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1 Context analysis of the Polish higher education and research system

1.1 Size and structures of research and development (R&D)

For the last few years, spending on R&D in Poland has grown considerably. There was a steady increase in **gross domestic expenditure on research and development (GERD) expressed as a percentage of gross domestic product (GDP)** from 0.88% in 2012 to 1.21% in 2018 (Figure 1). However, this indicator remained lower than the average for the European Union (EU), which fluctuated between 2% in 2012 and 2.1% in 2018 (Eurostat 2020a). R&D expenditures per capita in Poland are currently four times lower than the EU average (158 euros per inhabitant in 2018 compared to an EU average of 660 euros; Eurostat 2020b). This situates Polish science among Europe's most resource-poor systems, which also has an impact on the low levels of international research collaboration (Kwiek 2020).

The increase in spending on R&D in Poland between 2012 and 2018 was due in large part to the growth of expenditure in the business enterprise sector, where the share of **GERD in GDP** grew from 0.33% in 2012 to 0.8% in 2018. To a lesser extent, the increase took place in the higher education sector, where GERD as a percentage of GDP grew from 0.3% in 2012 to 0.38% in 2018. During the same period, the government sector experienced a decrease in R&D expenditure: from 0.25% in 2012 to 0.02% in 2018 (Figure 2). In 2018, the main sources of financing for R&D projects were the business enterprise sector and the government sector, whose expenditures constituted 53.3% and 35.4% of GERD, respectively (GUS 2019).

At the same time, public spending on education in Poland has decreased in recent years. Between 2012 and 2017, **government expenditure on education** fell from 4.81% to 4.56% of GDP (UNESCO Institute for Statistics 2020). This reflected a wider tendency in the EU-28 countries, where the mean general government expenditure on education fell from 5% in 2012 to 4.7% of GDP in 2017 (Eurostat 2020c)[1]. In response to a decrease in the number of enrolled students in Poland (OECD 2019), **expenditure on tertiary education as a percentage of total government expenditure on education** also decreased – from 24.4% in 2013 to 22.8% in 2017.[2]

1.2 Participation in tertiary education

In 2018, there were 1.2 million students in Polish higher education institutions (HEIs). Between 2012 and 2018, the number of students decreased by almost 20%. Accordingly, the

[1] Data published by Eurostat for Poland differ from those provided by the UNESCO Institute for Statistics. According to Eurostat, general government expenditure on education in Poland fell from 5.4% in 2012 to 5% in 2017 (Eurostat 2020c).

[2] These data were extracted on 22 Sept. 2020 from UIS.Stat; however, they are no longer available online at the time of writing this report. Eurostat data for Poland differ – according to its database, expenditure on tertiary education decreased from almost 28% of total government expenditure on education in 2012 to 24% in 2018 (Eurostat 2020c).

absolute numbers of tertiary education graduates also decreased. In 2018, 328,000 students graduated from HEIs – 32% fewer than in 2012 (485,000; GUS 2019).

At the same time, the level of tertiary education attainment gradually increased in Poland. While in 2013, **at least a Bachelor's or equivalent programme** (ISCED 6) was successfully completed by 22,6% of the population aged 25+ years, this figure was 24.9% in 2016, which indicates a growth of 10% (UNESCO Institute for Statistics 2020c)[3].

Among all graduates from tertiary education, only less than 1% graduated from a **programme at doctoral or equivalent level** (ISCED 8). The share of graduates from ISCED 8 in the total number of tertiary education graduates fluctuated from 0.62% in 2013 to 0.78% in 2018 (Figure 3).[4]

1.3 Human resources in science and research

There has been continuous growth in the number of R&D personnel in Poland. Between 2012 and 2018, total R&D personnel measured in full-time equivalents (FTE) rose by almost 80%, from 90,715.5 to 161,993. The growth in the absolute number of R&D personnel translated into an increase in relative terms: between 2012 and 2018, **total R&D personnel in FTE** grew from 2,373 to 4,272 **per million inhabitants**, from 5% to 8.8% **per thousand labour force**, and from 5.5% to 9.2% **per thousand total employment** (Table 1).

The composition of the R&D personnel by sector of employment measured both in FTE and head counts (HC) changed considerably. There was a substantial and steady growth in the share of business enterprise R&D personnel among total R&D personnel: from 28.4% in 2012 to 53.1% in 2018 in FTE and from 23.2% in 2012 to 40% in 2017 in HC. During the same period, the share of government R&D personnel (FTE) shrank from 24% in 2012 to 20.2% in 2015, and then to 2.7% in 2018, while the share of government-employed R&D personnel (HC) shrank from 19.2% in 2012, to 16.7% in 2015, and to 3.6% in 2017. While there were small fluctuations of up to 5% in the proportion of higher education R&D personnel, the general trend was downward: it decreased from 47.3% in 2012 to 43.3% in 2018 in FTE, and from 57.4% in 2012 to 55.3% in 2017 in HC. The share of private non-profit R&D personnel remained negligible during the considered period, increasing from 0.3% in 2012 to 0.9% in 2018 in FTE, and from 0.2% in 2012 to 1.1% in 2017 in HC (UNESCO Institute for Statistics 2020e).[5]

Researchers represented on average around three quarters **of total R&D personnel** during the period considered. More specifically, the share of researchers among total R&D personnel (FTE) rose from 73.9% in 2012 to 79.5% in 2017, and then fell to 72.7% in 2018 (Figure 4).

[3] Data for 2012 and after 2016 are unavailable. The data available in the Eurostat database are not fully comparable.
[4] The data for 2013–2017 were firstly calculated based on UIS.Stats data (08.2020). As they are no longer available online at the time of writing this report, the comparable Eurostat dataset is used here for verification and completion of data.
[5] Please note that in 2016 there was break in the series with the previous year for data in FTE, and that data for 2017 and 2018 in both FTE and HC do not correspond exactly to the Frascati Manual recommendation (UNESCO Institute for Statistics 2020e).

The shares of **researchers** employed **in different sectors** changed in accordance with the changes of the composition of total R&D personnel. There was substantial and steady growth in the proportion of researchers in the business enterprise sector – they constituted between 22.5% of total researchers in 2012 and 48.2% in 2018 (FTE) and between 18.2% of total researchers in 2012 and 36.8% in 2017 (HC). In the same time frames, the share of government-employed researchers in the total pool of researchers shrank from 20.3% to 2.6% in FTE and from 15.1% to 3.1% in HC. There was also a downward trend in the case of the percentage of researchers in the higher education sector: from 56.9% of total researchers in 2012 to 48.4% in 2018 (FTE), and from 66.5% of total researchers in 2012 to 59.2% in 2017 (HC).[6] Researchers from the private non-profit sector accounted for less than 1% of total researchers in both FTE and HC. The changes in the shares of researchers in FTE in different sectors are illustrated in Figure 5.

The number of academic staff oscillated around 95,000 between 2012 and 2018. The majority of academic staff (90%) were employed in public HEIs. In 2018, out of almost 86,700 academic teachers at public HEIs, 38% worked in universities, 20% in technical colleges and 14% in medical colleges. Twenty per cent of all academic staff had a Master's degree or equivalent, 49% had a doctoral degree, 20% had a post-doctoral degree (*habilitation*), and 10% were titular/full professors (OPI 2019).

1.4 Basic characteristics of the higher education and research system

The public sector remains an important R&D performer in Poland, with key HEIs belonging to this sector alongside a large number of public research organisations. The **key players** among them are universities, institutes of the Polish Academy of Sciences, and the Łukasiewicz Research Network[7]. Most higher education institutions are under the responsibility of the Ministry of Science and Higher Education. Some, however, are under the control of other competent ministries.

Funding for higher education and research in Poland comes in large part from public sources. The main source of public funding is the state budget in the form of statutory funding and grants. Statutory funding is mainly granted to institutions by the Ministry of Science and Higher Education on the basis of results of complex evaluations performed by the Committee for the Research Organisations Evaluation (KEJN), an advisory body for the Minister of Science and Higher Education. Grants are offered through open calls by agencies subordinate to the Minister of Science and Higher Education, including the National Science Centre, the National Centre for Research and Development and the Polish National Agency for Academic Exchange. HEIs and research organisations also use foreign sources of public funds, including the European Structural Funds and EU Research and Innovation Programmes. To a lesser degree, research is financed by non-governmental institutions (e.g. the Foundation for

[6] While the share of higher education researchers in the total pool of researchers shrank, their absolute number increased between 2012 and 2018 by almost 50% (from 38,152 to 57,049 in FTE). However, the number of private enterprise researchers grew much more dynamically during that period – by 275% (from 15,088 to 56727 in FTE; UNESCO Institute for Statistics 2020e).

[7] https://lukasiewicz.gov.pl/en/

Polish Science) and local authorities (Eurydice 2020; EURAXESS Poland, n.d.; Gulda et al. 2017).

The operation of public higher education institutions is heavily dependent on the state budget allocation. In 2018, 62% of the value of the total revenues of public universities came from this source (OPI 2019). Non-public HEIs can also be awarded public funding, in the form of grants for tasks related to financial support for students, and tasks related to the provision of conditions for full participation of disabled persons in the learning process and research activity. Non-public HEIs may also be granted a subsidy for the maintenance and development of their research capacities (Eurydice 2020).

The higher education sector in Poland has developed very dynamically since the beginning of the 1990s. However, since 2012, when 456 HEIs were operating, their number has been systematically decreasing, mainly due to the closure of non-public entities facing a decline in the number of students. By the end of 2018, 392 HEIs were in operation. Despite the fact that in recent years the number of HEIs has been systematically falling, Poland is one of the European countries with the largest number of HEIs per million inhabitants – in 2016, there were over 11.3 HEIs per million Poles. The **fragmentation of the higher education sector** is considered to be one of the reasons why Polish universities occupy low positions in world rankings (OPI 2019).

As for **the structure of the higher education system**, there are two types of HEIs in Poland: university-type HEIs and non-university HEIs. A university-type HEI conducts research activity and has received a high (A+, A or B+) research rating in at least one science or arts discipline. It may provide first-cycle programmes (ISCED 6), second-cycle and/or long-cycle programmes (ISCED 7), and doctoral education (ISCED 8). A non-university HEI is an institution which offers programmes responding to the needs of the socio-economic environment, and does not fulfil the criteria for a university-type HEI. It provides first-cycle programmes, and may also provide second- and/or long-cycle programmes, but is not authorised to award doctoral degrees or provide doctoral programmes. This type of institutions includes HEIs referred to as schools of higher vocational education, which are authorised to provide only first-cycle degree programmes (Eurydice 2020).

Of the 392 HEIs operating in 2018, 248 were non-public HEIs, 133 were public HEIs, and 11 were HEIs run by churches or religious associations. Non-university HEIs constituted 69% of all HEIs (270). The majority of non-university HEIs (84%) were non-public. At the same time, university-type HEIs constituted 31% of all HEIs (122), most of which (80%) were public (OPI 2019).

Among the 133 public HEIs operating in 2018, there were 34 state vocational colleges, 19 universities, 19 HEIs of art studies, 18 technical HEIs, 10 medical universities, 6 agricultural HEIs, 6 academies of physical education, 5 schools of economics, 5 pedagogical HEIs, 5 military academies, 3 government service HEIs, 2 HEIs of maritime studies and 1 theological HEI. In 2018, about three-quarters of tertiary students at Bachelor's level were attending public HEIs (OECD 2019), and 90% of academic staff were employed there (OPI 2019).

A categorisation of non-public HEIs in Poland is unavailable.

As of November 2020, there were 240 research institutions operating in Poland.[8] They included 107 research institutes and 77 units of the Polish Academy of Sciences, 2 international research institutes and 54 other scientific entities (https://polon.nauka.gov.pl/zasoby). While their primary task is to conduct research rather than providing degree programmes, some of the non-HEIs (including the Polish Academy of Sciences) are also authorised to provide doctoral education and award post-doctoral degrees (Eurydice 2020).

A reform of the Polish higher education and research system launched in 2018 has seen the introduction of several **legal and policy changes** that have a potential impact on the **international mobility** of scientists. The reform is addressing the problem of the fragmentation of the research system by providing for the possibility of creating federations between universities and research institutes. It is approaching the problem of insufficient research funding and a low level of internationalisation of Polish science by providing higher subsidies to research and higher education organisations and by introducing **financial incentives to units active in interdisciplinary research and global academic competition.** For example in 2019, 10 universities won the competition in the "**Excellence Initiative – Research University**" programme and received the status of research universities. In the years 2020–2026, they will receive an annual increase in subsidies (https://www.gov.pl/web/science/leaders-of-the-excellence-initiative--research-university-competition---the-best-universities-in-poland). This programme is meant to support universities in attracting scholars from overseas, luring Polish researchers back to the country and, in general, to enhance scientific mobility, which remains low (Matthews 2019).

As from 2021, academic mobility is an eligibility criterion for researchers applying for post-doc positions financed by the National Science Centre (as they are expected to have obtained a PhD degree in a research organisation other than the entity in which the employment in this position is planned, or to have completed at least a 10-month, continuous and documented postdoctoral fellowship in an entity other than the entity implementing the project and in a country other than the country in which the doctoral degree was obtained; NCN 2020).

To enhance the mobility of academic staff, the National Agency for Academic Exchange[9] was also established in 2018. Its aim is to develop a systemic solution to mobility to and from Poland, including scholarships and grants, and to support universities in their internationalisation efforts.

The latest reform of the higher education system also aims at increasing the pool of doctoral students and PhD holders by providing scholarships for all doctoral students enrolled in doctoral schools (OPI 2019; Eurydice 2020).

[8] Data for 2018 were inaccessible.

[9] https://nawa.gov.pl/en/nawa

Among the few measures aiming at enhancing the careers of female researchers, there is a regulation introduced by the National Science Centre stating that competitions for post-doc positions financed under research projects will be open to women who obtained a doctoral degree earlier than the statutory 7 years before the year of employment in the project, provided that they have given birth to or adopted a child/children. The period since obtaining the doctoral degree may be extended by 18 months for each child. As of the end of 2020, no other gender equality measures or policies had been announced.

1.5 Qualification and career structures for academic careers

First-cycle programmes (ISCED 6) in Poland last 3–4 years and lead to a Bachelor's degree (*licencjat*) or equivalent (*inżynier* in engineering sciences). Holders of a Bachelor's degree can enter second-cycle programmes (ISCED 7), which take 1.5–2 years depending on the area of study and lead to a Master's degree (*magister*). Only several fields of study offer long-cycle Master's degree programmes that last for 4–6 years. A person holding a Bachelor's or a Master's degree can be employed in the lowest academic position of an assistant lecturer (Eurydice 2020; EURAXESS n.d.).

The Master's degree provides access to third-cycle studies (ISCED 8) that last for 3-4 years. Doctoral studies lead to a PhD degree (*doktor*). A person holding at least a PhD degree can be employed in the position of an assistant professor and – if they have significant teaching, professional, and scientific or artistic achievements[10] – in the position of a university professor (Eurydice 2020; EURAXESS n.d.). A PhD degree is also recognised as a certificate in the labour market outside academia.

The next step in the academic career is habilitated doctor (*doktor habilitowany*), which can be awarded only to PhD degree holders. Habilitation gives its holders scientific autonomy to conduct their own research and lead a team. It is the highest qualification level awarded through the process of a university examination, and it is the key for access to a professorship (Eurydice 2020; EURAXESS n.d.). Habilitation is the real ticket to the position of a university professor as well as to university managerial positions.

Full seniority in rank is, however, achieved with the scientific title of professor (*profesor*), which is awarded by the President of the Republic of Poland upon a motion of a commission appointed by the Council of the Scientific Excellence. The title of professor may be granted to a person who: (1) holds an habilitated doctor degree (in specific cases a PhD); (2) has outstanding scientific or artistic achievements; and (3) participated in scientific projects granted under open calls (national or international) or in international fellowships or research conducted in higher education institutions or research centres in Poland or abroad. Titular professorship is necessary to obtain the highest academic position of professor (Eurydice 2020; EURAXESS n.d.).

[10] Depending on whether an academic teacher is employed in a teaching position (only with teaching duties) a research & teaching position (with research obligations and teaching duties), or a research position with an obligation to perform research and involvement in education of doctoral candidates (Eurydice 2020).

The average age for obtaining a PhD degree in Poland is 33–34 years. The period between the PhD and habilitation lasts, on average, 12–13 years. Habilitation is awarded, on average, at the age of 45. The average age for obtaining the title of professor has varied between 55 and 57 in recent years (Kwiek 2019; see Figure 6).

In 2018, 70% of academic staff in Poland had research and teaching positions obliging them to educate students, conduct research, and participate in the organizational work of universities. As of 2018, one in four representatives of the academic staff held teaching positions, and only 2% of the staff were academics whose primary responsibility was to conduct research.(OPI 2019). Academics employed in research and teaching positions spend a relatively large amount of time on teaching. Young academics devote on average 19.5 hours a week to educational activities and only 14 hours to research. Moreover, there are virtually no differences in the distribution of teaching and research time between young, middle-aged and senior scientists (Kwiek 2015b).

It is argued “that rigid rules on career progress in research organisations in Poland make the system less attractive to both domestic and foreign talents. The age structure of R&D staff is also cause for concern, along with the relatively late age of achieving autonomy in research. Interinstitutional and intersectoral mobility among R&D staff is discouraged by career progress regulations” (European Commission 2017: 57). Currently, international experience, such as visits, exchange, participation in Erasmus, etc., may be taken into consideration in the periodic staff appraisal and when assessing achievements for academic career progression; however, detailed performance-assessment criteria are laid down by individual institutions within their autonomy (Gulda et al. 2017).

2 Gender participation in tertiary education and academic careers

Women are more likely than men to complete tertiary education in Poland, and their attainment rate is growing faster than men's. The **tertiary attainment level for women** grew by almost 12% between 2013 and 2016 – from 24.8% to 27.7%. In the same timeframe, men's attainment rate increased from 20.2% to 21.9%, which represents a growth of 8.5% (UNESCO Institute for Statistics 2020c).[11] These differences are reflected in the **gender parity index in tertiary education attainment** (calculated by dividing the value for females by the value for males). It grew from 1.23 in 2013 to 1.26 in 2016, which signifies a growing disparity in favour of females.[12]

Gender disparity in tertiary education attainment is even higher if we focus only on the population of people aged 30–34. In 2016, the tertiary education attainment rate was 53.9% for women and only 35.6% for men (European Commission, n.d.).

As a consequence, a gender gap persists among **graduates of tertiary education** in Poland. Between 2013 and 2018, women constituted on average 65% of graduates from Bachelor's or equivalent programmes (ISCED 6) and 67% of graduates from Master's or equivalent programmes (ISCED 7). During the considered period, there were no considerable and interpretable changes in the proportions of male and female ISCED 6 and ISCED 7 tertiary graduates (see Table 2).

The gender gap among the graduates decreases with the move towards the highest level of tertiary education. Between 2013 and 2018, women constituted on average 55% of the **graduates from doctoral or equivalent programmes** (ISCED 8). There were slight fluctuations during the time considered, which may suggest an overall upward trend in the representation of women: their share among doctoral graduates reached the highest value of 56.2% in 2018 (see Table 2).[13]

The analysis of **tertiary graduates by field of study and sex** reveals that of all women graduating from tertiary education in 2018, most graduated from Education programmes (25%) and Business, Administration and Law programmes (24%). The smallest proportions of women completed Information and Communication Technologies programmes (1%), Agriculture, Forestry, Fisheries and Veterinary programmes (2%), and Natural Sciences, Mathematics and Statistics programmes (4%). Between 2015 and 2018, most changes in the proportions of female graduates by fields of study were insignificant, with the exception of Education and Health and Welfare, where shares of female graduates changed by between four and seven percentage points (Figure 7).

Employment in R&D remains gender imbalanced, despite the growth in the amount of total R&D personnel. Between 2015 and 2018, women constituted 36–37% (in FTE) of total R&D

[11] Data for 2012 and after 2016 are unavailable. The data available at the Eurostat database are not fully comparable.

[12] The data on the gender parity index were firstly calculated based on UIS.Stats data (28.08.2020). However they are not available at the time of writing this report, and no other publicly available dataset includes this variable.

[13] Eurostat data suggest that this upward tendency is long-lasting, as women constituted 49.4% of doctoral graduates in 2007 (European Commission 2019).

personnel (UNESCO Institute for Statistics 2020d, Eurostat 2020e). While there was a gender balance of 40–60% among government, higher education, and private non-profit R&D personnel (in FTE and HC), business enterprise R&D personnel was male dominated in 2018, with 26% women in FTE (and 27% in HC) (UNESCO Institute for Statistics 2020e; Eurostat 2020e).

In each sector of employment, there was an **increase of the proportion of female researchers** (in FTE). One of the highest rates of growth was in the government sector, where the share of female researchers in the total pool of researchers increased from 41.4% in 2012 to 50.6% in 2018 – a growth of 22%. This change was, however, not due to an increase in the actual number of female researchers, but rather to their lower dropout from the shrinking sector than among men. The share of female researchers also grew considerably (by 23%) in the private non-profit sector – from 37.1% in 2012 to 45.8% in 2018. However, employment in this sector remained negligible. There was also an increase in the share of women among researchers in the business enterprise sector: from 20.8% in 2012 to 23.4% in 2018, which represents a growth of 12.5%. Despite this change, business enterprise remains the most gender disproportionate sector. The smallest growth in the proportion of female researchers – 11% – was in the higher education sector: from 41.5% in 2012 to 45.9% in 2018 (Figure 8).

Between 2012 and 2018, in both the higher education and business enterprise sectors, the number of female researchers increased by around 10,000 FTE (from 15,821 to 26,177 and from 3,133 to 13,303, respectively). However, the picture is different when the HC measure is used: the number of female researchers grew by 22,754 (HC) in higher education (from 29,385 to 52,139) but only by 13,698 (HC) in the business enterprise sector (from 3,717 to 17,415; UNESCO Institute for Statistics 2020e, Eurostat 2020e). This indicates not only that still many more female researchers hold positions in higher education than in the business enterprise sector, but also that female researchers in academia work part-time more often than those employed in business enterprises.

Between 2012 and 2018, there was also a steady **increase in the proportion of female academic teachers**, although this increase was smaller than in the case of researchers. While in 2012, women constituted 43.6% of all teachers in tertiary education, in 2018 they made up 45%, which indicates a growth of 3,2% (own calculation based on UNESCO Institute for Statistics 2020f and OECD 2020b).[14]

The relatively high and continually growing number of female researchers and academic teachers in higher education can be interpreted as the result of an intervention of a few factors. Firstly, there is a tradition of female participation in academic science: as early as the 1970s, women already constituted around 30% of academic teachers (Linková et al. 2008); however, they used to occupy mainly lower ranks of the scientific hierarchy (Siemieńska 2001). Secondly, in recent years growing proportions of female graduates of tertiary education, including doctoral studies, have become natural candidates for pursuing a scientific career. Thirdly, it has been demonstrated that the shares of female researchers are relatively

[14] Data from 2019 confirm an upward tendency, as women made up 47% of all teachers in tertiary education in that year (RAD-on 2020).

high in countries where expenditure on research and development per capita is low (Linková et al. 2008).This is the case for the Polish higher education sector, where the level of remuneration is especially low. It is argued that low salaries push men out of academia in search of better pay, leaving more positions for women (Łazarowicz-Kowalik 2019).

In Poland, the distribution of **academic staff by grade** is gender unequal. In 2018, women accounted for 58% of grade D staff and 50% of grade C staff. The share of females dropped to 39% among grade B staff and to a quarter among grade A staff. The gap between women and men had been reduced slightly since 2013, when the proportion of women in grade D positions was 51%; in grade C it was 48 %; in grade B it was 34 %; and in grade A it was 23 % (Table 3).

Among female academic staff, only one in five achieved a senior academic position, of whom 17% obtained a post-doctoral degree, and 5% a professorship. At the same time, 37% of male academic staff achieved a senior academic position, including 14% who achieved a professorship (OPI 2019).

In none of the academic fields was there gender parity among **senior academic staff**. However, there was a clear differentiation between fields as far as the proportion of women among grade A staff is concerned. In 2016, women represented only 10,3 % of grade A academic staff in engineering and technology and 18.5% in natural sciences. Their highest shares among grade A academic staff were observed in medical sciences (32.5 %) and agricultural sciences (30.6%). Gender gaps had been reduced slightly in all academic fields compared with 2013, when the proportions of women among grade A staff ranged from 0.3 percentage points (pp) lower in the agricultural sciences to 3.9 pp lower in the social sciences (Figure 9).

The relatively small share of female researchers in senior positions seems to be the result of an interplay of many factors that will be discussed in the next chapter.

3 Gender-specific aspects of scientific careers

3.1 Horizontal and vertical segregation

There is considerable **horizontal gender segregation** in tertiary education and science in Poland, which manifests itself in different proportions of men and women enrolling in and graduating from various areas of studies and pursuing careers in various scientific disciplines. In 2018, women were vastly overrepresented in Education programmes (83% of new entrants and 79% of graduates of all levels of tertiary education) and Health and Welfare programmes (78% of new entrants and 81% of graduates). They were underrepresented in Information and Communication programmes (14% of new entrants and 23% of graduates) as well as, to a smaller extent, in Engineering, Manufacturing and Construction programmes (35% of new entrants and 42% of graduates; OECD 2020a).

Shares of women academics are also uneven across fields of research and development. While women constituted 55% of academic staff in medical and health sciences and 51% in agricultural sciences, they made up only 27% of academics in engineering and manufacturing and 39% of researchers in natural sciences in 2015 (European Commission 2019).

Considerable **vertical gender segregation** also persists in Polish science. Figure 10 illustrates the scale of gender disproportions throughout a typical academic career. Women significantly outnumber men among the graduates at Bachelor's and Master's or equivalent levels, and are more numerous than men among doctoral graduates. However, their shares rapidly decline, and the gender disproportions change and widen with the move to successive career stages (from grade C to grade A). The gap between men and women widens with rank, with women having the highest shares among the lowest-ranked and the lowest-paid positions (European Commission 2017), whereas in the high-ranking positions the number of women is significantly lower.

Between 2013 and 2018, there was an improvement leading to gender parity among grade C holders, an increase in female grade B staff of five percentage points (from 34% to 39%) and in female grade A staff of two percentage points (from 23 to 25%). Despite these recent improvements, women's chances to be promoted to the highest rank of an academic career are improving very slowly – between 2007 and 2016, the Glass Ceiling Index (GCI) for Poland decreased by only 0.02 points from 1.8 to 1.78 (European Commission 2009, 2019).[15] Lesser chances for advancement are reflected in lower remuneration for female researchers. The gender pay gap in the scientific research and development sector is wider than in the economy as a whole. In 2014, the gender pay gap in the Polish economy amounted to 7.7% and to 16.6% in R&D (European Commission 2019).

[15] The GCI indicates the relative chances for women compared to men of reaching a top position. It is calculated as a fraction of the proportion of women full professors and the proportion of women among doctors, doctors with habilitation, and full professors. A GCI of 1 indicates that there is no difference between women and men regarding promotion. The higher the value, the thicker the glass ceiling (Linková et al. 2008).

Women are also underrepresented at **higher levels of management** in higher education institutions, managerial boards and decision-making bodies. In 2018, women constituted 36% of HEI managers. However, the proportion of women decreased with the rise to higher levels of the organisational hierarchy. While women held 55% of the positions of deputy directors of university institutes, 33% of faculty deans and 30% of vice-rectors, only 18% of heads of HEIs were female (OPI 2019). The proportion of women among heads of HEIs accredited to deliver PhDs was even lower – in 2017 it was 12% (European Commission 2019). In the group of 19 universities (the biggest, most prestigious and public HEIs) there was not a single woman among the rectors in 2018. In general, the shares of women in managerial positions are higher in private HEIs than in public HEIs. In all public HEIs, their share among rectors was 10%, while in private HEIs it amounted to 25% (Sułkowski et al. 2019).

Women are also underrepresented in national-level scientific boards – in 2017, they made up 24% of board members and 16% of board leaders (European Commission 2019). Women's shares in boards had not risen significantly since 2013, when they made up 20% of board members and 16% of board leaders (European Commission 2016).

There are a number of factors that interactively contribute to the underrepresentation of women in the senior academic positions in Poland. They are operating both outside and within the research and higher education system.

3.2 Social, cultural and institutional context

Gender stereotypes and traditional attitudes towards gender roles seem to prevail in Poland. According to a Special Eurobarometer survey on attitudes towards gender equality conducted in 2017 (European Commission 2017b), 80% of respondents in Poland agreed with the statement that women are more likely than men to make decisions based on their emotions, and 77% agreed that the most important role of a woman is to take care of her home and family. In 2015, women were much less often perceived as having a predisposition to do science (26%) than to be active in other domains of professional life, including culture and arts (58%) and social affairs (56%). Female scientists were also more often associated with such disciplines as biology, pharmacy, and chemistry than with information technology, engineering, astronomy and maths (L'Oreal Foundation 2016). The inclusion of gender role models, and the recognition of women as scientists in school textbooks remains insufficient (Chmura-Rutkowska et al. 2019).

Gender disproportions in the **time spent on paid work or study and on unpaid work (domestic activities) and care work** also remain striking. According to the OECD Family Database, women in Poland spend almost half as much time per day (12%) on paid work or study as men (22%), twice as much time as men (19% in comparison to 9%) on unpaid work, and twice as much time as men on care (3.3% in comparison to 1.5%). In one third of couples with at least one child aged 0–14 years, one partner (mostly the woman) is not working (OECD n.d.). This finding coincides with one of the lowest enrolment rates in early childhood education and care services for 0–2-year-olds in the OECD (10% in 2017). The share of 3–5-year-old children enrolled in early childhood education and care or primary education has been constantly rising, and reached 80% in 2017, mainly through higher enrolment rates of

children aged 5 years (92%) and 4 years (85%). At the same time, only 67% of 3-year-olds were enrolled in formal early childhood education and care (OECD 2019). A relatively low level of enrolment in formal early child care and education is related to the above-mentioned persistence of **conservative family values** –shaped by deep-rooted Catholicism – including the belief that the mother is the preferred provider of care and education for infants and small children. Another factor contributing to lower percentages of children in formal childcare and education is **weak** (but improving) **child-care infrastructure**, which deteriorated with the neoliberal turn that brought budget cuts in welfare expenditures (Heinen and Wator 2006).

Gender-based gaps persist also in other aspects of social life. In 2018, Poland's score on the EIGE **Gender Equality Index**[16] was 55.8 points, which was 12.1 points below the score for EU as a whole. The lowest scores were for gender equality in decision-making positions across the political, economic and social spheres (30 points) and for gender equalities in the allocation of time spent doing care and domestic work and social activities (52.5). The highest scores were for gender equality in health (83.1) and gender equality in access to financial resources and women's and men's economic situation (75.5).

Gender equality has not long been among the priorities for policy makers in Poland. Policy proposals aimed at advancing gender equality used to be contested at first as a remnant of the previous, communist system. Nowadays, they are opposed within broad (and transnational) political mobilizations against liberal values and 'gender ideology' (Korolczuk and Graff 2018). As a result, no national-level regulations or policies have been adopted to ensure gender equality in HEIs and RPOs (see EIGE 2016). However, individual HEIs are slowly making progress in establishing gender equality bodies and implementing gender equality measures.[17]

3.3 Institutional and structural reasons for the under-representation of women scientists

Empirical studies on reasons for the underrepresentation of women in science in Poland confirm that the career paths of female and male scientists are clearly different from each other: for example, women obtain subsequent academic degrees and titles later than men (Siemieńska 2001, Majcher 2007); they are among the most productive scientists less frequently than men; and they participate in international research projects, have long-term research stays abroad, and are co-authors of international papers less frequently than men (Kwiek 2015a, 2015b; Majcher 2007; European Commission 2019). Similarly, their publications have, on average, a lower impact (measured by the number of citations) than men's (European Commission 2019). Female-led research teams have a worse chance of obtaining research grants funded by the national research funder – the National Science Centre:

[16] The Gender Equality Index is a tool to measure the progress of gender equality in the EU, developed by the European Institute for Gender Equality (EIGE; https://eige.europa.eu/gender-equality-index).
[17] In 2020, the University of Warsaw became the first academic organisation in Poland to implement a Gender Equality Plan.

between 2011 and 2018 their success rate was 20% compared to 23% for teams led by males (NCN 2019). Women also carried out projects with a smaller budget (NCN 2019; Łojkowska et al. 2020).

An analysis of **sex differences in international mobility** in 2016 suggests that while among early-stage researchers women were slightly more mobile during their PhD than men (by 1.3 percentage points), in the group of senior researchers men more often than women (by 10.4 pps) reported that they had worked for at least three months in the last decade of their post-PhD careers (European Commission 2019).

Among the factors responsible for these gender disproportions, most attention is paid to the **issue of work–life balance**, which has been proved to be challenging among various categories of academics, including both early-career researchers (Knapińska and Szyszko 2018), and professors (Majcher 2007), those working in the fields of life sciences (Wagner et al. 2017), physics (Chudzicka et al. 2008), political science (Włodkowska-Bagan and Winiarczyk-Kossakowska 2018), and the arts (Gromada et al. 2015), as well as among scholarship holders of the Fulbright programme (Walczak 2010). The overall conclusion is consistent with findings from other countries that it is more difficult for women to achieve this balance between work and life, mainly due to the impact of having children on their careers and mobility (Knapińska and Szyszko 2018; Majcher 2007, Wagner et al. 2017; Walczak 2010). An inability to reconcile work and private responsibilities is also reported as an important reason for women leaving science (Kowzan et al. 2016).

Moreover, **low salaries** in higher education, together with an identified tendency to **prioritise the male career** in dual-career couples (Wagner et al. 2017) do not justify the high professional involvement of women at the expense of others, mainly domestic responsibilities. Women's research work is often treated as a supplement to the basic income from the male partner's work (Kowzan et al. 2016; Łazarowicz-Kowalik 2019).[18] **The requirement of habilitation** to pursue an academic career might also be an important factor contributing to women's slower progress; it has been argued that this is the case in the Swiss scientific system (Leeman et al. 2010).

Organizational factors contributing to gender disproportions in Polish science have also been identified. Several studies have highlighted the problem that women have worse access to informal networks, including support from their superiors and colleagues in obtaining employment, grants, going abroad or preparing publications (Gromada et al. 2015; Majcher 2007; Włodkowska-Bagan, Winiarczyk-Kossakowska 2018). The negative role of gender bias and microaggressions towards female academic teachers has also been identified (Budziszewska et al. 2019; Gromada et al. 2015; Włodkowska-Bagan, Winiarczyk-Kossakowska 2018; Sekula et al. 2018; Krzaklewska et al. 2019).

[18] Additionally, women researchers working in the Polish higher education sector are slightly more likely than men to be employed under 'precarious' contracts. In 2016, 6.9% of women and 4.6% of men researchers worked with no contract, on fixed-term contracts of up to one year, or on other non-fixed term, non-permanent contracts (European Commission 2019).

Higher education institutions in Poland also contribute insufficiently to facilitating work–life balance, as they rarely provide affordable on-campus child day care. Institutionalized forms of childcare are perceived by Polish researchers as one of the advantages of foreign research centres over Polish ones (Łazarowicz-Kowalik 2019).

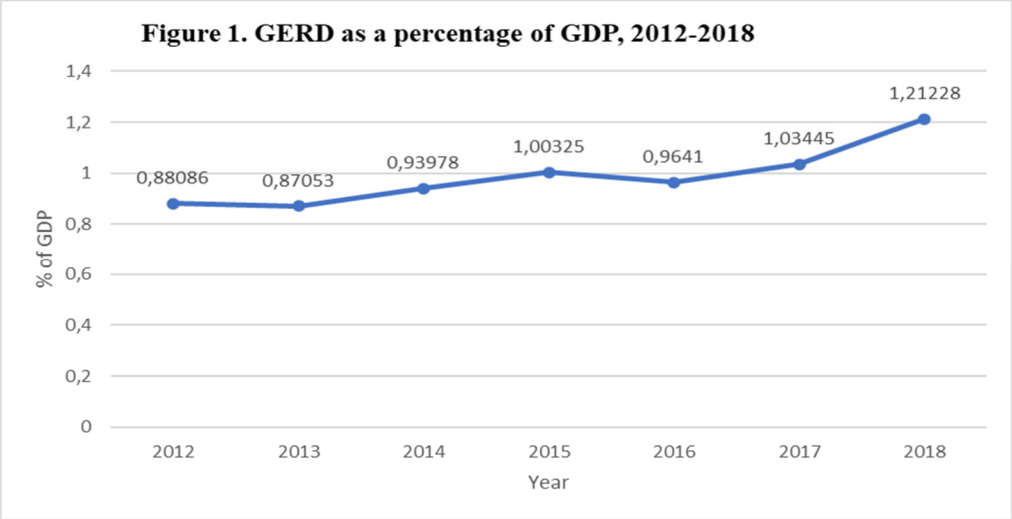
3.4 Gender-specific costs of the COVID-19 pandemic for scientific careers

There have been no systematic analyses to date of the gender-specific costs of the COVID-19 pandemic for careers in Polish science and higher education. Preliminary results of a survey conducted recently at Jagiellonian University in Krakow that addressed work and life during the COVID-19 pandemic suggest that while all academics reported a negative impact of the pandemic on their research and teaching activities, working conditions and psychological well-being, scientists with children reported more often than scientists without childcare obligations that working from home was a burden and that they had less time for writing academic papers. Female academics with care obligations most often reported that as a result of the pandemic they had less time for research work.[19]

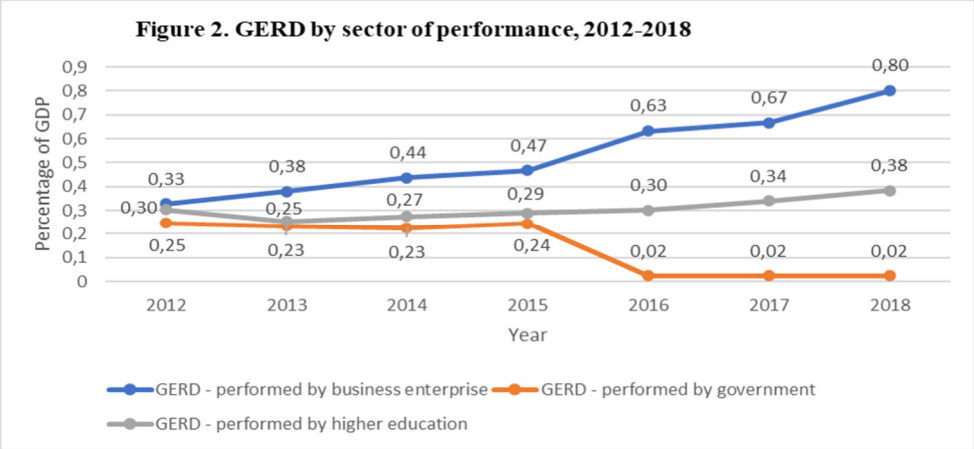
[19] https://act-on-gender.eu/sites/default/files/ewa_krzaklewska_marta_warat_-_on_measuring_covid-19_consequences.pdf 30.11.2020.

Appendix. Figures, tables and bibliography

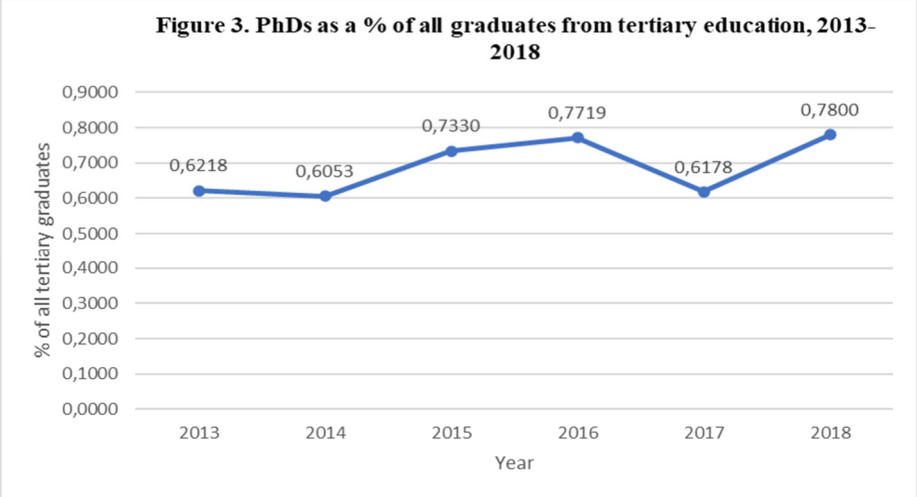
Figures



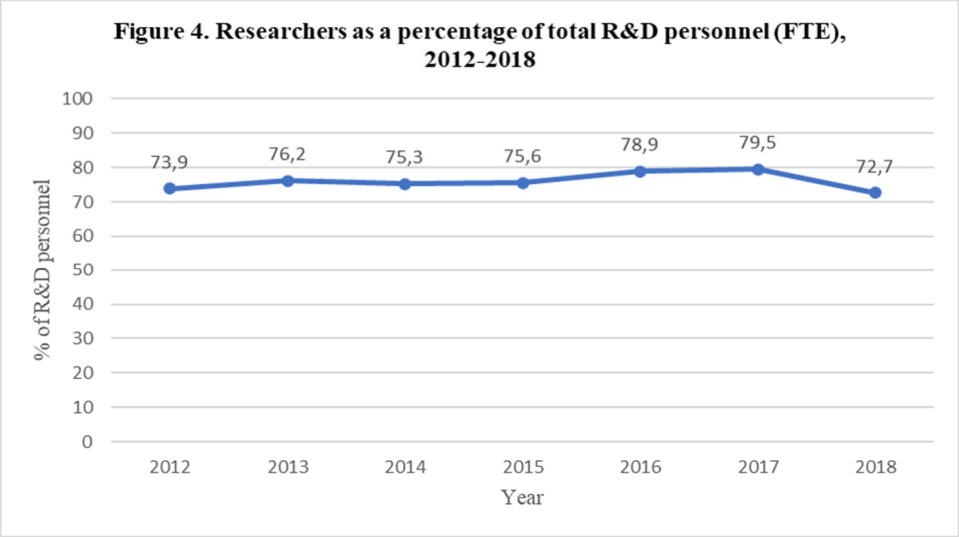
Source: UNESCO Institute for Statistics 2020a



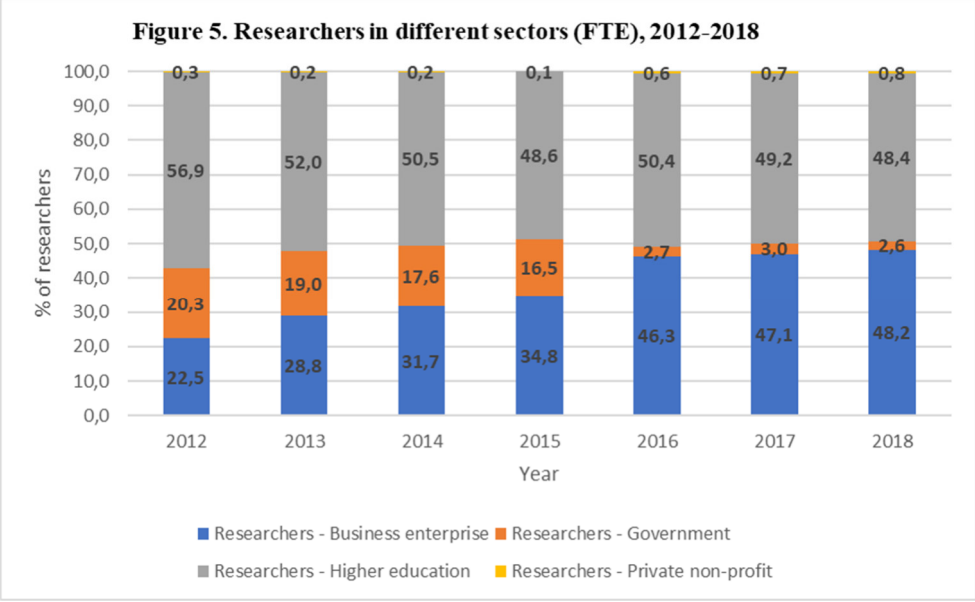
Data for GERD performed by the private non-profit sector are not available. Source: UNESCO Institute for Statistics 2020b



Source: own calculations based on Eurostat 2020d

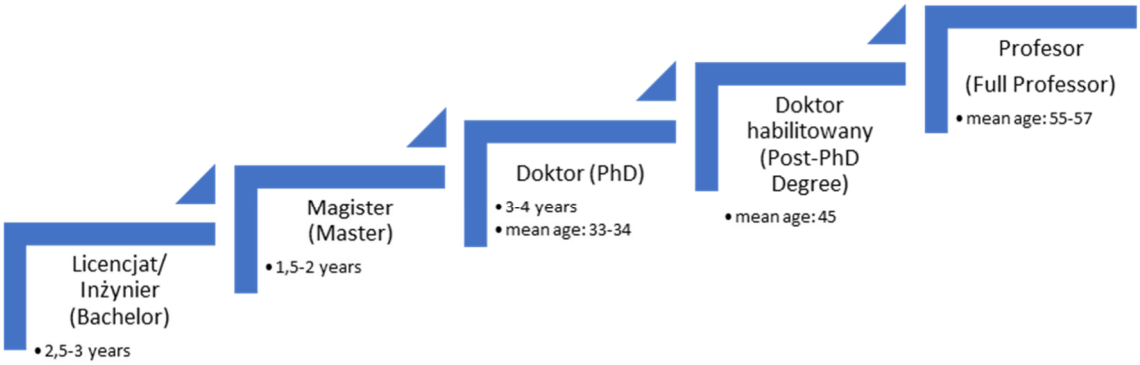


Data for 2017 and 2018 do not correspond exactly to the Frascati Manual recommendation. Source: UNESCO Institute for Statistics 2020e

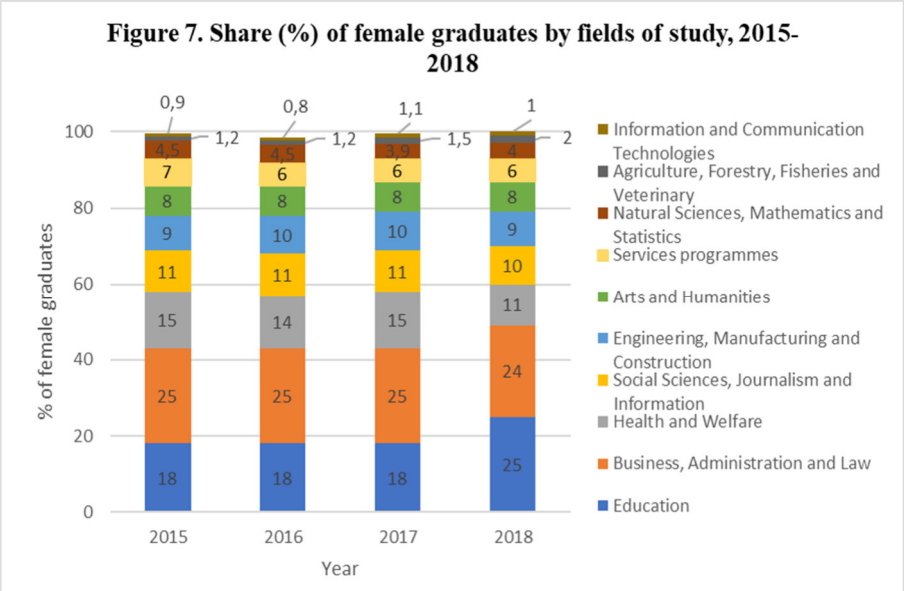


In 2016 there was a break in the series with previous year, and data for 2017 and 2018 do not correspond exactly to the Frascati Manual recommendation. Source: UNESCO Institute for Statistics 2020e.

Figure 6 Typical scientific career in Poland



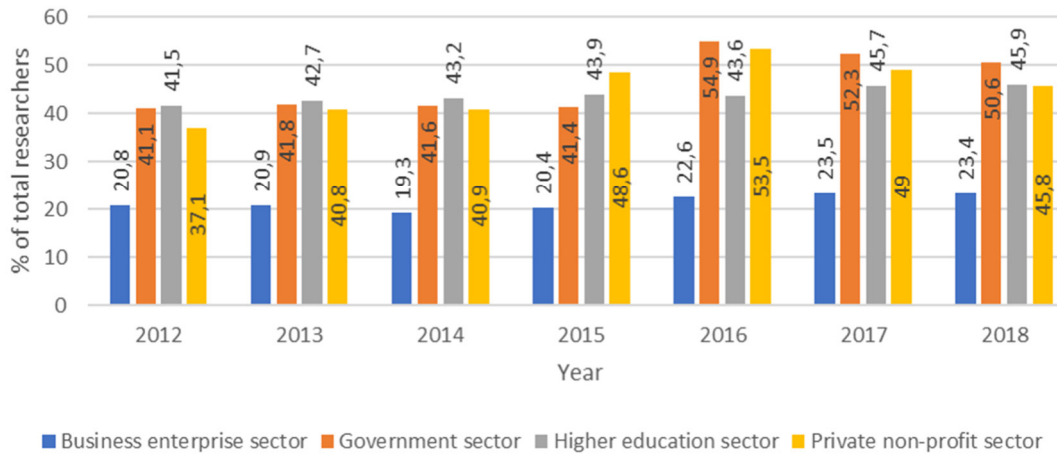
Source: Eurydice 2020; Kwiek 2015b



Source: OECD 2020a20

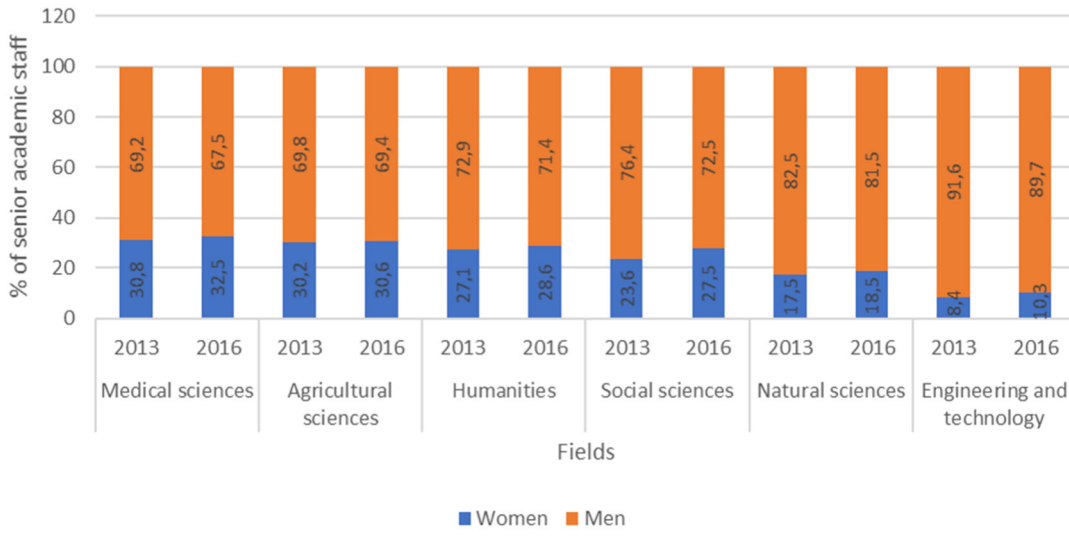
[20] These data were first extracted on 28 Sept. 2020 from UIS.Stat.However, they were no longer available at the time of writing this report. National data on tertiary graduates are not comparable, as they use different classification of fields of study .

Figure 8. Percentage of female researchers (FTE) by sector of employment, 2012-2018



Source: UNESCO Institute for Statistics 2020e, Eurostat 2020e

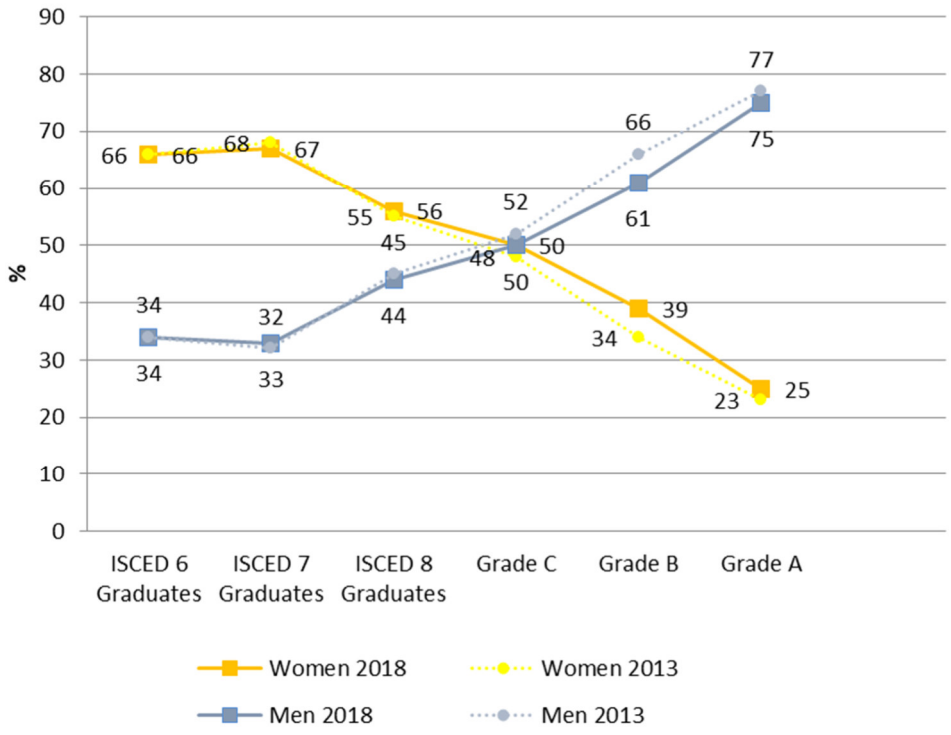
Figure 9. Senior academic staff (Grade A), by field of science and sex (%), 2013 and 2016



Source: European Commission 2016, 2019[21].

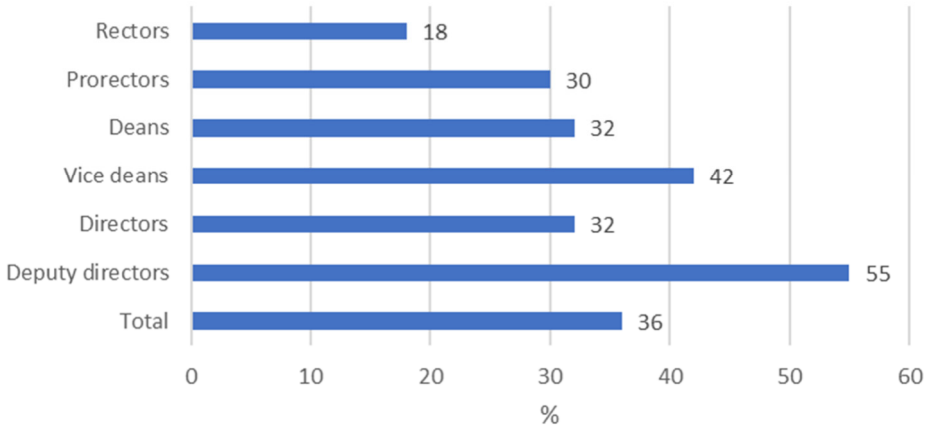
[21] Available national data sources do not provide information on the distribution of senior academic staff by field of science and sex.

Figure 10. Women and men in a typical academic career, graduates and academic staff, 2013 and 2018



Source: own calculations based on Eurostat 2020d, European Commission 2016, RAD-on 2020.

Figure 11. Shares (%) of women in academic managerial positions, 2018



Source: OPI 2019

Tables

Table 1 Total R&D personnel in FTE, 2012–2018

	2012	2013	2014	2015	2016	2017	2018

Per million inhabitants	2,373	2,457	2,740	2,872	2,943	3,797	4,272
Per thousand labour force	4.9	5.1	5.7	5.9	6.1	7.8	8.8
Per thousand total employment	5.5	5.7	6.2	6.4	6.5	8.2	9.2

The data for 2018 are provisional and do not correspond exactly to the Frascati Manual recommendation. Source: UNESCO Institute for Statistics 2020e

Table 2 Proportion (%) of women among tertiary graduates in Poland, 2013-2018

Educational level	Year					
	2013	2014	2015	2016	2017	2018
ISCED 6	65.7	65.2	64.9	65.0	64.7	65.6
ISCED 7	67.6	67.5	67.7	67.1	66.3	66.6
ISCED 8	55.1	53.2	54.9	53.9	55.3	56.2

Source: own calculation based on Eurostat 2020d[22].

Table 3 Proportion (%) of women among academic staff by grade, 2013 and 2018

	Grade D		Grade C		Grade B		Grade A	
Year	2013	2018	2013	2018	2013	2018	2013	2018
% of women	52	58	48	50	34	39	23	25

Source: European Commission 2016 and own calculation based on RAD-on 2020.

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[22] The data for 2013-2017 were firstly calculated based on UIS.Stats data (08.2020). As they were no longer available online at the time of writing this report, the Eurostat dataset is used here for verification and completion of data.

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