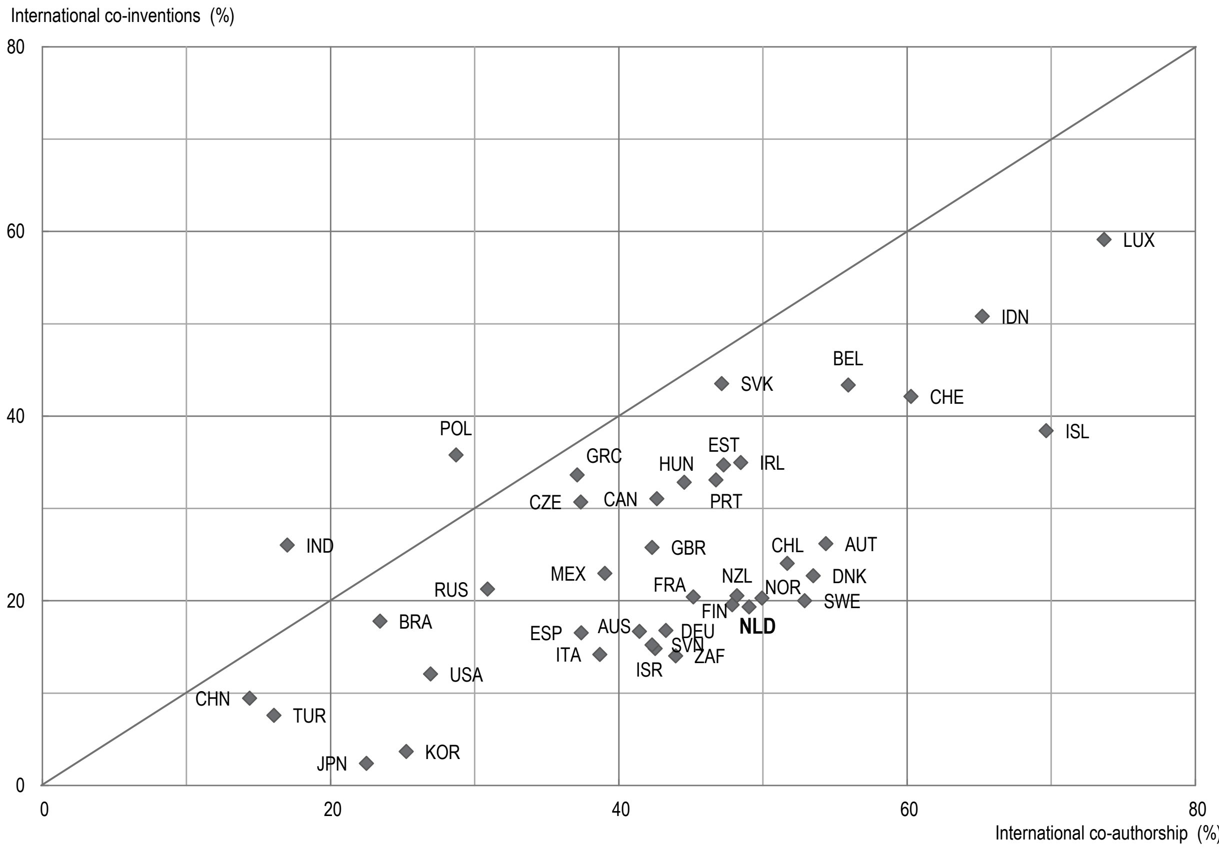
Source: EPO (2014) and Eurostat (2014), Statistics database, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database.

International collaboration can be a channel for technology transfer. However, the reasons behind international connections are not always obvious. International co-patenting, for instance, may signal both arm's-length collaboration and within-firm activities across national jurisdictions, as is often the case for multinational enterprises. High rates of international collaboration may reflect functional similarity (which permits integration into international knowledge production chains), the ownership and location regimes of multinational affiliates, and may also be affected by geographical proximity to major centres of technology production (Maggioni and Uberti, 2009). However, the degree of international collaboration is also affected by the size of national innovation systems. Those large enough to contain entire knowledge production chains and capacities across a wide range of technological areas are less likely to engage in international collaboration.

Figure 3.24 displays international collaboration rates in patenting (co-inventions) and publications (co-authorship). Countries that co-invent tend also to co-author internationally. This suggests that the degree of international collaboration in these two knowledge production settings is at least partly driven by common factors. In the Netherlands, 49% of scientific publications are produced with international partners, while only 19.3% of Patent Cooperation Treaty (PCT) patent applications involve collaboration with international inventors. Most countries in fact have higher shares of international collaboration on scientific publishing than on patent applications. Nevertheless, the share of co-invention is below several OECD countries, including larger advanced systems such as the United Kingdom.

Figure 3.24. International collaboration in science and innovation, 2007-11

Co-authorship and co-invention as a percentage of scientific publications and PCT patent applications



Note: International co-authorship of scientific publications is based on the share of articles with authors affiliated with foreign institutions in total articles produced by domestic institutions. Co-inventions are measured as the share of patent applications with at least one co-inventor located abroad in total patents invented domestically.

Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en.

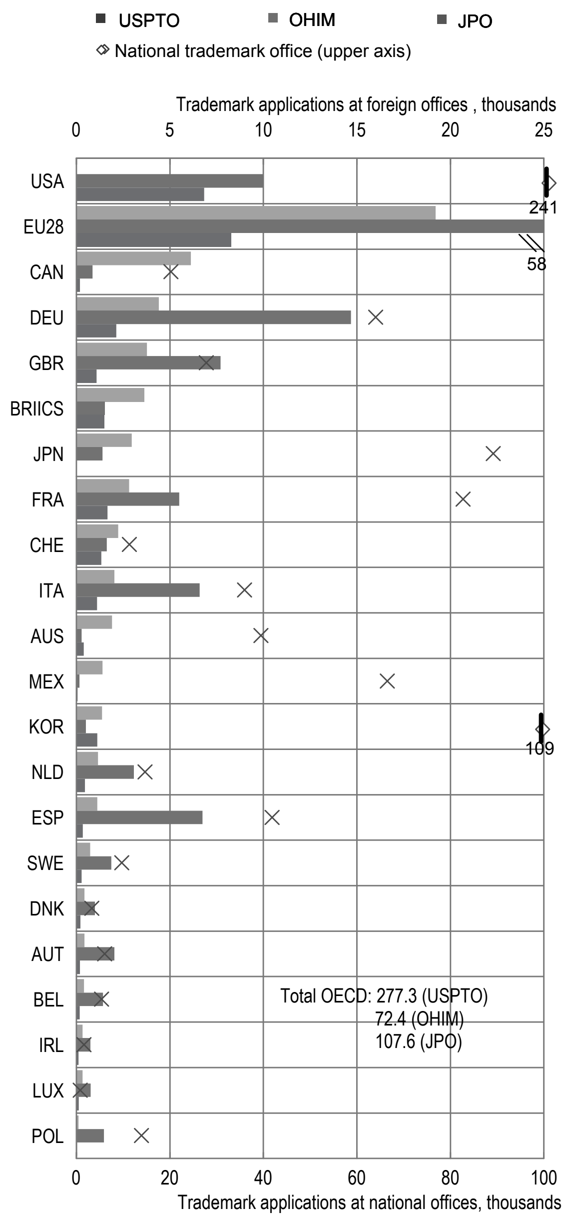
Trademarks

Trademarks are a legal instrument intended to protect distinctive features of a firm such as its brand. Trademarks, like patents, are considered indicators of the generation of economically useful innovations and are therefore considered an indicator of innovation output. Compared to patents, trademarks are especially relevant to innovation in the services sector and are more representative of the activities of smaller firms and of non-technological innovation. In addition, trademarks are well correlated with other innovation indicators (Millot, 2009) as well as with firms' market value (Sandner and Block, 2012) and are a proxy for activity that is closer to the commercialisation stage of innovation (Mendoça et al., 2004).

Figure 3.25 presents trademark applications in three major intellectual property offices (JPO, OHIM and USPTO). The Netherlands displays relatively high numbers of trademark applications at the OHIM, only behind much larger countries: Germany, the United Kingdom, France, Italy and Spain.

Figure 3.25. Top 20 trademark applicants, 2009-11 average

Trademark applications at USPTO, OHIM, JPO and national trademark offices, thousands

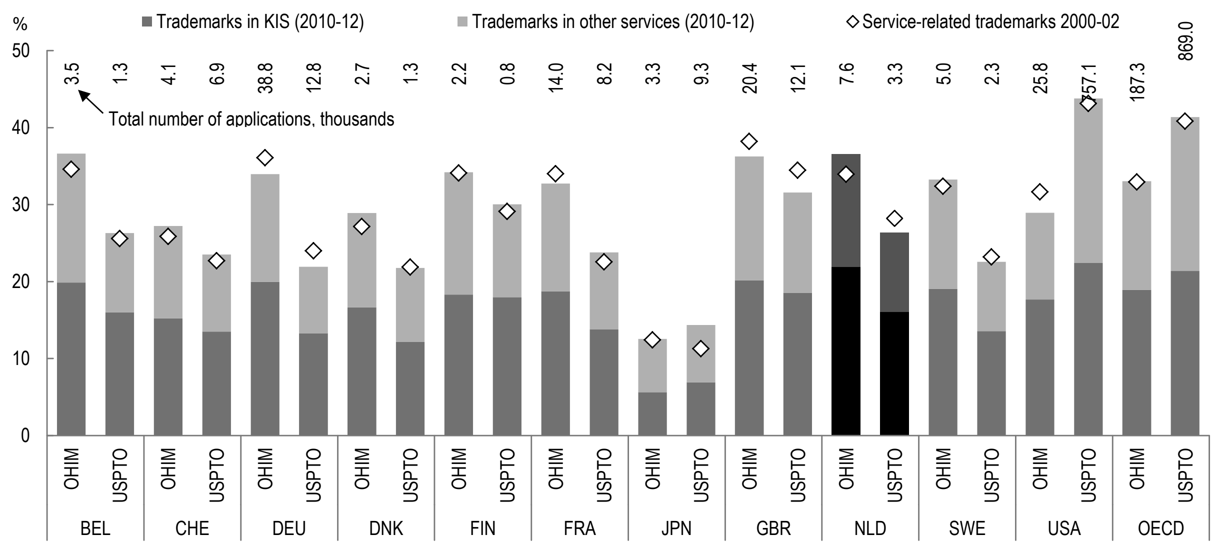


Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en; US Patent and Trademark Office Bulk Downloads: Trademark Application Text hosted by Google; OHIM Community Trademark Database CTM Download, May 2013; JPO Annual Reports 2001-12; WIPO statistics Database, March 2013.

Figure 3.26 presents the share of trademarks in service-sector classes[7] in total trademarks for two periods a decade apart (2000-02 and 2010-12). Over these periods, service-related trademarks increased in importance in the Netherlands at the OHIM but decreased in importance at the USPTO. Trademarks in knowledge-intensive services (KIS) at the OHIM represented 22% of total trademark applications from the Netherlands, the highest value of the countries considered; the share of USPTO KIS trademarks was below the OECD average.

Figure 3.26. Service-related trademark applications at USPTO and OHIM, selected OECD and non-OECD economies, 2000-02 and 2010-12

As a percentage of total trademark applications

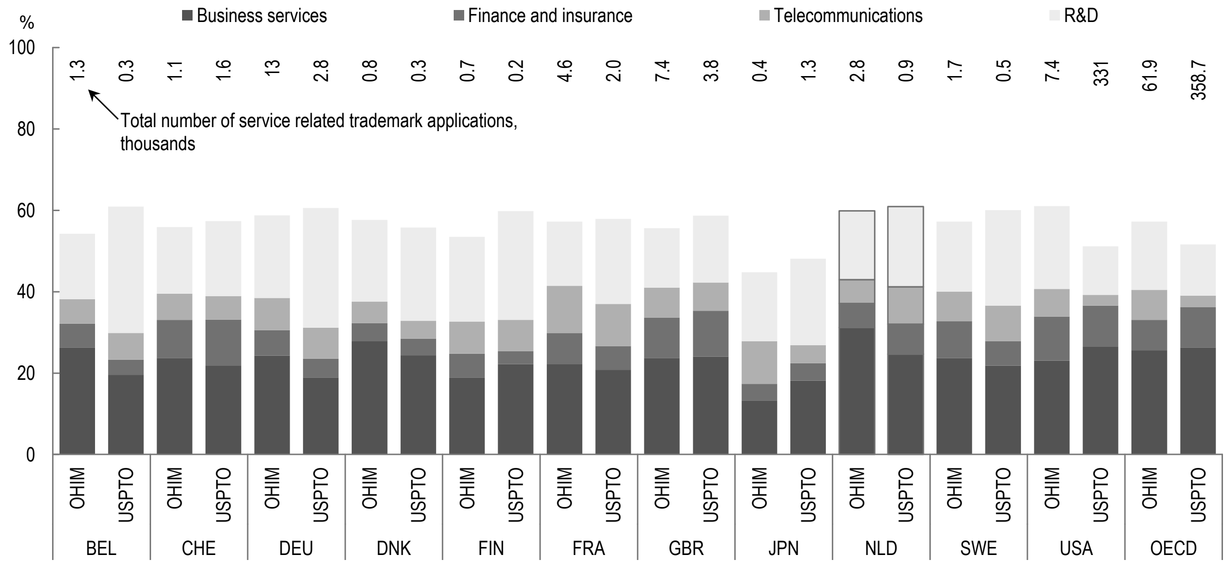


Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en.

Figure 3.27 shows trademark classes classified as pertaining to KIS[8] as a percentage of total trademarks in service-sector classes and offers a breakdown by type of service (business services, finance and insurance, telecommunications or R&D). Altogether, around 60% of service-related trademarks are in KIS, which places the Netherlands among the leading OECD countries. Most KIS trademarks in the Netherlands were in the business services category (31%, OHIM), and here too the Netherlands leads the OECD.

Figure 3.27. Trademarks in knowledge-intensive services for selected countries, 2010-12

As a percentage of total service-related trademarks



Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en.

Impact of innovation

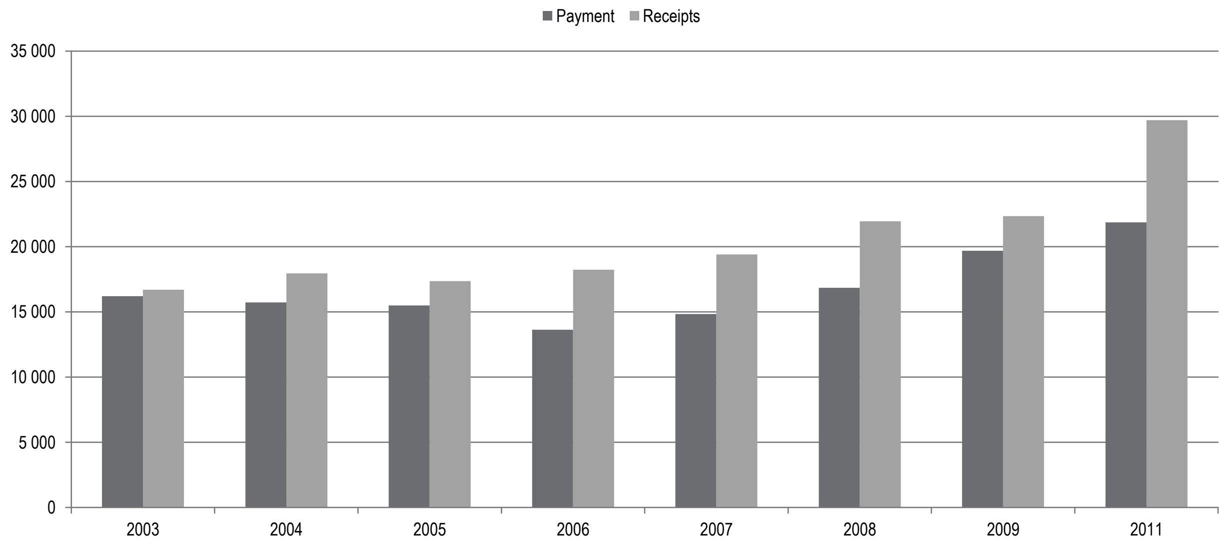
Innovation is a means towards other ends, such as increased profits, productivity, market share, or aggregate economic growth and meeting social challenges. However, few measures of impact are readily available and the ones that exist are only partial. Few patents generate a lot of income and the link between investments in R&D and high-technology exports, for example, is not direct. Therefore the handful of indicators presented here provides only a partial and imperfect picture of the economic value generated by innovation[9].

The technology balance of payments (TBP) corresponds to financial transactions related to international technology transfer. It consists of money paid or received for the acquisition and use of patents, licences, trademarks, designs, know-how and related technical services (including technical assistance) and for industrial R&D carried out abroad (OECD, 2014a). TBP can be a proxy of the market value of the technology produced in a given country and of the presence of framework conditions promoting its appropriation.

For the Netherlands, TBP data show an increase in both receipts and payments, resulting in a positive net balance that was particularly high in 2011, the latest available year (Figure 3.28). In that year, the Netherlands exported around USD 30 billion of technology, while imports accounted for around USD 21 billion. The rising positive net balance is a sign of the ability of the Netherlands to produce economically exploitable innovations. Table 3.6 presents the source of payments and receipts (shares), disaggregated in terms of sale/purchase of inventions, licensing from patents and trademarks, and income from the provision of technology-related services. The largest share of payments and receipts corresponds to patent licensing (over 60%), which is on an increasing trend since 2003. Moreover, in 2011 the balance of payments was positive for all of the reported sub-classes.

Figure 3.28. Technology payments, receipts and balance of payments

Millions of US dollars, constant 2005 prices PPP, 2003-11



Source: OECD, Technology Balance of Payments Database.

Table 3.6. Technology payments and receipts, by source of payments, 2003-11 (%)

Technology payments									
	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	n/a	
Sale/purchase of patents and inventions	0.06	0.07	0.12	0.00	0.07	0.28	0.03		0.17
Patent licensing	33.17	32.92	31.30	34.40	37.53	49.34	57.38		63.54
Trademarks, patterns and designs	19.74	17.19	18.38	14.55	15.76	11.79	12.78		10.19
Technology-related services	21.66	25.58	24.47	30.72	30.90	26.61	20.60		16.77
R&D carried out abroad	25.38	24.25	25.74	20.33	15.72	11.98	9.21		9.33
Technology receipts									
	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	n/a	100.00
Sale/purchase of patents and inventions	0.05	1.11	0.00	2.82	0.03	0.00	0.00		0.25
Patent licensing	42.08	42.03	38.23	38.03	42.42	53.75	57.84		68.65
Trademarks, patterns and designs	12.70	13.53	14.68	14.39	13.21	10.61	12.69		8.50
Technology-related services	25.44	24.77	23.11	21.31	27.38	22.84	19.45		14.10
R&D carried out abroad	19.73	18.55	23.97	23.44	16.95	12.79	10.01		8.50

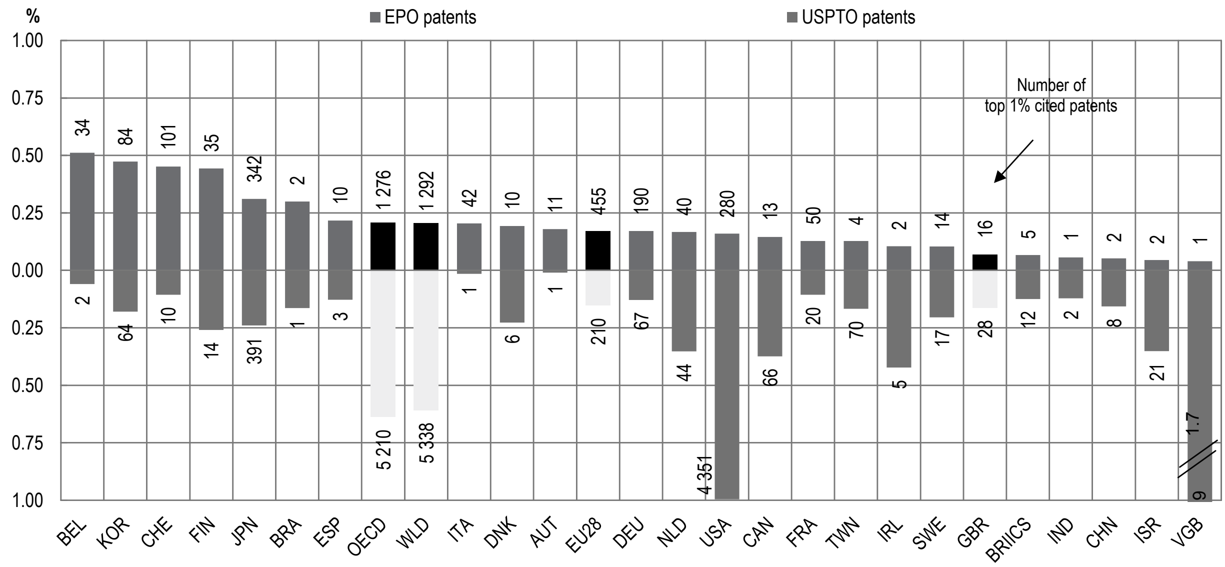
Source: OECD, Technology Balance of Payments Database.

Information from patent citations can also be used to understand the impact of technological output. Figure 3.29 displays the number of top 1% cited patent applications, at the EPO and USPTO over the period 2002-06. These figures should be interpreted with care, as they are based on a denominator with very low counts. The impact of patented inventions from the Netherlands at the EPO is on par with the most advanced innovation systems, even if considerably below Belgium, Korea, Switzerland, Finland and Japan.

The Netherlands is distinguished by a relatively high share of high-impact patents at the USPTO (excluding the United States and the British Virgin Islands, only behind Ireland and Canada), possibly an indication of a tendency to be more selective with USPTO filings and/or of the influence of the activities of multinational enteprises (see section 4.1). Overall, patented technological innovation from the Netherlands appears to have high impact.

Figure 3.29. Highly cited patent applications, 2002-06

Top 1% cited applications, as a share of total EPO and USPTO patents



Source: OECD (2013b), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing. doi: 10.1787/sti_scoreboard-2013-en; calculations based on the Worldwide Patent Statistical Database, EPO, April 2013.

Notes

1. The change in measurement in 2011 included for the first time "[…] the small-scale and incidental R&D activities of companies […]" (CBS, 2013, p. 157), which is in line with the OECD's Frascati Manual, recommendation that "all enterprises performing R&D, either continuously or occasionally, should be included in R&D surveys" (OECD, 2002, p.128).
2. In June 2013 Statistics Netherlands published revised figures for HERD for the whole period 1999-2011. These changes are not reflected in internationally comparable OECD statistics. However initial estimates suggest that they would imply HERD figures that are lower on average by about USD 400 million than those contained in Figure 2.3, the gap increasing to about USD 500 million for 2008-09 and to about USD 700 million for 2010.
3. If the period considered is 2000-10, the average annual increase drops to -0.4%.
4. According to the revised figures for HERD published by Statistics Netherlands (not reflected in internationally comparable OECD statistics) the share was 0.53%.
5. To give an indication of the magnitude of the change, the difference between the number of business R&D personnel and business researchers was about 25 000, with limited variation over the preceding decade, but it rose abruptly to 42 000 in 2011.
6. International students are students who have crossed borders expressly with the intention to study. The UNESCO Institute for Statistics, the OECD and Eurostat define as international students those who are not residents of their country of study or those who received their prior education in another country.
7. Classes 35 to 45 of the Nice classification (OECD, 2011, p. 62).
8. Business trademark applications designate Class 35; finance Class 36, telecommunications Class 38 and R&D Class 42 of the Nice classification (OECD, 2011, p. 62).
9. As discussed in the last chapter, the Dutch government is making extensive efforts to evaluate the impact of its innovation policy [see e.g. Hassink et al. (2013)].

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