

# State of scientific research in Finland

Statistics on research funding, research personnel and scientific publishing



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# Finnish research and innovation system



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# Finnish research and innovation system 1/2

- The Finnish higher education system consists of 13 universities and 22 universities of applied sciences that operate under the Ministry of Education and Culture.
- There are 12 public research institutes operating under relevant ministries.
- Higher education and research institutes work closely with private business partners. Private business accounts for 67% of total Finnish RDI expenditure.
- The major research funding agencies are the Academy of Finland, Business Finland and various foundations.



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# Finnish research and innovation system 2/2

- Higher education and science policy comes under the Ministry of Education and Culture, which drafts legislation, budget proposals and government decisions relating to education.
- Innovation policy is the responsibility of the Ministry of Economic Affairs and Employment.
- Development of the innovation system is coordinated by the Research and Innovation Council, which is chaired by the Prime Minister.



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# Research funding

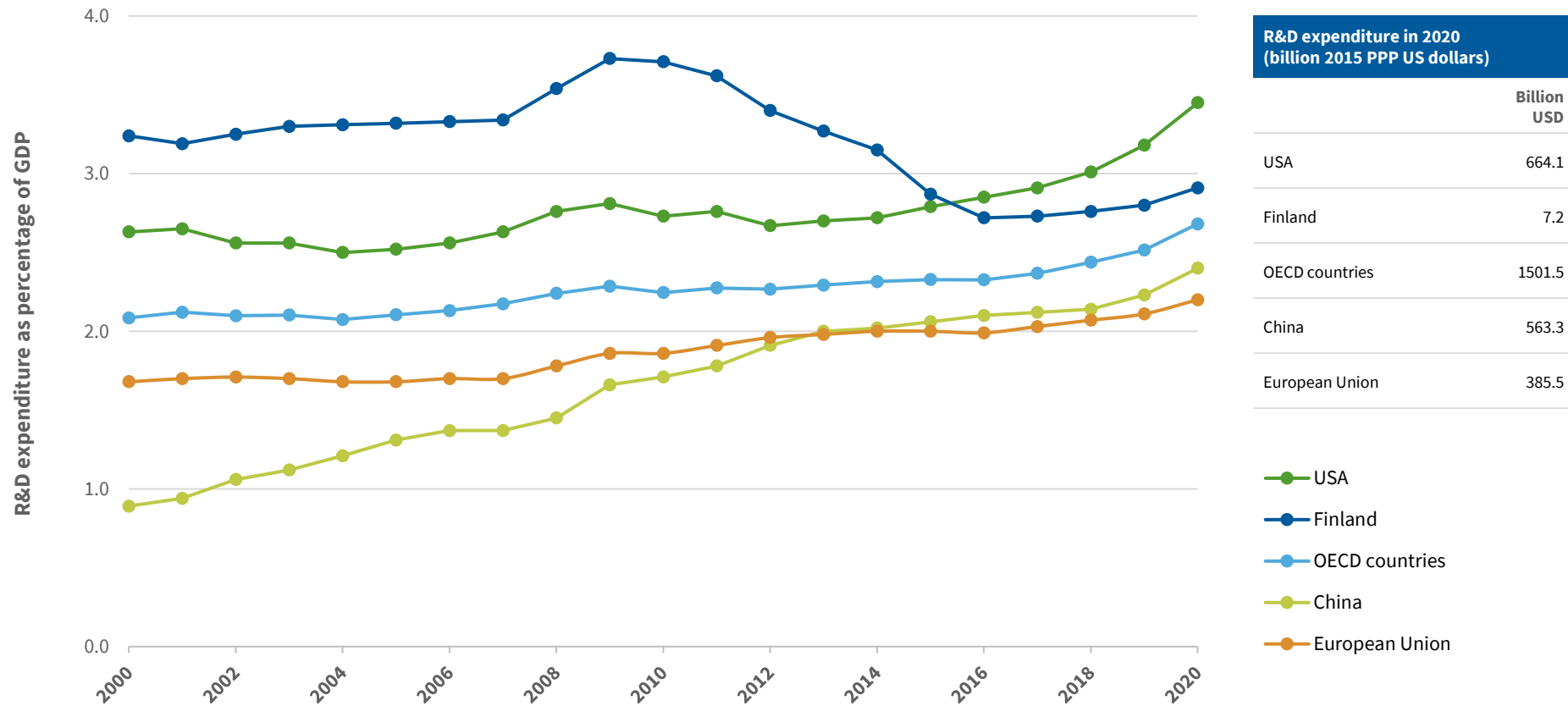


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Figure 1.1a

# Finnish R&D intensity in international comparison 2000–2020.

Finland and European Union, USA, China and OECD countries.



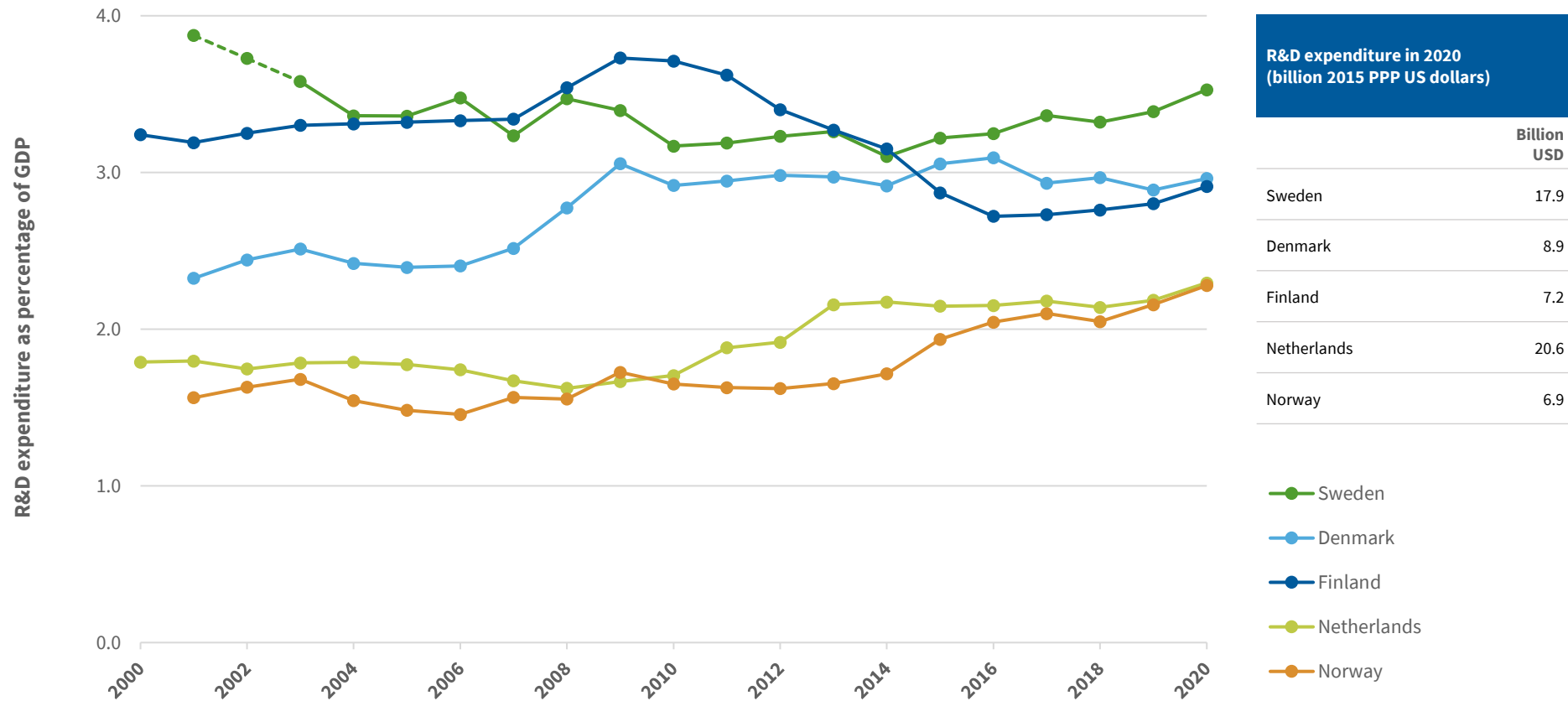
• United Kingdom included in EU figures up to 1 February 2020.

Sources: OECD Main Science and Technology Indicators (data published in March 2022); OECD: Science, Technology and R&D Statistics.

Figure 1.1b

# Finnish R&D intensity in international comparison 2000–2020.

Finland, the Nordic countries except Iceland, and Netherlands.



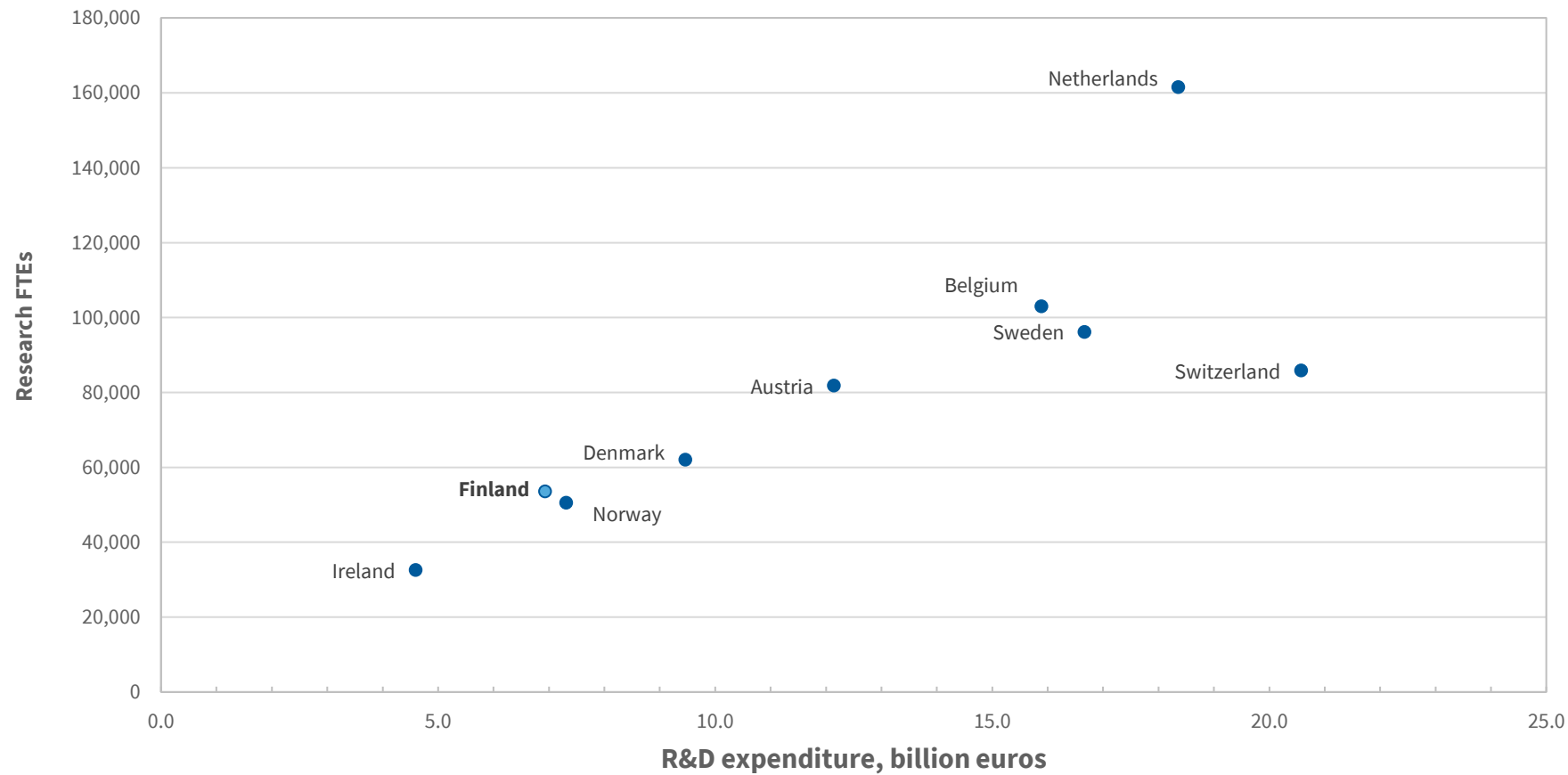
• Gaps in Swedish data for some years indicated by broken line, assuming constant change.

Sources: OECD Main Science and Technology Indicators (data published in March 2022); OECD: Science, Technology and R&D Statistics.



Figure 1.2

## Research FTEs in Finland and in peer countries relative to R&D expenditure in 2020.



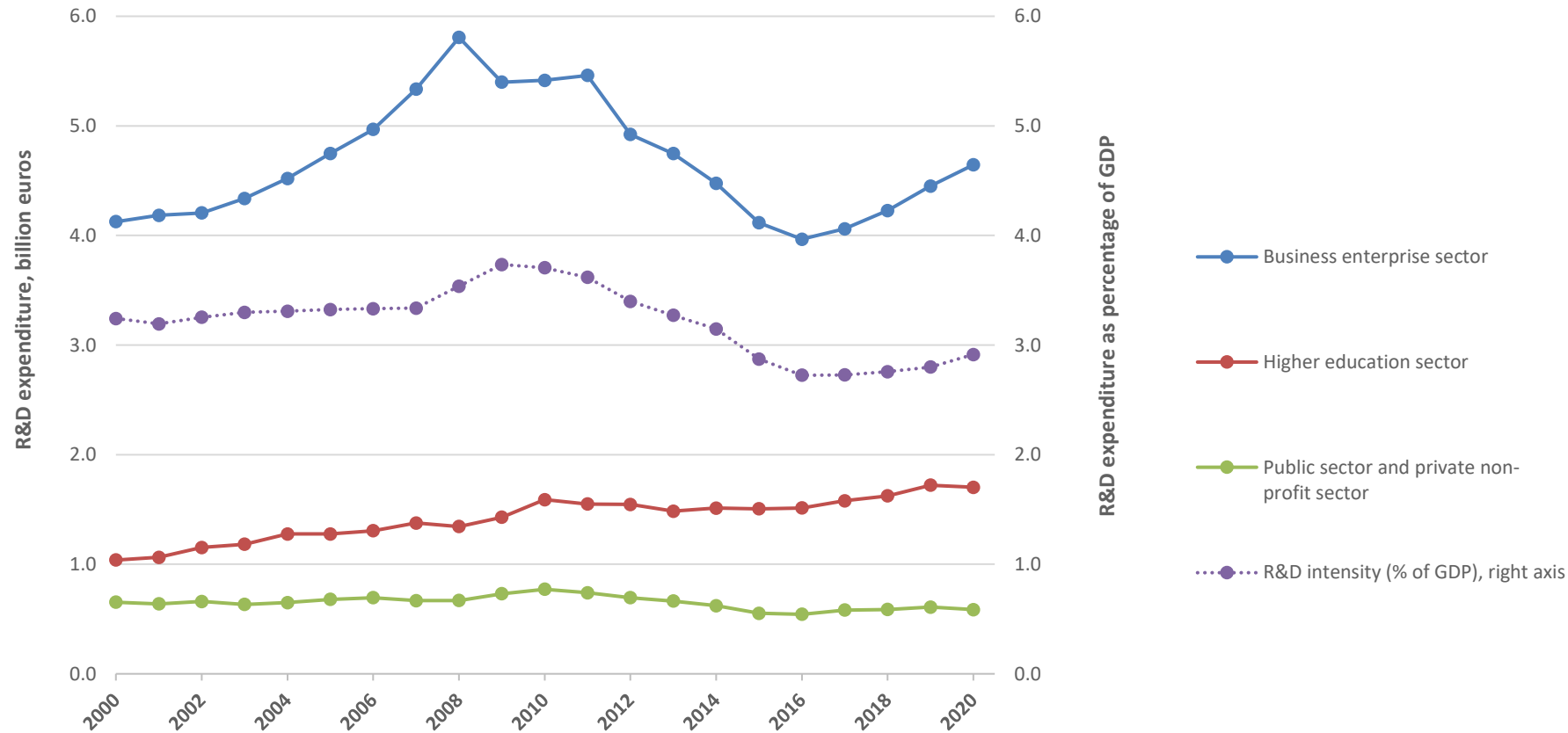
• Swiss data is for 2019.

Source: Eurostat, science and technology, total researchers by sectors of performance - full time equivalent and GERD by sector of performance (data published in December 2021).

Figure 1.3

## Finnish R&D expenditure (billion euros) and R&D intensity (R&D expenditure as percentage of GDP) by sector of performance 2000–2020.

Sectors as defined in Statistics Finland's R&D statistics.



- The higher education sector comprises universities, university hospitals and universities of applied sciences. In addition to universities operating under the Ministry of Education and Culture, the sector includes the National Defence University (from 2016) and the Police University College and the Åland University of Applied Sciences (from 2013); the latter three were previously classified in the public sector. The public sector comprises central government branches and government research institutes, municipalities (since 2007) and other public institutions.

- R&D expenditure figures are adjusted for inflation.

Sources: Statistics Finland, Research and development; 2000–2020 R&D intensity data drawn from OECD Main Science and Technology Indicators (data published in March 2022).

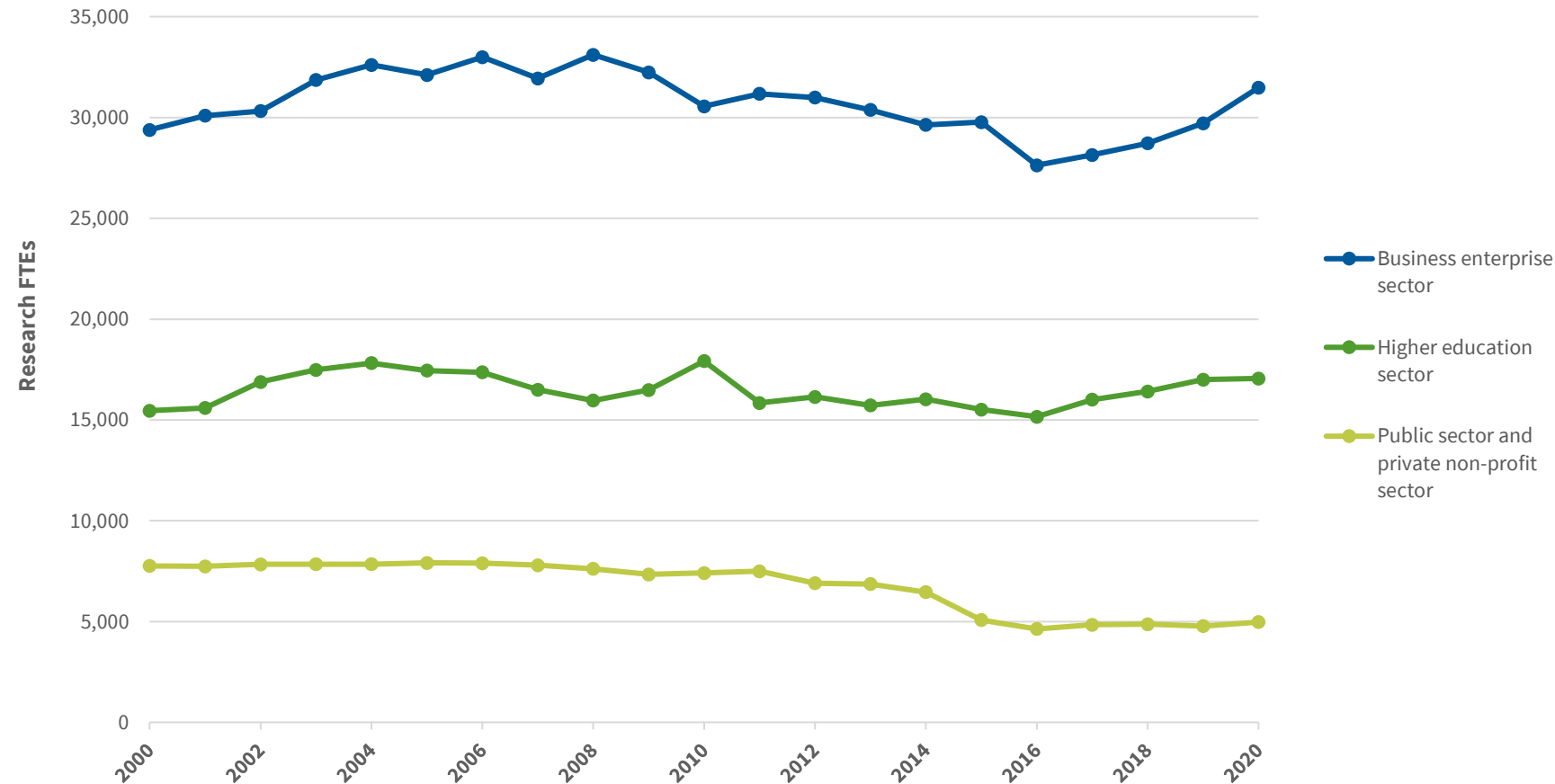
# Research personnel



Figure 2.1

## Research FTEs by sector of performance 2000–2020.

Sectors as defined in Statistics Finland's R&D statistics.



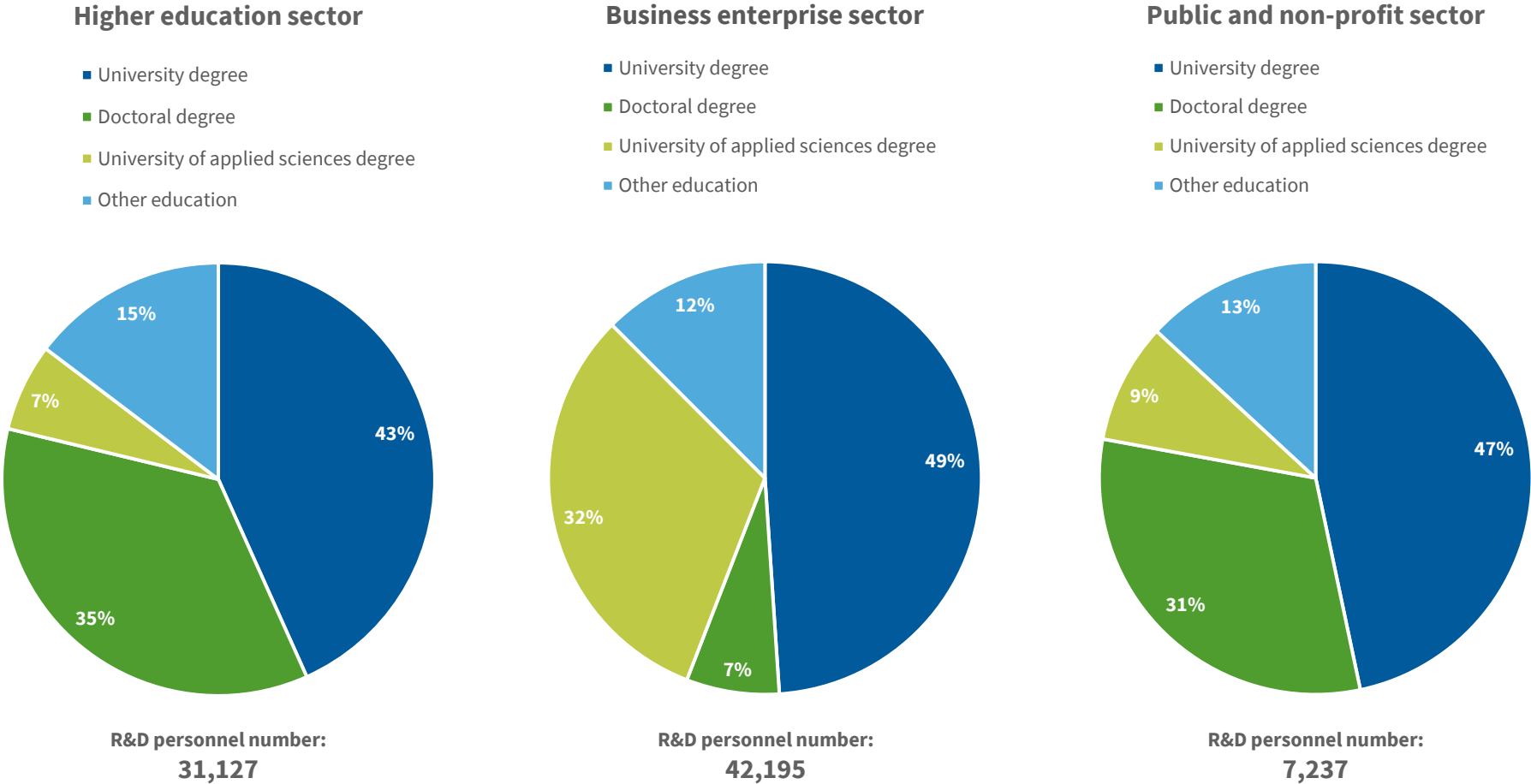
- The higher education sector comprises universities, university hospitals and universities of applied sciences. In addition to universities operating under the Ministry of Education and Culture, the sector includes the National Defence University (from 2016) and the Police University College and the Åland University of Applied Sciences (from 2013); the latter three were previously classified in the public sector. The public sector comprises central government administrative branches and government research institutes, municipalities (since 2007) and other public institutions

Source: Statistics Finland, Research and development.

Figure 2.2

# Educational level of R&D personnel by sector in 2020.

The graph shows the percentage share of each educational level in total R&D personnel and total number of R&D personnel by sector.



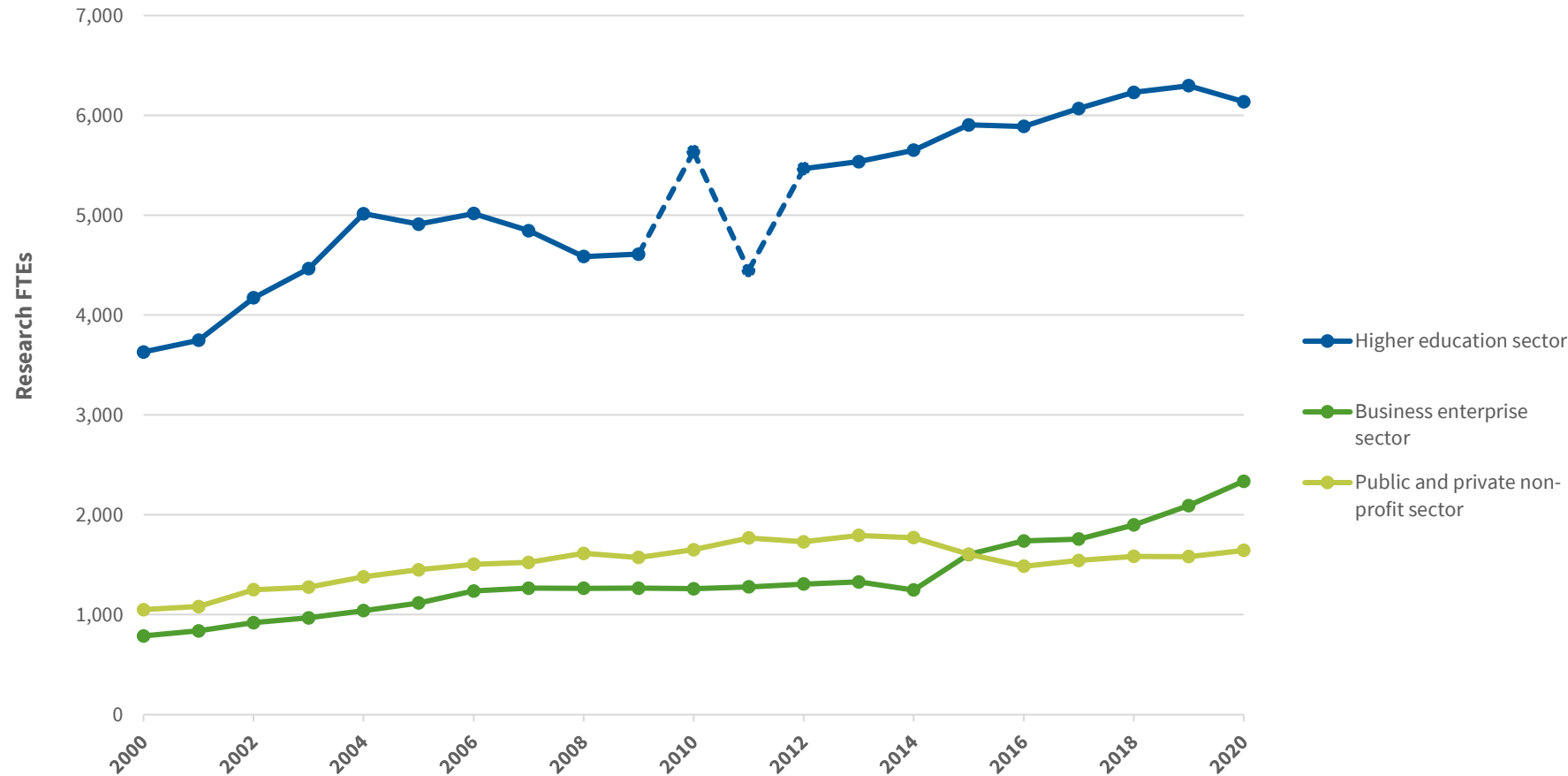
- The higher education sector comprises universities, university hospitals and universities of applied sciences. In addition to universities operating under the Ministry of Education and Culture, the sector includes the National Defence University (from 2016) and the Police University College and the Åland University of Applied Sciences (from 2013); the latter three were previously classified in the public sector. For the higher education sector, 'Other education' includes missing data for education.
- The public sector comprises central government administrative branches and government research institutes, municipalities (since 2007) and other public institutions.

Source: Statistics Finland, Research and development.

Figure 2.3a

## PhDs' research FTEs by sector in 2000–2020.

Sectors as defined in Statistics Finland's R&D statistics.



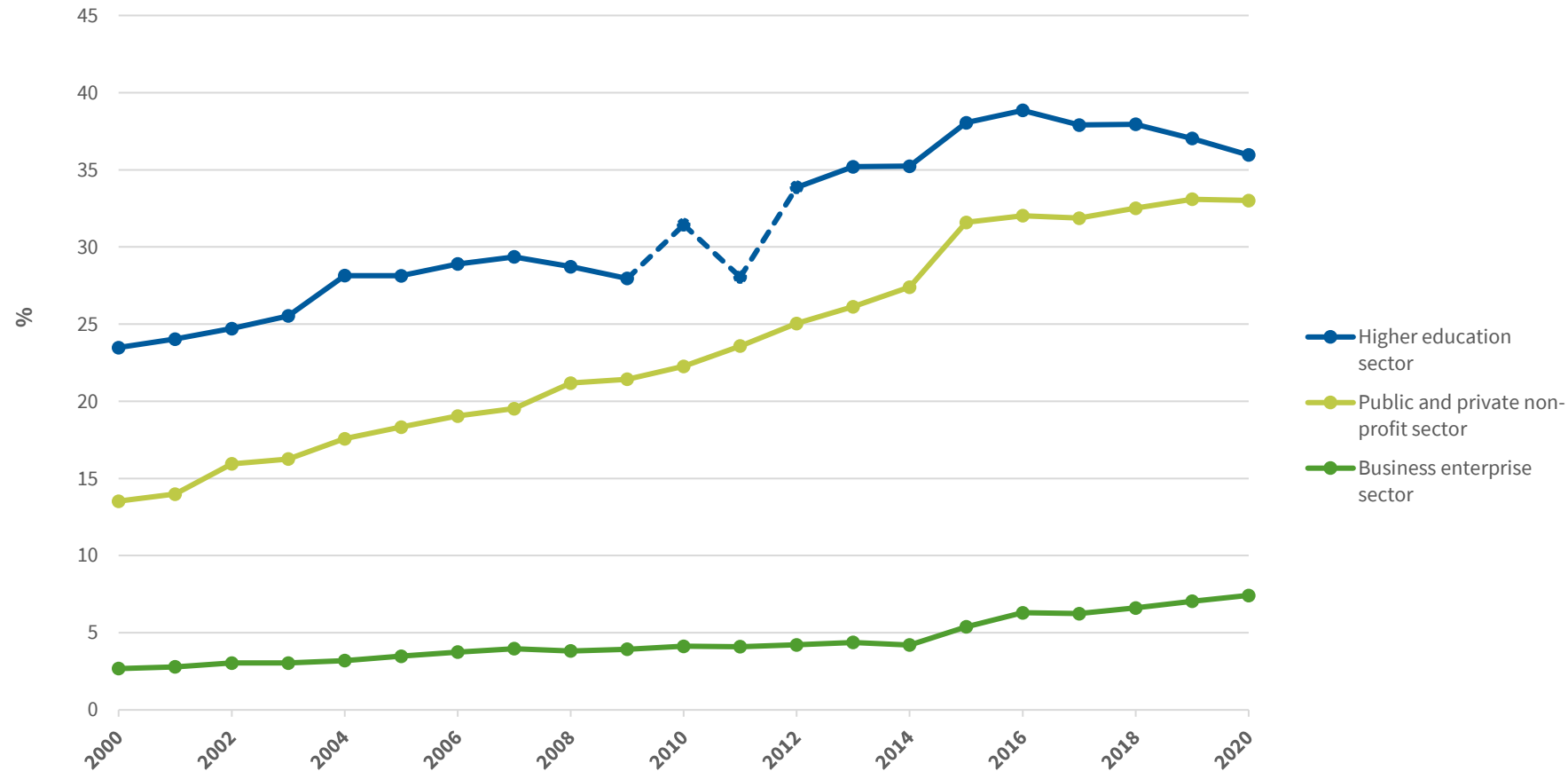
- The higher education sector comprises universities, university hospitals, universities of applied sciences and public or private research institutes closely integrated with university research activities. In addition to universities operating under the Ministry of Education and Culture, the sector includes the National Defence University (from 2016) and the Police University College and the Åland University of Applied Sciences (from 2013); the latter three were previously classified in the public sector. The public sector comprises central government administrative branches and government research institutes, municipalities (since 2007) and other public institutions.

Source: Statistics Finland, Research and development.

Figure 2.3b

## PhDs' research FTEs as proportion of total research FTEs 2000–2020.

Sectors as defined in Statistics Finland's R&D statistics.

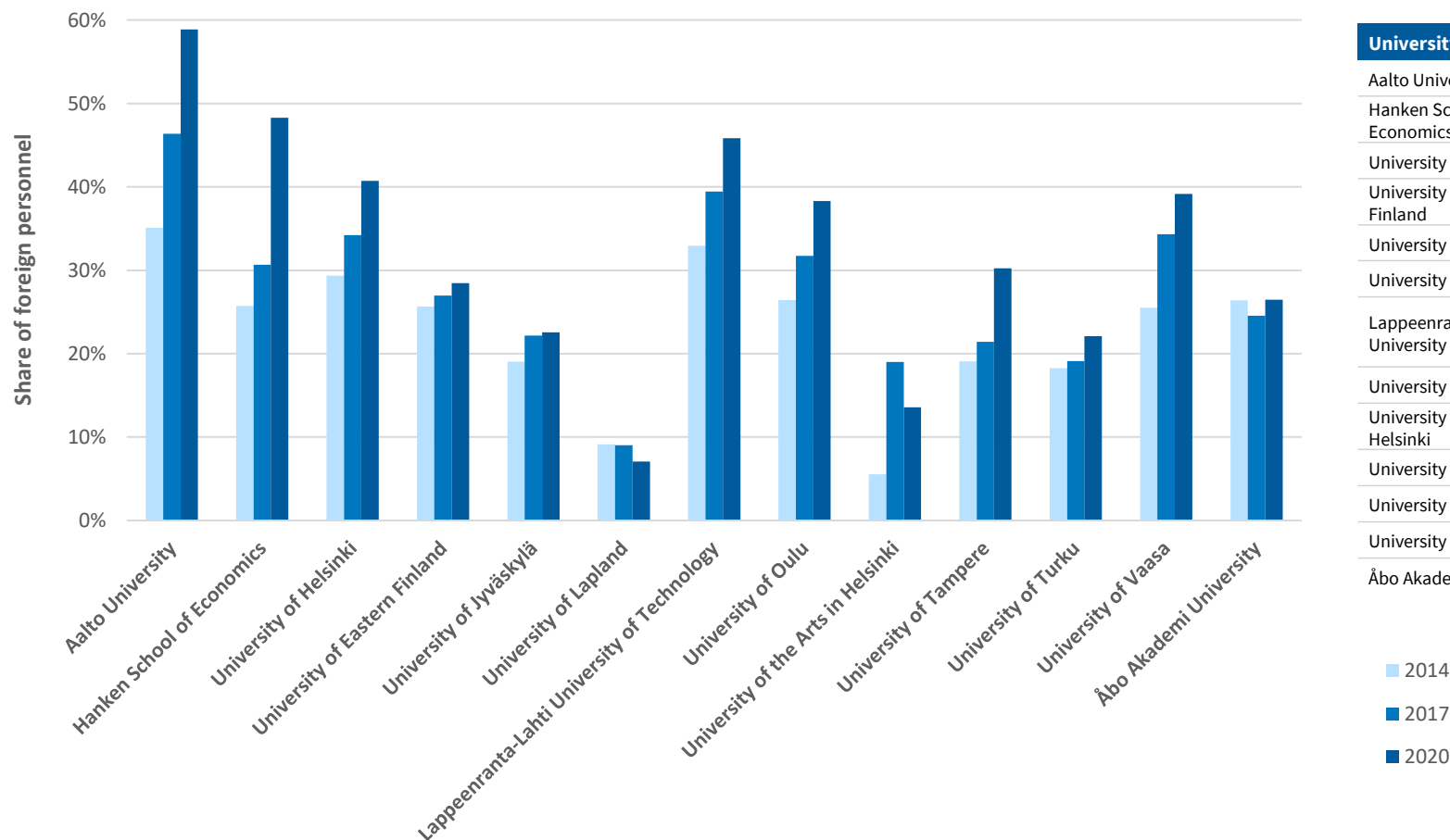


- The higher education sector comprises universities, university hospitals, universities of applied sciences and public or private research institutes closely integrated with university research activities. In addition to universities operating under the Ministry of Education and Culture, the sector includes the National Defence University (from 2016) and the Police University College and the Åland University of Applied Sciences (from 2013); the latter three were previously classified in the public sector. The public sector comprises central government administrative branches and government research institutes, municipalities (since 2007) and other public institutions.

Source: Statistics Finland, Research and development.

Figure 2.8a

## Foreign teaching and research personnel FTEs as proportion of total university teaching and research personnel FTEs by university at career stages I–II in 2014, 2017 and 2020.



University	FTEs
Aalto University	1,591
Hanken School of Economics	88
University of Helsinki	2,212
University of Eastern Finland	833
University of Jyväskylä	950
University of Lapland	185
Lappeenranta-Lahti University of Technology	381
University of Oulu	1,169
University of the Arts in Helsinki	199
University of Tampere	1,347
University of Turku	1,073
University of Vaasa	171
Åbo Akademi University	407

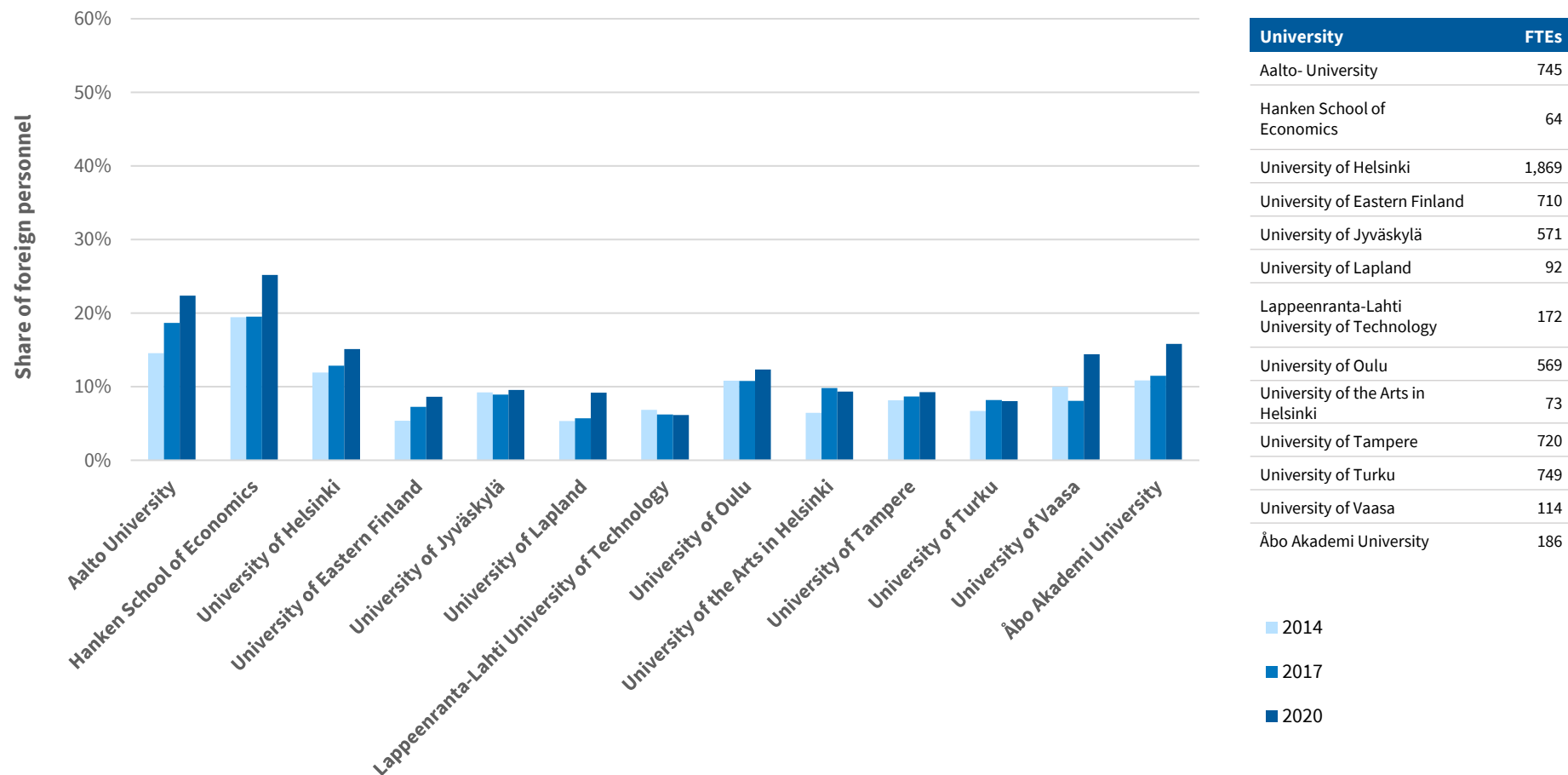
- The University of Helsinki aligned its statistical practices with other universities in 2017 and began to report data for teaching and research assistants under the category of support staff for teaching and research. This implied a transfer of some 250 FTEs from career stage I teaching and research personnel to support staff for teaching and research. Therefore, the data reported for 2014 do not accurately reflect the true situation at the University of Helsinki.
- FTE reporting practices at the University of the Arts in Helsinki were updated in 2019. FTEs for lecturers were previously allocated to career stage III, but since 2019 they have been reported under career stage II. Thus, the change in FTE figures for career stages I–II seen in the graph does not accurately reflect the true change at the University of the Arts in Helsinki or in the disciplinary group of arts and literature studies.
- FTE data do not include the category 'data on citizenship missing', which in 2017 accounted for 1 FTE at career stages I–II.

Source: Vipunen -- Education Statistics Finland, University education, Personnel.



Figure 2.8b

## Foreign teaching and research personnel FTEs as proportion of total university teaching and research personnel FTEs by university at career stages III–IV in 2014, 2017 and 2020.



University	FTEs
Aalto- University	745
Hanken School of Economics	64
University of Helsinki	1,869
University of Eastern Finland	710
University of Jyväskylä	571
University of Lapland	92
Lappeenranta-Lahti University of Technology	172
University of Oulu	569
University of the Arts in Helsinki	73
University of Tampere	720
University of Turku	749
University of Vaasa	114
Åbo Akademi University	186

- FTE figures for university teaching and research personnel do not include grant-funded personnel. Universities also differ in how they allocate positions to different career stages.
- FTE reporting practices at the University of the Arts in Helsinki were updated in 2019. FTEs for lecturers were previously allocated to career stage III, but since 2019 they have been reported under career stage II. Thus, the change in FTE figures for career stages III–IV seen in the graph does not accurately reflect the true change at the University of the Arts in Helsinki or in the disciplinary group of arts and literature studies.

Source: Vipunen -- Education Statistics Finland, University education, Personnel.

Table 2.11

## University teaching and research personnel FTEs at career stages III-IV by gender and disciplinary group in 2014, 2017 and 2020.

Disciplinary group	2014		2017		2020	
	Share of women, %	FTEs total	Share of women, %	FTEs total	Share of women, %	FTEs total
Mathematics, statistics	12%	195	16%	181	16%	193
Physics, geosciences, space science	15%	365	15%	372	19%	426
Chemistry, chemical engineering	26%	212	31%	200	29%	199
ICT and electrical engineering	14%	489	12%	495	15%	581
Materials science, materials engineering	15%	102	21%	122	21%	147
Engineering, other fields	22%	307	23%	278	27%	287
Business studies and economics	34%	440	34%	502	35%	550
Ecology, environmental science, plant biology	34%	259	41%	301	41%	289
Agricultural and forest sciences	48%	213	49%	165	53%	193
Biomedicine, biosciences	41%	509	45%	549	47%	609
Clinical medicine	46%	468	47%	430	51%	481
Health sciences	58%	204	60%	213	62%	222
Behavioural sciences	62%	569	63%	573	65%	598
Social sciences, other fields	43%	649	48%	714	53%	782
Languages	61%	379	64%	425	65%	381
Arts, literature studies	47%	456	49%	431	53%	296
Humanities, other fields	40%	349	40%	340	45%	386
<b>All disciplines</b>	<b>39%</b>	<b>6,180</b>	<b>41%</b>	<b>6,310</b>	<b>43%</b>	<b>6,634</b>

- 'All disciplines' includes FTEs in the disciplinary group 'other natural sciences': 13 FTEs in 2014, 19 FTEs in 2017 and 15 FTEs in 2020.
- FTE figures for university teaching and research personnel do not include grant-funded personnel. Universities also differ in how they allocate positions to different career stages.
- FTE reporting practices at the University of the Arts in Helsinki were updated in 2019. FTEs for lecturers were previously allocated to career stage III, but since 2019 they have been reported under career stage II. Since 2019 career stage II has comprised postdoctoral researchers, lecturers and university teachers; and career stage III university lecturers, university researchers, Academy Research Fellows and assistant professors.

Source: Vipunen -- Education Statistics Finland, University education, Personnel.

Table 2.13

## Foreign RDI personnel FTEs as proportion of total FTEs at universities of applied sciences in 2014, 2017 and 2020.

	2014	2017	2020
Share of foreign personnel, %	1%	2%	3%
Foreign personnel, FTEs	14	24	38
Total RDI personnel, FTEs	1,033	1,070	525

- Citizenship is not a compulsory data collection item for universities of applied sciences. In 2014 data were missing for 9 FTEs, in 2017 for 8 FTEs and in 2020 for 101 FTEs. This introduces some uncertainty to the calculation of percentage shares.

Source: Vipunen -- Education Statistics Finland, University of applied sciences education, Personnel.

Table 2.14

## Universities of applied sciences teaching and RDI personnel FTEs by gender and disciplinary group in 2014, 2017 and 2020.

Disciplinary group	2014		2017		2020	
	Share of women, %	FTEs total	Share of women, %	FTEs total	Share of women, %	FTEs total
Mathematics, statistics	37%	116	39%	90	41%	79
Physics, geosciences and space science	12%	56	14%	44	15%	48
Chemistry, chemical engineering	63%	55	56%	60	48%	92
ICT and electrical engineering	23%	643	22%	609	21%	660
Materials science, materials engineering	32%	34	27%	28	33%	17
Engineering, other fields	23%	829	26%	782	25%	840
Business studies and economics	60%	944	60%	938	62%	1,320
Ecology, environmental science, plant biology	54%	8	27%	9	45%	7
Agricultural and forest sciences	51%	221	54%	184	53%	185
Biomedicine, biosciences	98%	21	100%	14	100%	11
Clinical medicine	81%	33	94%	18	82%	15
Health sciences	89%	1,141	88%	1,129	89%	1,099
Behavioural sciences	76%	255	77%	231	77%	275
Social sciences, other fields	68%	699	68%	657	69%	605
Languages	87%	420	86%	363	87%	351
Arts, literature studies	54%	349	53%	276	54%	257
Humanities, other fields	68%	214	73%	148	79%	149
<b>All disciplines</b>	<b>59%</b>	<b>6,050</b>	<b>59%</b>	<b>5,594</b>	<b>59%</b>	<b>6,018</b>

- 'All disciplines' includes FTEs in the disciplinary group 'other natural sciences': 13 FTEs in 2014, 16 FTEs in 2017 and 9 FTEs in 2020.
- FTEs for which data on discipline is missing are not included in the table: 456 FTEs in 2014, 454 FTEs in 2017 and 567 FTEs in 2020.

Source: Vipunen -- Education Statistics Finland, University of applied sciences education, Personnel.

# Scientific publishing



Table 3.1

# Publication profile in Finland and in peer countries by disciplinary group 2016–2019.

Data from Web of Science database. Publication share for discipline highlighted when it is at least 0.5 percentage points higher than the world average.

Number of publications (fractional)		Share of country's publications, %														
Disciplinary group	Finland	Finland	Netherlands	Belgium	Ireland	United Kingdom	Austria	China	Norway	France	Sweden	Switzerland	Germany	Denmark	United States	World
Mathematics and statistics	920	2.1	1.4	2.3	1.6	1.9	3.9	2.6	1.9	4.4	1.8	2.8	2.3	1.3	2.1	2.5
Physics, geosciences, space science	4,439	10.3	9.1	10.5	7.7	10.2	11.9	14.0	10.5	15.8	9.6	14.8	14.3	8.7	9.9	12.4
Chemistry, chemical engineering	2,240	5.2	4.1	6.2	5.1	4.5	6.2	13.3	3.5	7.4	5.3	8.2	6.4	4.6	4.6	8.2
ICT and electrical engineering	6,151	14.3	7.8	9.9	12.2	8.8	13.1	16.2	9.0	13.1	10.6	11.4	9.6	9.1	9.3	12.8
Materials science, materials engineering	1,424	3.3	2.4	3.5	3.6	2.8	3.8	8.0	1.9	4.1	3.4	4.4	3.7	2.3	3.2	5.1
Engineering, other fields	2,561	6.0	4.5	5.4	4.3	5.2	6.4	10.3	9.8	5.0	6.8	6.1	4.5	6.5	4.6	7.2
Business studies and economics	1,688	3.9	3.2	2.7	2.8	3.5	2.8	1.5	3.5	2.4	3.1	2.5	2.5	2.8	2.5	2.3
Ecology, environmental science and plant biology	2,959	6.9	4.9	6.1	4.2	4.7	5.9	5.7	6.5	5.5	5.8	5.1	5.7	6.2	5.5	5.9
Agricultural and forest sciences	1,246	2.9	1.9	3.3	4.9	1.7	2.7	2.0	2.8	2.0	1.8	2.0	2.3	3.1	2.1	2.8
Biomedicine, biosciences	3,523	8.2	11.6	11.8	10.0	9.7	10.8	11.3	7.8	10.9	10.6	10.9	12.4	12.5	12.6	10.7
Clinical medicine	5,924	13.8	24.5	17.4	17.2	16.8	16.5	8.5	14.2	17.4	18.2	16.7	19.0	22.4	20.1	14.5
Health sciences	2,110	4.9	5.6	3.5	6.4	5.1	2.2	0.8	7.4	2.1	6.2	2.1	3.5	5.7	5.8	3.3
Behavioural sciences	1,951	4.5	5.1	3.9	5.0	4.6	2.3	1.1	4.9	1.4	3.4	3.0	2.6	2.5	4.8	2.8
Social sciences, other fields	2,892	6.7	6.7	5.7	6.3	9.0	4.2	1.7	8.6	2.1	6.4	3.3	4.0	5.7	5.3	3.7
Humanities	1,681	3.9	3.5	4.9	6.4	7.9	3.5	0.6	4.3	3.4	3.0	3.2	3.0	3.1	4.3	2.7
General scientific journals	1,295	3.0	3.7	3.1	2.3	3.5	3.7	2.4	3.3	3.0	3.9	3.5	4.4	3.5	3.3	2.9
All disciplines	43,004	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

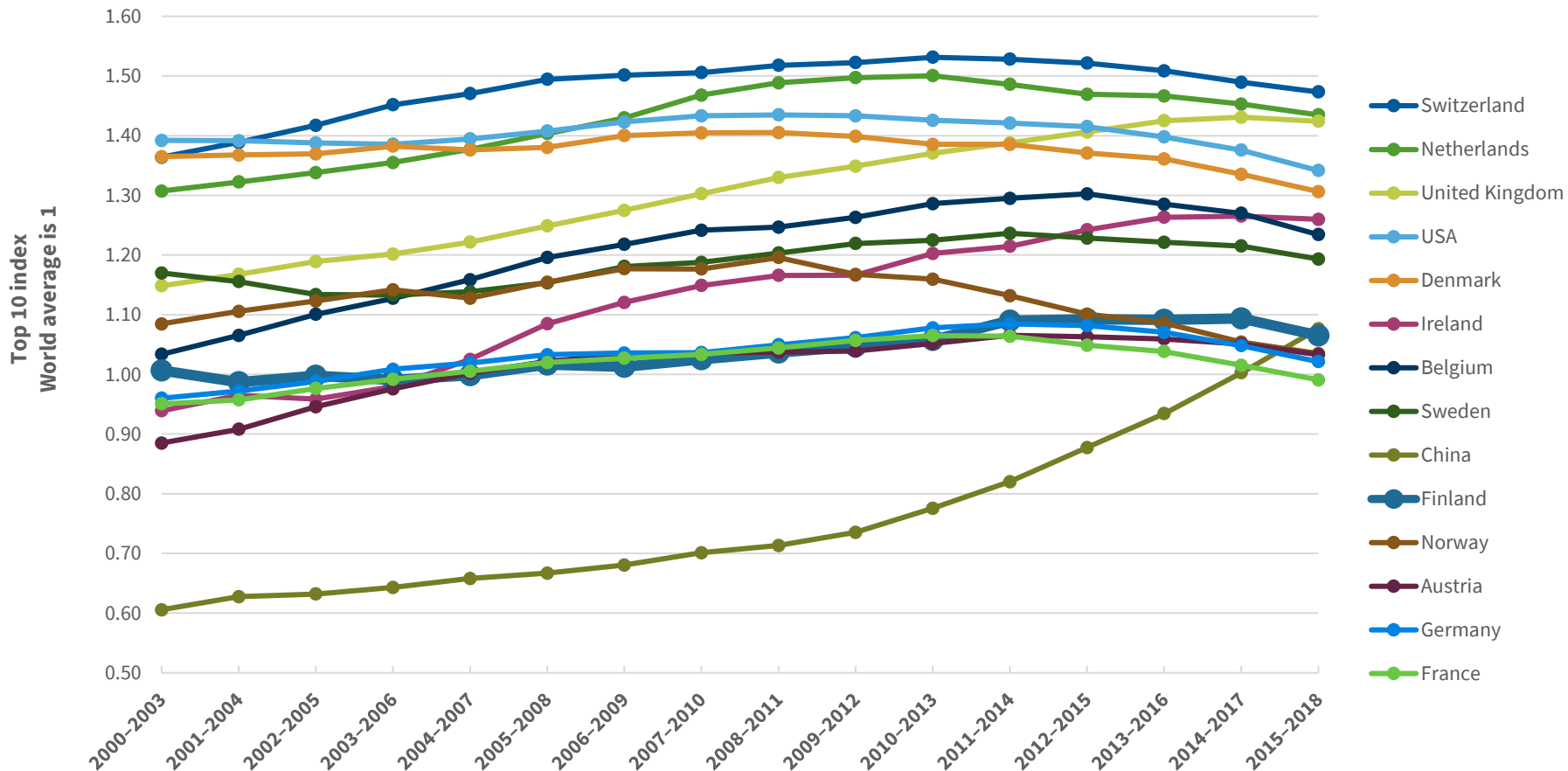
- International co-publications and publications classified into more than one discipline are fractionalised.
- Publication counts for Finland vary depending on whether the figures are drawn from Education Statistics Finland's data for Finland and Finnish organisations or from international comparative data. The difference stems from the fact that in international comparative data, publications are fractionalised based on country data alone, whereas for Finnish publications this is done based on the publishing organisation.
- Publications in many social sciences and humanities fields in particular are inadequately represented in Web of Science data. Therefore the number of WoS publications does not accurately reflect the true extent of scientific publishing in these fields.

Source: Clarivate Analytics Web of Science based data, bibliometric computing by CSC Ltd, 2021.

Figure 3.2

# Scientific impact in Finland and in peer countries as measured by top 10 index 2000–2018.

Data from Web of Science database.



• The top 10 index describes the proportion of the 10% most cited publications in the discipline. The world average in each discipline is 1. A top 10 index greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications. When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year. Publications are fractionalised between countries and disciplines so that each publication is counted only once. When examined at the national level, publications are fractionalised not only between countries and disciplines but also between Finnish research organisations so that each of the publications is counted only once.

Source: Clarivate Analytics Web of Science based data, bibliometric computing by CSC Ltd, 2021.

Table 3.3b

# Scientific impact in Finland and in peer countries by disciplinary group 2015–2018.

Data from Scopus database. Three highest-impact disciplines highlighted for each country.

Number of publications (fractional)		Top 10 index													
Tieteenalaryhmä	Finland	Finland	Netherlands	Belgium	Ireland	United Kingdom	Austria	China	Norway	France	Sweden	Germany	Switzerland	Denmark	USA
Mathematics, statistics	1,417	1.11	1.25	1.24	1.15	1.44	1.08	1.06	1.25	1.06	1.12	1.03	1.50	1.36	1.24
Physics, geosciences, space science	4,143	1.24	1.64	1.31	1.32	1.55	1.22	0.93	1.14	1.17	1.29	1.28	1.75	1.60	1.48
Chemistry, chemical engineering	1,837	0.98	1.54	1.18	1.24	1.34	0.89	1.18	0.75	0.92	1.20	1.08	1.53	1.17	1.48
ICT and electrical engineering	7,609	1.16	1.16	1.18	1.09	1.40	0.92	1.06	0.94	0.88	1.17	0.90	1.59	1.47	1.46
Materials science, materials engineering	2,352	1.02	1.32	1.21	1.17	1.27	0.80	1.24	0.76	0.83	1.13	0.91	1.38	1.12	1.28
Engineering, other fields	3,305	1.32	1.44	1.44	1.57	1.45	0.83	1.04	0.98	1.12	1.32	0.93	1.58	1.44	1.01
Business studies and economics	2,530	1.24	1.68	1.26	1.03	1.40	1.20	1.22	1.09	0.87	1.24	0.99	1.36	1.42	1.34
Ecology, environmental science, plant biology	2,806	1.24	1.88	1.50	1.51	1.67	1.43	0.96	1.28	1.31	1.60	1.37	1.83	1.69	1.29
Agricultural and forest sciences	1,470	1.45	1.76	1.37	1.85	1.67	1.30	1.04	1.45	1.30	1.51	1.18	1.47	1.65	1.29
Biomedicine, biosciences	4,273	1.12	1.48	1.34	1.67	1.53	1.27	0.84	1.05	1.12	1.25	1.16	1.59	1.28	1.44
Clinical medicine	6,371	1.27	1.55	1.39	1.17	1.41	1.17	0.78	1.25	1.00	1.47	0.99	1.36	1.48	1.43
Health sciences	1,858	1.24	1.42	1.46	1.39	1.34	1.18	1.18	1.09	0.59	1.10	0.77	1.44	1.31	1.17
Behavioural sciences	1,666	1.29	1.79	1.43	1.01	1.27	0.97	0.90	1.15	0.42	1.07	1.02	1.10	1.19	1.22
Social sciences, other fields	2,864	1.22	1.81	1.25	1.05	1.36	1.28	1.13	1.27	0.52	1.39	1.09	1.47	1.56	1.19
Humanities	2,066	1.10	1.63	1.00				1.27	1.26	0.55	1.30	0.93		1.38	
Yleistieteelliset lehdet	601	1.02	1.61	1.14	1.28	1.43	1.36	0.61	1.20	1.24	1.24	1.35	2.01	1.61	1.97
All disciplines	47,168	1.20	1.54	1.31	1.28	1.43	1.10	1.01	1.12	0.99	1.30	1.05	1.52	1.43	1.36

- The top 10 index describes the proportion of the 10% most cited publications in the discipline. The world average in each discipline is 1. A top 10 index greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications. When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year. Publications are fractionalised between countries and disciplines so that each publication is counted only once. When examined at the national level, publications are fractionalised not only between countries and disciplines but also between Finnish research organisations so that each of the publications is counted only once.
- The top 10 index value is not calculated if the publication count is less than 50 or if internal coverage is below 40%. Internal coverage refers to the proportion of references in database publications that are also indexed in the database.

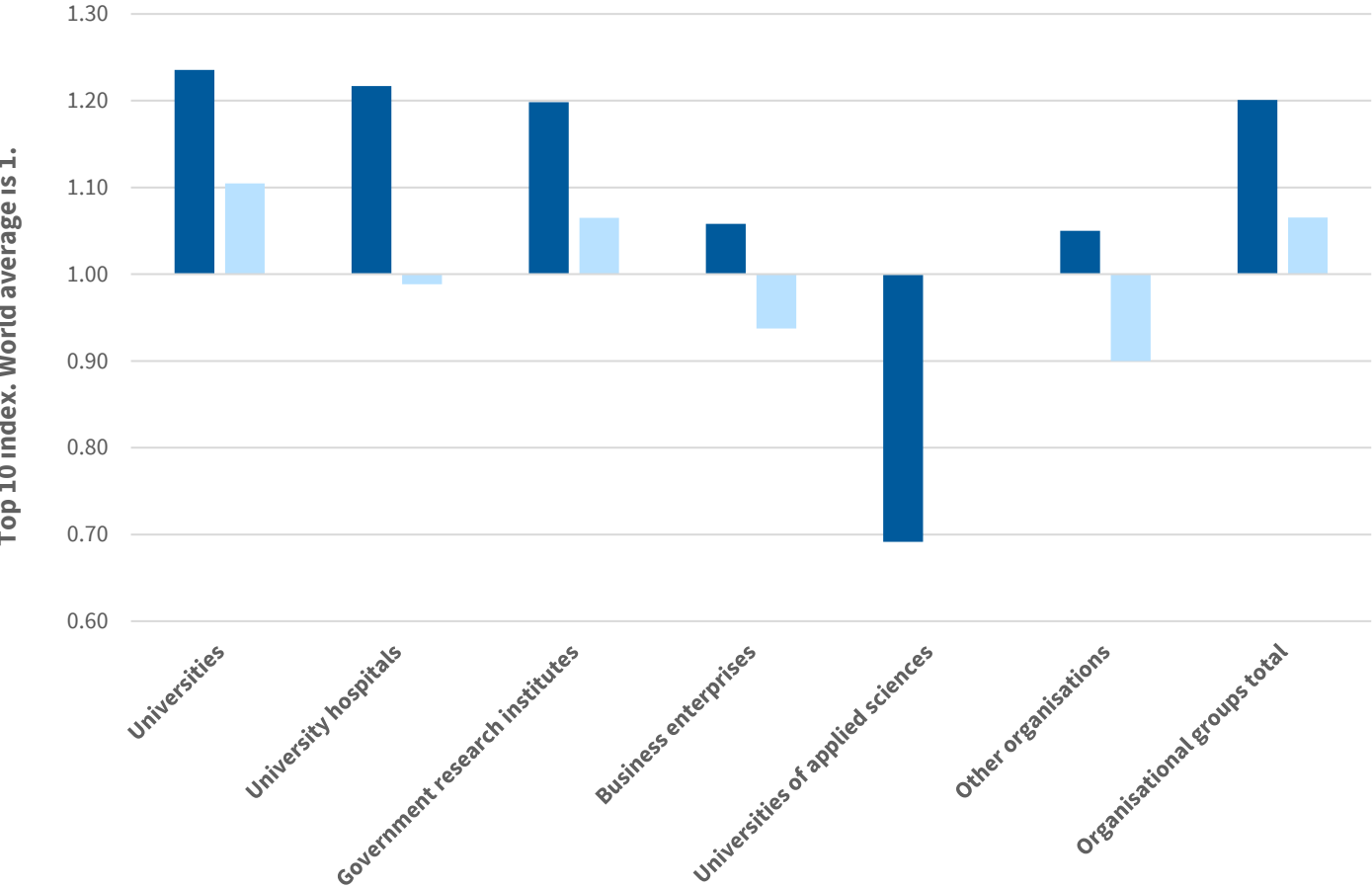
Source: Elsevier Scopus based data, bibliometric computing by CSC Ltd, 2021.



Figure 3.5

# Number of publications and scientific impact of organisational groups 2015–2018.

Data from Scopus and Web of Science databases.



	Publication count	
	Scopus	WoS
All organisational groups	34,035	31,006
Universities	1,889	3,235
University hospitals	5,081	4,535
Government research institutes	616	1,885
Business enterprises	714	625
Universities of applied sciences	4,719	1,923
Other organisations	47,055	43,210

■ Top 10 index Scopus  
■ Top 10 index WoS

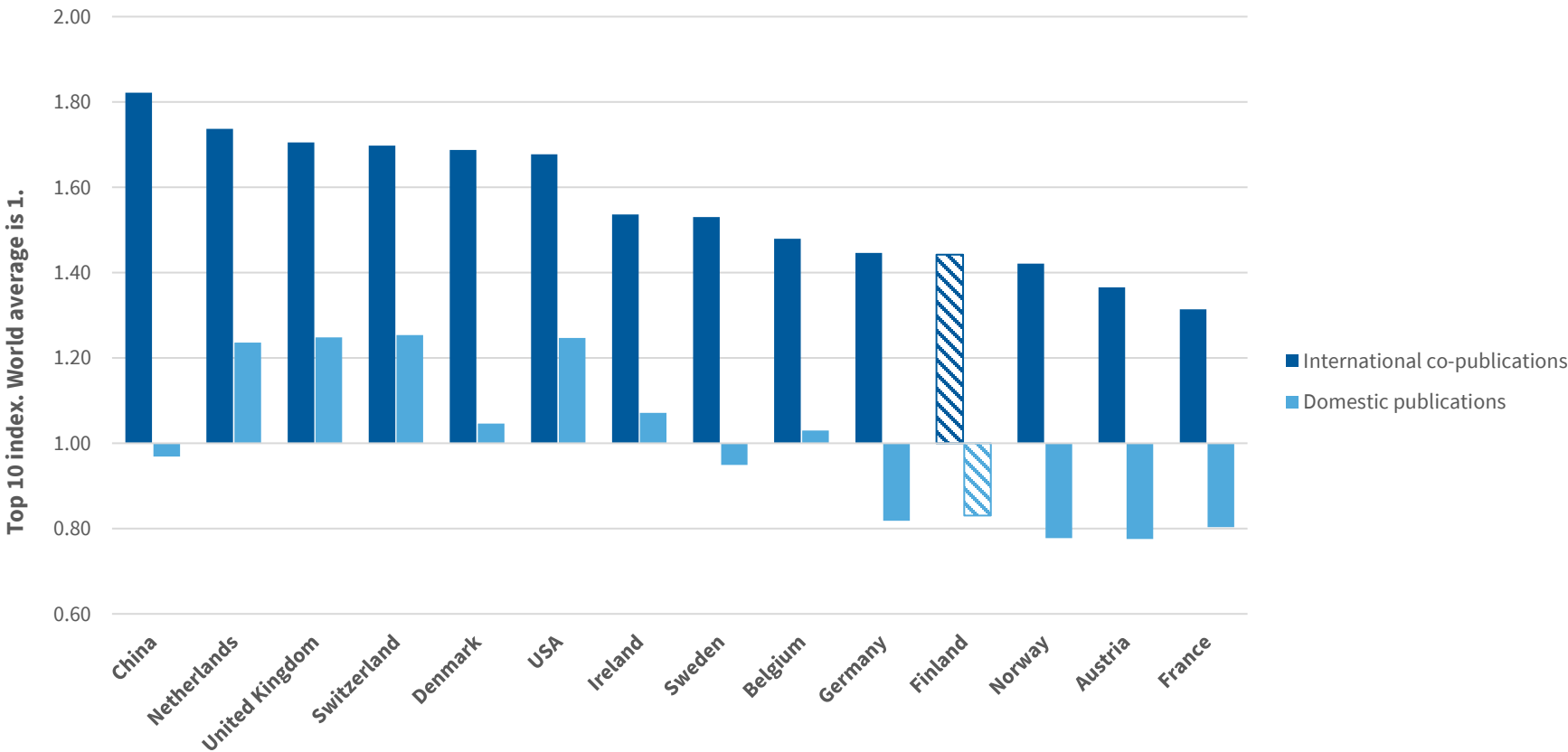
- Other organisations include: National Defence University, Police University College, Åland University of Applied Sciences, Finnish Institute of International Affairs, other hospitals, municipal organisations, scientific societies, central government organisations, religious organisations, sports clubs, labour market organisations, industry federations and associations, interational organisations, and publications with incomplete Finnish address.
- The top 10 index describes the proportion of the 10% most cited publications in the discipline. The world average in each discipline is 1. A top 10 index greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications. When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year. Publications are fractionalised between countries and disciplines so that each publication is counted only once. When examined at the national level, publications are fractionalised not only between countries and disciplines but also between Finnish research organisations so that each of the publications is counted only once.
- The top 10 index value is not calculated if the publication count is less than 50 or if internal coverage is below 40%. Internal coverage refers to the proportion of references in database publications that are also indexed in the database.
- Publication counts for Finland vary depending on whether the figures are drawn from Education Statistics Finland's data for Finland and Finnish organisations or from international comparative data. The difference stems from the fact that in international comparative data, publications are fractionalised based on country data alone, whereas for Finnish publications this is done based on the publishing organisation.

Sources: Elsevier Scopus based data and Clarivate Analytics Web of Science based data, bibliometric computing by CSC Ltd, 2021.

Figure 3.11

# Scientific impact of publications in Finland and in peer countries by type of co-publishing 2015–2018.

Data from Web of Science database. Countries listed in order of top 10 index for international co-publications.



- The top 10 index describes the proportion of the 10% most cited publications in the discipline. The world average in each discipline is 1. A top 10 index greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications. When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year. Publications are fractionalised between countries and disciplines so that each publication is counted only once. When examined at the national level, publications are fractionalised not only between countries and disciplines but also between Finnish research organisations so that each of the publications is counted only once.
- At least one author of international co-publications is affiliated with an organisation in a country other than that under consideration. The authors of domestic publications all work in the country concerned.

Source: Clarivate Analytics Web of Science based data, bibliometric computing by CSC Ltd, 2021.

Table 3.12

# Finland's top 10 bilateral co-publishing partners, publication counts and scientific impact 2005–2008 and 2015–2018.

Data from Web of Science database. Countries listed in order of co-publication counts.

2005–2008					2015–2018				
Country	Co-publications with Finland (fractional)	Top 10 index for co-publications	Total publication count (fractional)	Top 10 index for all publications	Country	Co-publications with Finland (fractional)	Top 10 index for co-publications	Total publication count (fractional)	Top 10 index for all publications
USA	961	1.48	1,341,008	1.41	USA	1,310	1.61	1,650,565	1.34
Sweden	575	1.04	59,497	1.15	Sweden	1,035	1.07	84,545	1.19
United Kingdom	531	1.45	328,414	1.25	United Kingdom	827	1.64	425,855	1.42
Germany	478	1.03	293,977	1.03	Germany	760	1.33	386,300	1.02
Russia	314	0.58	95,703	0.24	China	722	1.50	1,507,621	1.08
Netherlands	200	1.85	90,850	1.40	Russia	579	0.65	184,718	0.23
Italy	175	1.13	175,779	0.90	Italy	376	1.43	258,726	1.01
Canada	174	1.20	183,663	1.20	Spain	360	1.34	207,149	0.96
China	173	0.88	494,152	0.67	France	313	1.20	253,999	0.99
France	167	1.22	209,018	1.02	Australia	287	1.30	221,660	1.34
<b>Total</b>	<b>3,751</b>	<b>1.23</b>	<b>3 272,062</b>	<b>1.14</b>	<b>Total</b>	<b>6,573</b>	<b>1.34</b>	<b>5,181,140</b>	<b>1.15</b>

- The top 10 index describes the proportion of the 10% most cited publications in the discipline. The world average in each discipline is 1. A top 10 index greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications. When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year. Publications are fractionalised between countries and disciplines so that each publication is counted only once. When examined at the national level, publications are fractionalised not only between countries and disciplines but also between Finnish research organisations so that each of the publications is counted only once.
- Finland's total publication count for the four-year period 2005–2008 was 32 863 (top 10 index 1.02), for 2015–2018 it was 43 210 (top 10 index 1.07).
- Publication counts given on the Total row are calculated based on unrounded numbers. Total publication counts and top 10 index figures refer to the publication counts and top 10 indices for the 10 countries concerned.

Source: Clarivate Analytics Web of Science based data, bibliometric computing by CSC Ltd, 2021.

Table 3.15b

## Academic-corporate co-publications as proportion of university publications by main field of science 2017–2020.

Publication data from Ministry of Education and Culture.

Organisational group	Natural sciences	Engineering	Medical and health sciences	Agricultural and forest sciences	Social sciences	Humanities	All disciplines total
<b>Co-publications with business enterprises, %</b>							
University	6.2	13.9	7.3	8.8	1.9	0.4	5.5
University of applied sciences	3.8	8.5	2.6	3.8	1.4	1.4	2.9
<b>Total number of publications (fractional)</b>							
University	37,353	16,383	35,870	2,639	36,239	20,749	149,233
University of applied sciences	1,210	2,971	3,271	809	9,600	1,997	19,858

- The Table shows the publication counts for the following main categories of the Ministry of Education and Culture's classification of publication types: A) peer-reviewed scientific articles; B) non-refereed scientific articles; C) scientific books (monographs); and D) publications intended for professional communities.
- Publications not included in total publication count if co-publications data or if data on discipline is missing.

Source: Vipunen – Education Statistics Finland, Higher education and R&D activity, Publications.

# Background, data and methods



# State of scientific research in Finland – statistics



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1. Research funding
2. Research personnel
3. Scientific publishing

## Main perspectives

- **Sectors** (universities, universities of applied sciences, research institutes)
- **Disciplinary groups:** 17 groups (personnel) and 16 groups (publishing)
- **International comparisons** of research funding and publishing



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# Peer countries

## **European countries comparable to Finland in terms of size and research system:**

Netherlands, Belgium, Ireland, Austria, Norway, Sweden, Switzerland, Denmark

## **Large, traditional science countries:**

United Kingdom, France, Germany, USA

## **Large, emerging science country:**

China





# Disciplinary groups

Statistics on research personnel are compiled using disciplinary groups formed by clustering together Statistics Finland's field of science categories.

- Mathematics, statistics
- Physics, geosciences, space science
- Chemistry, chemical engineering
- ICT and electrical engineering
- Materials science, materials engineering
- Engineering, other fields
- Business studies and economics
- Ecology, environmental science, plant biology
- Agricultural and forest sciences
- Biomedicine, biosciences
- Clinical medicine
- Health sciences
- Behavioural sciences
- Social sciences, other fields
- Languages
- Arts, literature studies
- Humanities, other fields





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# Bibliometric disciplinary groups

Statistics on publishing are compiled using Scopus and Web of Science subject categories that are merged into larger clusters primarily based on Statistics Finland's field of science categories.

- Mathematics, statistics
- Physics, geosciences, space science
- Chemistry, chemical engineering
- ICT and electrical engineering
- Materials science, materials engineering
- Engineering, other fields
- Business studies and economics
- Ecology, environmental science, plant biology
- Agricultural and forest sciences
- Biomedicine, biosciences
- Clinical medicine
- Health sciences
- Behavioural sciences
- Social sciences, other fields
- Humanities
- General scientific journals



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# Definition of concepts 1/5

## **Research and development** (Statistics Finland)

- Research and development (R&D) refers broadly to systematic work aimed at increasing the existing stock of knowledge and to the use of this knowledge for developing new applications.
- R&D should involve an appreciable element of novelty.
- R&D comprises basic research, applied research and experimental development.

## **R&D expenditure** (Statistics Finland)

- R&D expenditure comprises wage and salary spending, costs from purchased services, other current expenditure and investment and acquisition costs.





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# Definition of concepts 2/5

## **Gross domestic product (GDP)** (Statistics Finland)

- GDP, gross domestic product at market prices is the final result of the production activity of resident producer units.

## **R&D intensity**

- In this set of slides R&D intensity is expressed in terms of national R&D expenditure as a percentage of GDP.



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# Definition of concepts 3/5

## **Public sector and private non-profit agencies** (Statistics Finland)

- The public sector comprises central government administrative branches and research institutes, municipalities (since 2007), social security funds and institutions, as well as private non-profit agencies.

## **Higher education sector** (Statistics Finland)

- The higher education sector comprises universities, university hospitals, universities of applied sciences and the National Defence University (since 2016).
- Some public or private research institutes that have close links with university research can also be included in the higher education sector.



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# Definition of concepts 4/5

## **Full-time equivalent (FTE)** (Ministry of Education and Culture)

- Regular annual working hours, excluding overtime and other work exceeding normal working hours.
- FTE is not reduced by paid or partly paid sick time.
- The maximum FTE for a full-time person is 1.

## **Research FTE** (Statistics Finland)

- Calculated full-time R&D work (including holidays) conducted during one year.

## **R&D personnel** (Statistics Finland)

- Persons who during the statistical year spend at least 10% of their working hours in administrative, office or other support roles directly related to R&D work or R&D projects.



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# Definition of concepts 5/5



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## **Research career stages** (Ministry of Education and Culture)

- FTE statistics for university teaching and research personnel use a four-tiered research career model:

**Stage I** (e.g. doctoral student, early-career researcher)

**Stage II** (e.g. postdoctoral researcher)

**Stage III** (e.g. university lecturer)

**Stage IV** (e.g. professor, Academy professor, research professor, research director)

Universities differ in how they allocate positions to different career stages.



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# Data sources 1/2

- Data for the analyses of scientific publishing are drawn from Elsevier's Scopus database and from the Clarivate Analytics Web of Science database.
- The following publication types are included: article, review, letter, proceedings paper (WoS), conference paper (Scopus), book chapter and book.
- Citations are calculated using an open citation window from the year of publication until 2020. The most recent publication period for the top 10 index is 2015–2018. The use of an open citation window means that the citation indicator values for earlier publications are also updated as new citations are added.





# Data sources 2/2

- The Web of Science's internal coverage (the proportion of citations in database publications to other publications that are also indexed in the database) is too low (less than 40%) for some organisations and disciplines and therefore citation indices cannot be calculated in these cases.
- The Scopus database is used to complement WoS data in analyses of individual organisations or disciplinary groups.
- Main differences between Scopus and Web of Science databases:
  - In country-level analyses WoS-based and Scopus-based data give a very similar picture of the standard of research as assessed using the top 10 index.
  - Analyses based on disciplinary groups yield somewhat different results, among other reasons because of differences in database coverage. Scopus covers a larger number of scientific journals, and there are also some differences in fields of science classifications.



# Methods: disciplinary group



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- A publication's disciplinary group is determined based on the subject category used in the Clarivate Analytics Web of Science database or in Elsevier's Scopus database for the publication channel (e.g. a scientific journal or conference publication).
- Many publication channels are classified into several different disciplinary groups.
- For the present review, disciplines are clustered into larger groups based on the bibliometric classification of fields of science (see slide 34).
- Approaches based on field of science classifications are poorly suited for examinations of interdisciplinary or phenomenon-based research.



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# Methods: co-publications

- Co-authorship analyses make a distinction between
  - international co-publications: authors are affiliated with organisations from at least two countries (based on the authors' affiliation as reported in the publication and not, for instance, on nationality)
  - domestic co-publications: authors are affiliated with at least two organisations from the same country (e.g. Finland), no authors from outside the country concerned
  - single organisation publications: authors from one research organisation only



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# Methods: fractionalisation

- International co-publications are equally fractionalised between the countries contributing to the publication.
- The sum of the country-specific fractions is 1.0.
- Publications classified into several disciplines are fractionalised between the disciplines concerned, and domestic publications are fractionalised between the Finnish research organisations.
- Fractionalisation is based on the number of countries and disciplines and in the case of Finnish publications on the number of organisations contributing to the publication and not, for instance, on the number of researchers involved from different countries.



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# Methods: top 10 index 1/2

- Index describes the proportion of the 10% most cited publications in the discipline.
- The average for each discipline is 1. An index value greater than 1 means that more than 10% of a country's/organisation's publications rank among the 10% most cited publications.
- When calculating the top 10 index, the number of citations to a publication is only compared to the number of citations to publications appearing in the same discipline in the same year.
- Self-citations are omitted from the analysis.
- Publications are fractionalised between countries and organisations and in the case of Finland additionally between Finnish research organisations.
- The top 10 index is not calculated if the publication count is under 50 or if internal coverage is less than 40%. Internal coverage refers to the proportion of references in database publications that are also indexed in the database.



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# Methods: top 10 index 2/2

- If calculations are based on a small publication count, the top 10 index value can vary for random reasons. An examination of trends over several years will yield a more reliable picture of how the index has developed.
- The top 10 index describes the proportion of the 10% most cited publications in the discipline, and therefore the numbers and shares of all publications impact upon the index values. In comparisons of countries and organisations, variation in the top 10 indices especially for countries and organisations with large publication numbers impacts upon the index values for others.
- Citations are calculated using an open citation window from the year of publication until 2020. The most recent publication period is 2015–2018. The use of an open citation window means that the citation indicator values for earlier publications are also updated as new citations are added.



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# Limitations of the data and methods used

- Citation indicators such as the top 10 index offer only one perspective on scientific impact, but they do not in themselves provide a true overall impression of the standard of research.
- Peer reviews are a key mechanism for the evaluation of scientific quality.
- Publications in the humanities and many social sciences in particular are inadequately represented in international citation databases.
- Publications indexed in these databases alone do not provide an accurate picture of the true extent of publishing in these fields of science.

# Bibliometric sources

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