11. Innovation, Research and Creativity[1]

In the last year, there has been a general improvement in the domain indicators (Table 1). The R&D expenditure as a percentage of GDP and intellectual property investment, which are the only two indicators that remain substantially stable compared to the previous year, are still higher than in 2010. In the last year, there are also positive signs for Cultural employment, Brain circulation, and Patent propensity. However, the comparison with 2010 remains unfavorable.

Table 1. Innovation, research and creativity: value for the latest available year. Percentage variations on previous year and on 2010

INDICATOR	Latest available year value	% variation (compared with the previous year)	% variation (compared with 2010)
1. R&D intensity *(%, 2017)*	**1.4**		
2. Patent propensity *(per Mil, 2016)*	**75.8**		
3. Impact of knowledge workers on employment *(%, 2018)*	**17.3**		
4. Innovation rate of the national productive system *(%, 2016)*	**48.7**	—	
5. Intellectual property products (as part of gross fixed capital formation) *(2007=100, 2018)*	**120.3**		
6. Cultural employment (% of total employment) *(%, 2018) (a)*	**3.7**		
7. Brain circulation (italians, 25-39 years old) *(‰, 2018) (b)*	**-4.0**		

Improvement | Stability | Deterioration | — Comparison not available

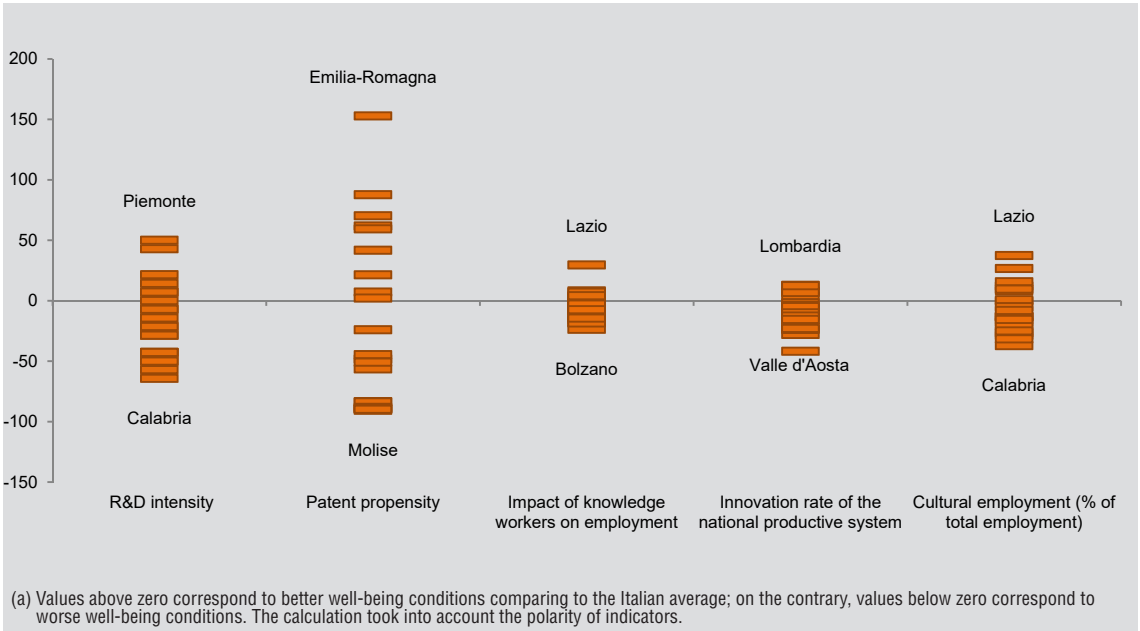
(a) 2010 data not available, variation based on 2011 data;
(b) 2010 data not available, variation based on 2012 data.

Note: Variations between two points in time above 1% are considered positive (in green), below -1% are considered negative (in red). Variations between -1 and +1% refer to stability (in grey).

1 This chapter was edited by Rita De Carli with contributions from: Francesca Licari and Valeria Mastrostefano.

Analysis of regional heterogeneity shows striking territorial differences, mainly due to the size of innovation, i.e. number of patent applications about resident population and R&D intensity (Figure 1). With some exceptions in smaller territorial areas, such as Valle D'Aosta or the autonomous province of Bolzano, it is mostly in the northern regions of the Country that values are higher than national average: in Emilia Romagna, the number of patents per million inhabitants is one and a half times higher than the national average, while in Piemonte R&D expenditure is 50% higher than the average. Lazio is also characterized by a higher number of cultural or high technology sectors employees.
There are also large differences between territories in the Brain circulation indicator, which is obtained as a balance. Emilia Romagna is the first region hosting young graduates from other countries or regions (+16.2 per 1000), while Calabria is the leading region for the net emigration of 25-39-year-old graduates (-31.1 per 1,000)[2].

Figure 1. Percentage variation for Innovation, research and creativity indicators comparing to the value for Italy by region. Latest available year (a)



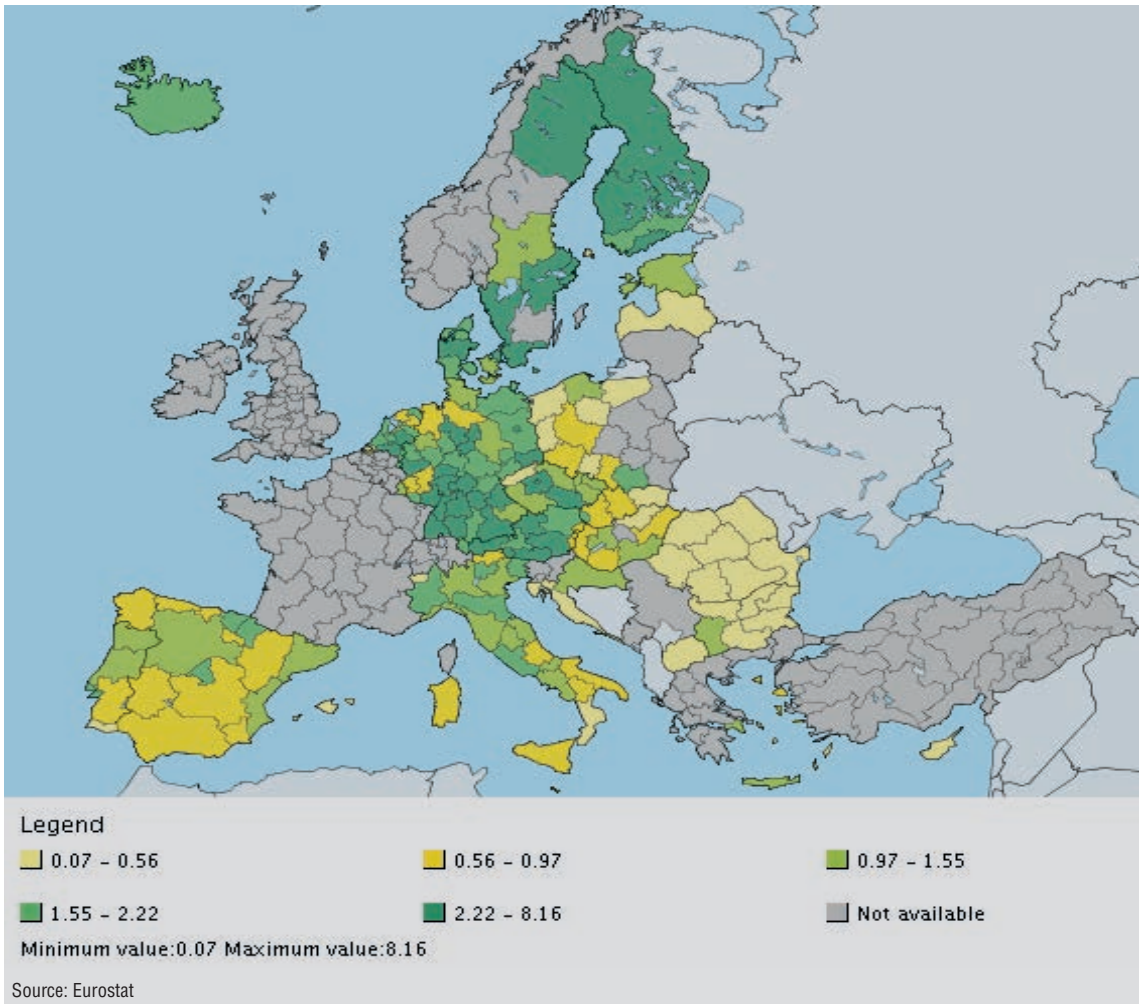
(a) Values above zero correspond to better well-being conditions comparing to the Italian average; on the contrary, values below zero correspond to worse well-being conditions. The calculation took into account the polarity of indicators.

International comparison

Compared to the rest of the European countries, Italy still has a low level of R&D expenditure rate, even if some Northern regions show more evidence of vitality.
In 2017, intra-muros expenditure on Research and Development (R&D) as a percentage of GDP in the Italian regions also shows significant variability compared to the rest of the European regions. northern regions' values are close to those of the Netherlands and Germany, while in the South and Islands area of Italy levels are close to those in Spain, Portugal or in some regions of eastern Europe (Figure 2).

2 Percentage change concerning the Italian value is not computed for this indicator since the average value is a balance between input and output flows.

Figure 2. Intramural R&D expenditure (GERD) by NUTS2. Year 2017. Percentage of GDP

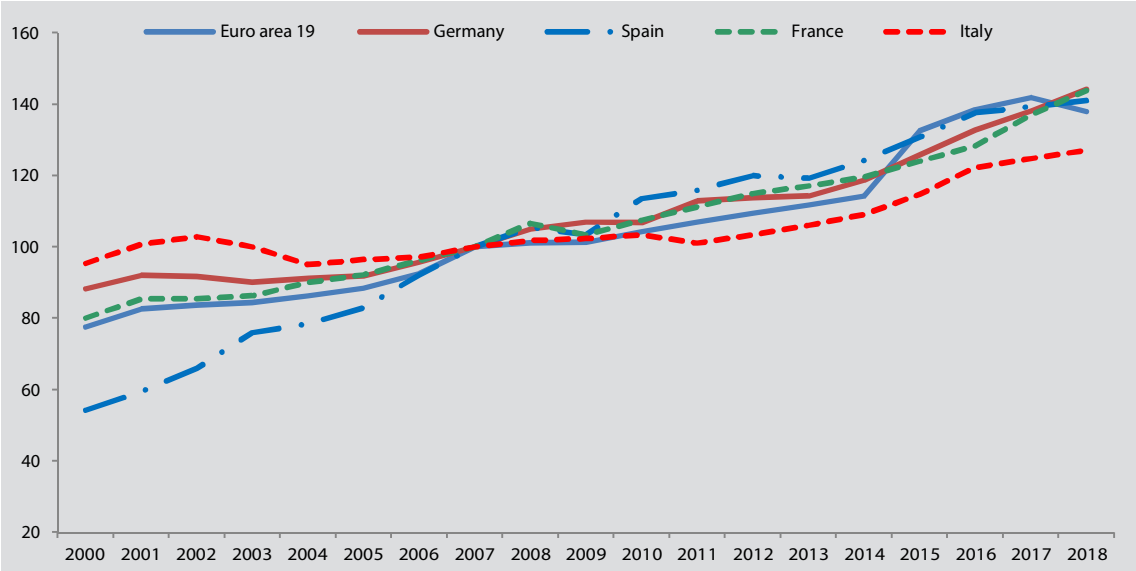


Source: Eurostat

During the last decade, Intellectual Property Products (IPR) investments, including Research and Development (R&D) and Software expenditure, has gradually increased in EU countries (+37.9 points from 2007 to 2018), compared to a slight fall in euro area countries (-3.9 points). Italy, lagging behind European countries (+27 points), however, shows an increase of 2.2 points compared to the Eurozone.

In 2018, the cultural employment share in Europe remains stable compared to the previous year (3.8%), with an increase in Luxembourg (+0.7 percentage points) and Malta (+0.5 percentage points), and a decrease in Latvia (-0.5 percentage points). Italy (3.6%) remains slightly below the European average, in line with France and just above Spain (3.5%) (Figure 4). The highest percentage of employment in these sectors is recorded in Estonia (5.6%), while the lowest is in Romania (1.6%).

Figure 3. Intellectual property products (as part of gross fixed capital formation) in major European countries - Years 2000-2018. Chain values, index numbers 2007=100

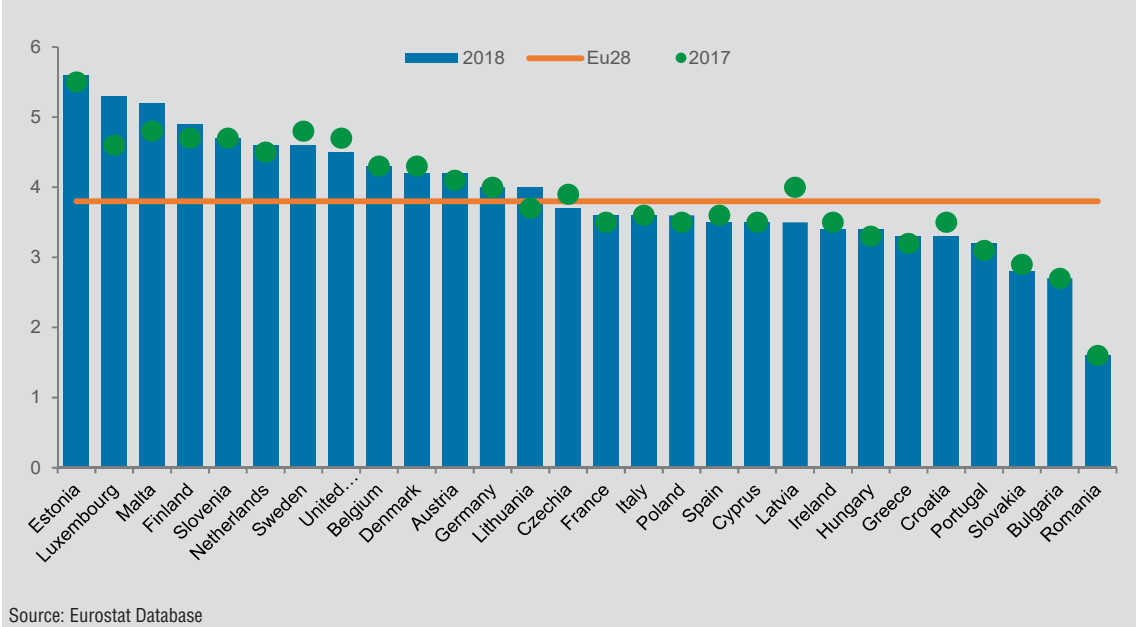


Source: Eurostat database

Also the patents propensity indicator calculated for Italy continues to be about one third lower than the European average (68.5 and 106.8 per million inhabitants respectively) (Figure 5).

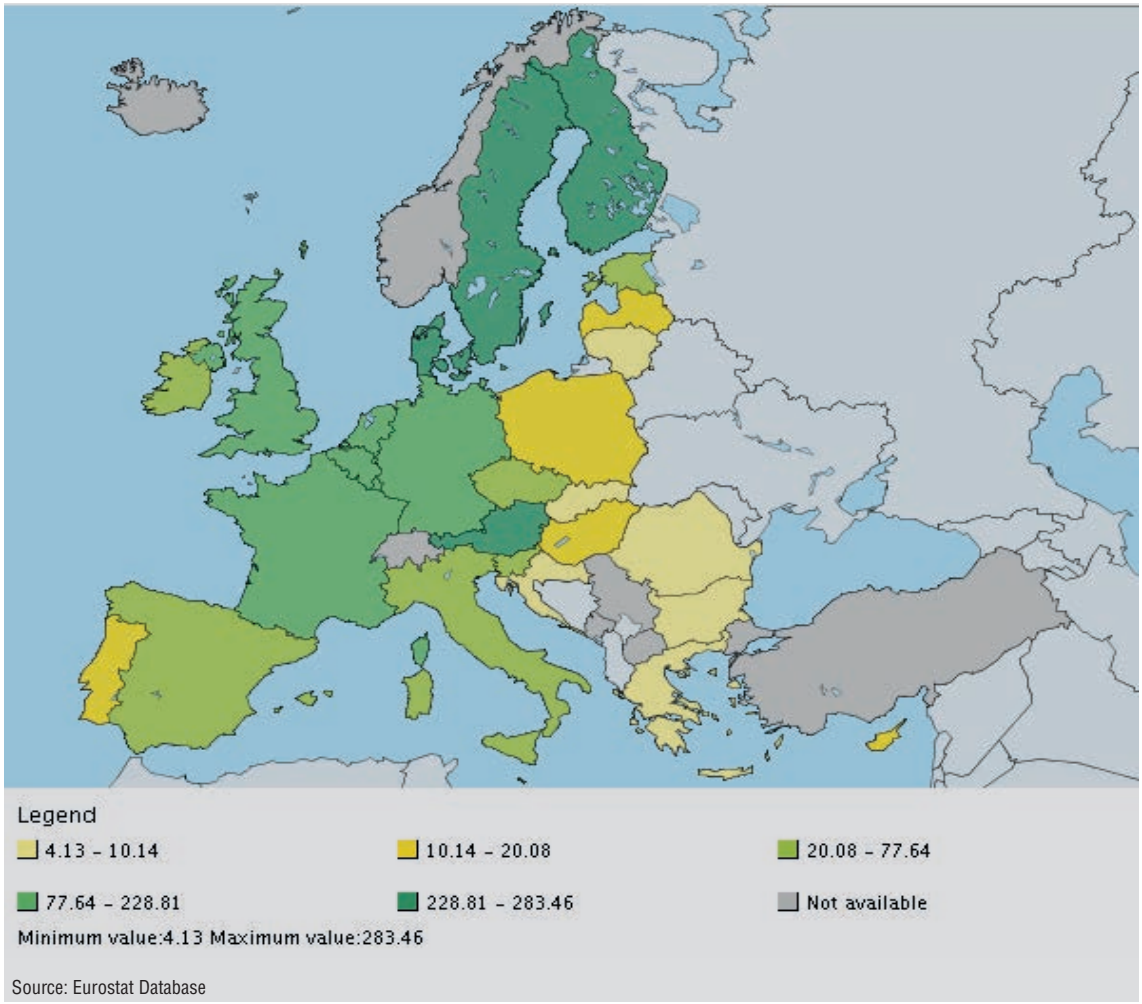
The most intense patent propensity intensities are found in Northern European countries, particularly in Sweden, Denmark, Finland, Austria, Germany, and the Netherlands, with figures ranging from 200 to about 300 patent applications submitted per million inhabitants. On the other hand, in Greece, Lithuania, Romania, Croatia, Bulgaria, and Iceland, the ratio does not exceed 10. In this framework, values recorded for Italy are close to those of Ireland (77.6) and Slovenia (55.3).

Figure 4. Cultural employment in Europe. Year 2018. Percentage of total employment



Source: Eurostat Database

Figure 5. Patent applications to the European Patent Office (EPO) by priority year. Year 2017. For millions of inhabitants



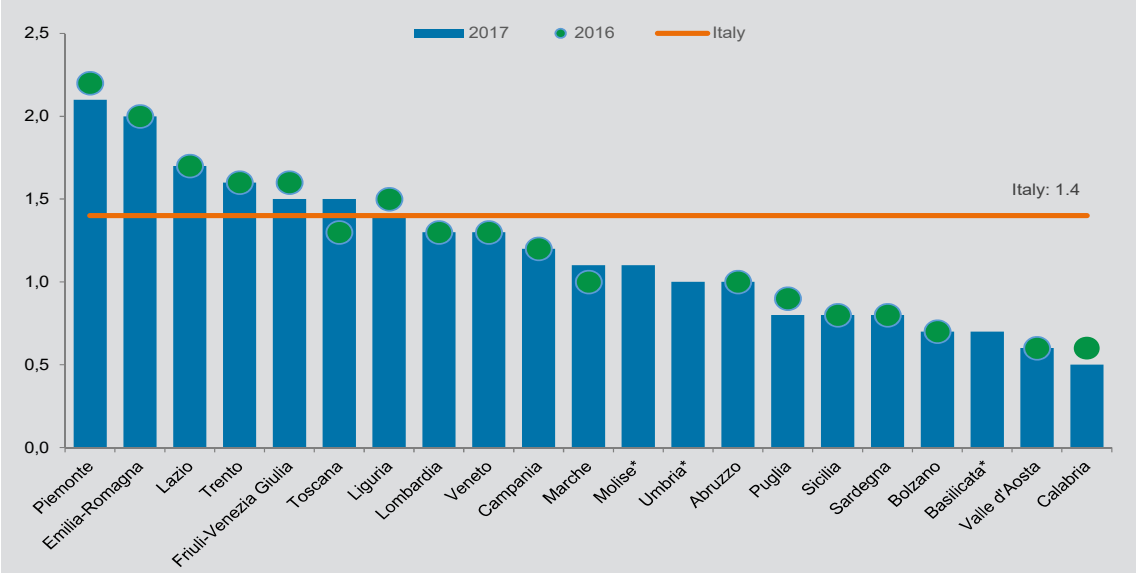
Source: Eurostat Database

Analysis of national data

Stable R&D spending

In 2017, R&D expenditure in proportion to GDP remains at the levels recorded in the previous year (1.4%) (Figure 6).
Piemonte and Emilia Romagna are the most research-intensive regions, with an incidence of R&D expenditure on the regional GDP greater than or equal to 2%. On the contrary, the indicator's value is still low and below the national average in southern Italy, particularly in Calabria, where the share is less than 1%.
In Toscana and Marche, there are small signs of improvement compared to 2016 (+0.2 and +0.1 percentage points respectively), while there is a decrease in Puglia, Calabria and Piemonte, Friuli-Venezia Giulia and Liguria (-0.1 points).

Figure 6. R&D intensity by region. Years 2016 and 2017. Percentage of expenditure on GDP

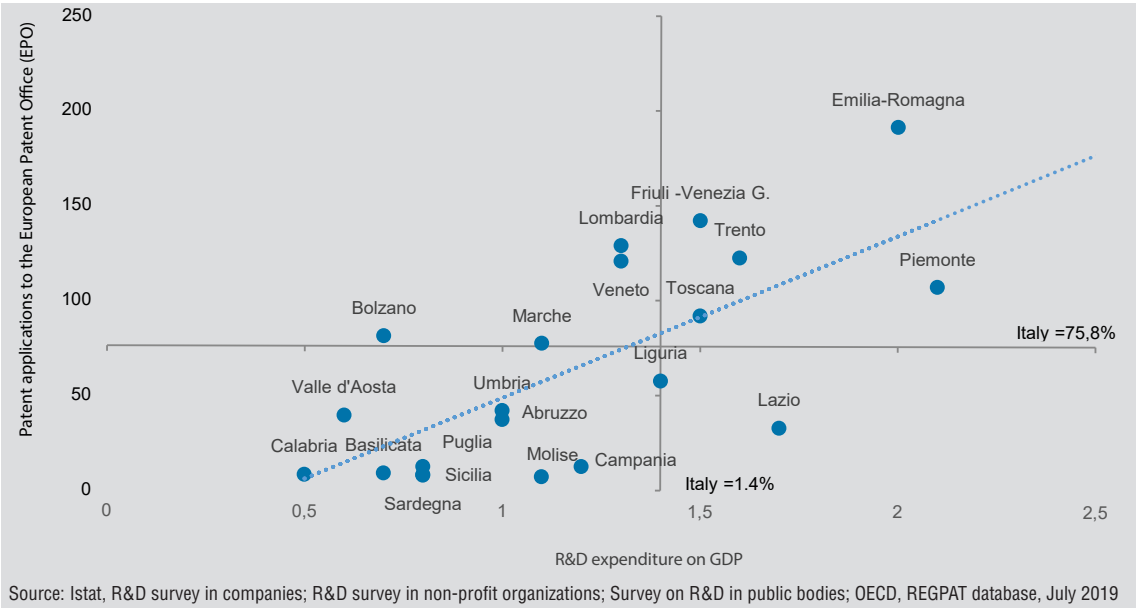


Source: Istat, R&D survey in companies; R&D survey in non-profit organizations; Survey on R&D in public bodies
(*) 2016 data not available.

More patents in Emilia Romagna

With regard to patent applications, the differences between territories are considerable. The highest values of this indicator occur in the North of the country while in the South and Islands is below the national average. In 2016, Emilia Romagna was the region with the highest number of patents submitted to the European Patent Office (EPO) (191.6 per million inhabitants) while all the regions of southern Italy are significantly below the Italian average (75.8). In Basilicata, Calabria, Sicilia and Sardegna patent applications are less than 10 per million inhabitants.

Figure 7. R&D expenditure on GDP (2017) and Patent applications to the European Patent Office (EPO) (2016) by priority year per million of inhabitants, by regions. Years 2017 and 2016



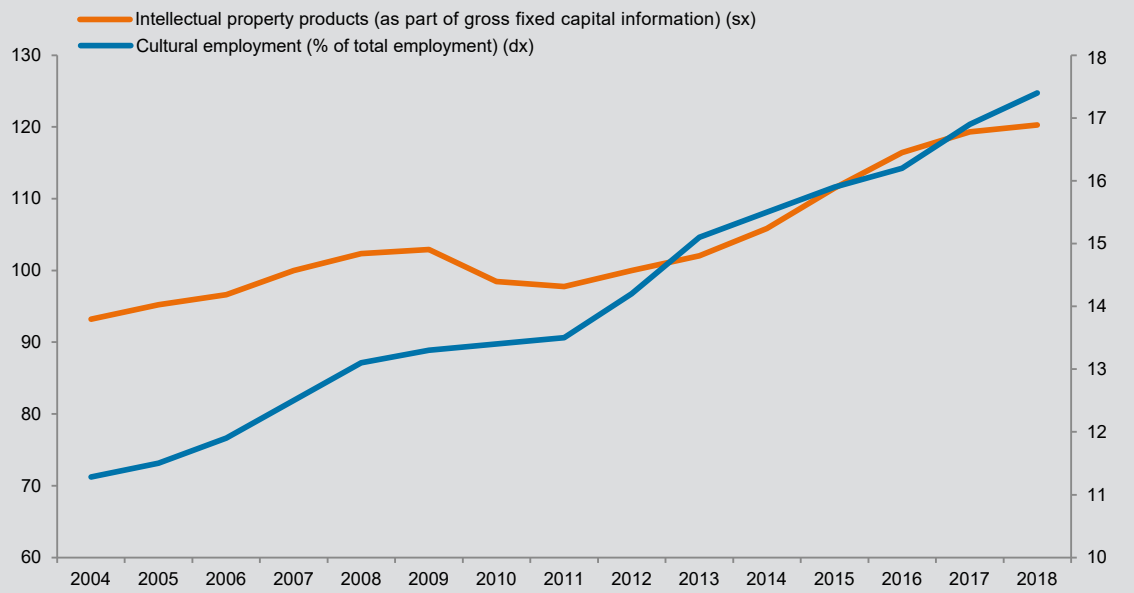
Source: Istat, R&D survey in companies; R&D survey in non-profit organizations; Survey on R&D in public bodies; OECD, REGPAT database, July 2019

As expected, there is a synergy between patents and the share of research and development. However, in some cases, there is a deviation, as for Lombardia and Veneto, where higher values in patent propensity are combined with lower R&D values, or for Lazio, where the higher R&D expenditure corresponds to patent propensity below the Italian average (Figure 7).

Improving employment in science and technology sectors

In terms of intellectual property products (PPI) investments, there are weak signs of improvement, with an indexed monetary expenditure of 120.3 in 2018, up by about one point compared to the previous year (119.3). Also concerning the dynamics of the percentage of workers employed in the Scientific and Technological sectors, there is a growing trend both in the last year and in the decade, with 17.3% of employees in these sectors in 2018 (it was 16.8% in 2017) (Figure 8).

Figure 8. Intellectual property products (as part of gross fixed capital formation) and Cultural employment (% of total employment). Years 2004-2018. Percentage and indexes 2007=100

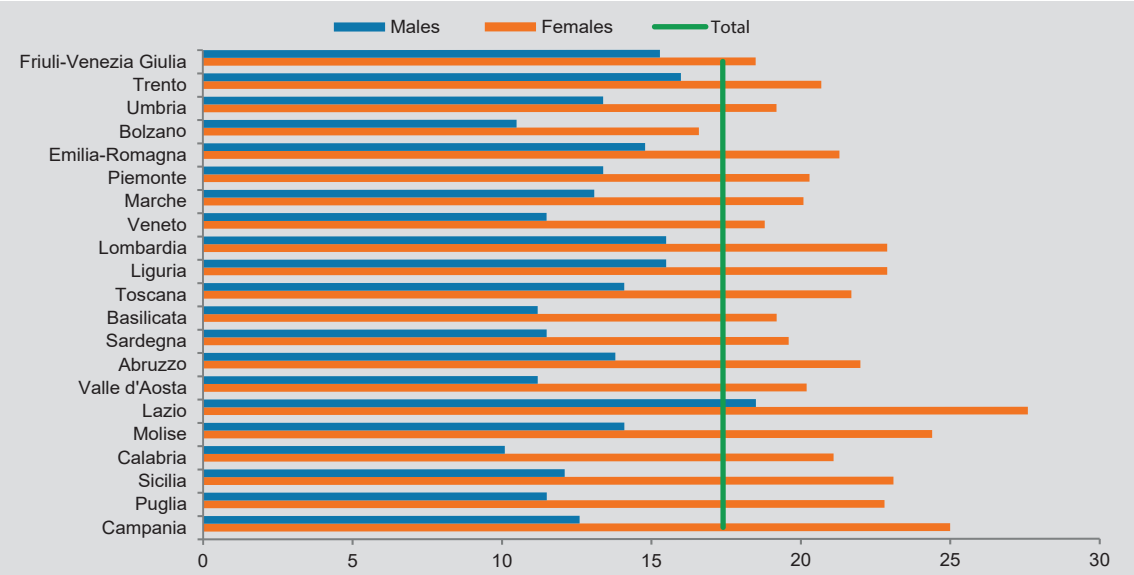


Source: Istat, Labour Force Survey and National Accounting

Women exceed men in the scientific and technological professions

In relative terms, the proportion of Italian graduated employees working in scientific-technological professions is still higher among women (22.0% compared to 13.8% among men), with shares significantly higher for those living in the Centre (23.9%) and the South and Island (22.6%) than in the North of the country (21.0%) (Figure 9). The gender gap is wider in the South and Islands reaching its maximum in Campania, Puglia, Sicilia, Calabria, and Molise, where there is a gender differential of more than 10 points, while in Friuli-Venezia Giulia and the province of Trento the gap is less than 5 points.

Figure 9. Employees with tertiary education (ISCED 5-6-7-8) in the scientific-technological occupations (ISCO 2-3) by gender and region. Year 2018. Percentage on total employees

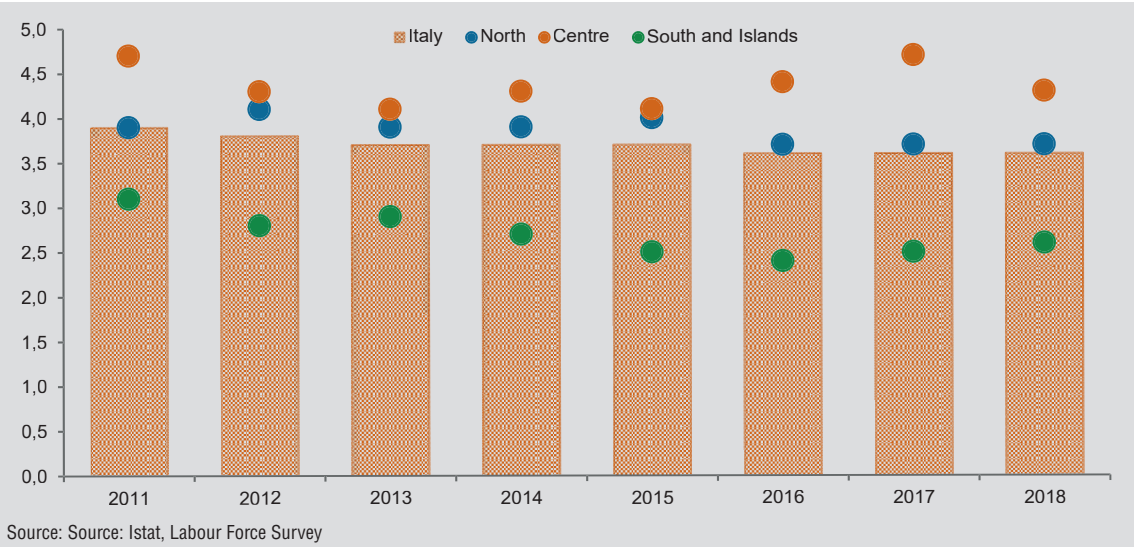


Source: Istat, Labour Force Survey

Percentage of cultural employment is rising

In 2018, the share of employees in Cultural and Creative Enterprises (CCI) is growing again, albeit only slightly (3.7%, it was 3.6% in 2017), after approaching 4% at the beginning of the decade[3]. In the central regions (particularly in Lazio) there are the highest percentages of employees in these sectors (4.6% and 5% respectively), while in the southern regions and Islands (particularly in Calabria and Sicilia) the values are lower than the Italian average (2.8% and 2.5% respectively) (Figure 10).

Figure 10. Cultural employment by geographic areas. Year 2018. Percentage of total employment



Source: Source: Istat, Labour Force Survey

3 Data on employment in the cultural and creative sectors in Italy presented here may differ slightly from those published by Eurostat, due to the selection of the employment categories pertaining to the ISCO 08 employment sectors based on Istat classification of professions.

The North is still more attractive among young graduates

The migration rate of young graduates, which was negative for the entire period considered (2012-2018), fell, albeit slightly in absolute terms, from -4.1 per thousand resident graduates in 2017 to -4.0 in 2018. The regions of southern Italy and in the Islands, in particular Calabria (-31.1 per thousand), remain at the top of the list for the number of young graduates migrated. The outflow of young graduates increases in these regions (from -23 per thousand in 2017 to -23.2 per thousand in 2018), but is reduced in the Centre (from -2.9 per thousand to -2.4 per thousand). However, the attractiveness of the North decreases, where incoming flows go from +7.7 per thousand in 2017 to +7.2 per thousand in 2018. Emilia Romagna shows the greatest capacity to retain or attract young graduates (+15.5 per thousand, constantly growing in the last five years).
All over the country, the migratory phenomenon involves mostly males (-4.7 per thousand compared to -3.1 of females). In Emilia Romagna, however, the gender gap is narrower, involving young graduates of both sexes equally (respectively +14.7 and +14.2 per thousand) (Figure 11).

Figure 11. Brain circulation (italians, 25-39 year olds) by regions. Year 2018. For 1,000 graduates in the same age group

Source: Istat, Registrations and cancellations from the registry for residence transfer and Labour Force Survey

Indicators

1. **R&D intensity:** Percentage of R&D expenditure on GDP.
   Source: Istat, R&D survey in companies; R&D survey in non-profit organizations; Survey on R&D in public bodies.
2. **Patent propensity:** Number of patent applications filed to the European Patent Office (EPO) per million of inhabitants.
   Source: Ocse, Database Regpat.
3. **Impact of knowledge workers on employment:** Percentage of employees with tertiary education (ISCED 5-6-7-8) in scientific-technological occupations (ISCO 2-3) on total employees.
   Source: Istat, Labour force survey.
4. **Innovation rate of the national productive system:** Percentage of firms that have introduced technological (product or process), organizational or marketing innovation in a three-year period on total number of firms with at least 10 persons employed.
   Source: Istat, Cis (Community Innovation Survey).
5. **Intellectual property products (as part of gross fixed capital formation):** The value of expenditure on research and development, mineral exploration and evaluation, computer software and database, entertaiment literary or artistic originals and other intellectual proprety procucts intended to be used for more than one year. Chained values, reference year 2010 (millions of euro), Indexed 2007 = 100.
   Source: Istat, National Accounts
6. **Cultural employment (% of total employment):** Percentage of employees in cultural and creative enterprises (ISCO-08, Nace rev.2) out of the total number of employees (15 years and over).
   Source: Istat, Labour force survey
7. **Brain circulation (italians, 25-39 year-olds):** Net migration rate of holders of a tertiary degree: (immigrants-emigrants) / total resident population * 1,000. Both numerator and denominator refer to italian holders of a tertiary degree, 25-39 year-olds.
   Source: Istat, Registrations and cancellations from the registry for residence transfer and Labour Force Survey

Indicators by region and geographic area

REGIONS AND GEOGRAPHIC AREAS	R&D intensity (a)	Patent propensity (b)	Impact of knowledge workers on employment (c)
	2017	2016	2018
Piemonte	2.1	107.4	16.3
Valle d'Aosta/Vallée d'Aoste	0.6	39.3	15.3
Liguria	1.4	57.5	18.7
Lombardia	1.3	128.9	18.5
Trentino-Alto Adige/Südtirol	1.1	102.3	15.5
Bolzano/Bozen	*0.7*	*81.2*	*13.2*
Trento	*1.6*	*122.6*	*17.9*
Veneto	1.3	120.8	14.5
Friuli-Venezia Giulia	1.5	142.2	16.6
Emilia-Romagna	2.0	191.6	17.6
Toscana	1.5	92.0	17.3
Umbria	1.0	42.0	15.8
Marche	1.1	77.3	16.1
Lazio	1.7	32.9	22.4
Abruzzo	1.0	37.2	17.0
Molise	1.1	7.1	18.0
Campania	1.2	12.4	16.8
Puglia	0.8	12.3	15.4
Basilicata	0.7	8.9	14.2
Calabria	0.5	8.1	14.1
Sicilia	0.8	8.0	16.0
Sardegna	0.8	7.7	14.8
North	1.5	129.2	17.1
Centre	1.5	57.6	19.5
South and Islands	0.9	12.0	15.9
Italy	**1.4**	**75.8**	**17.3**

(a) Percentage of R&D expenditure on GDP.
(b) Per million of inhabitants.
(c) Per 100 in employment.
(d) Percentage values.
(e) Chain linked values, reference year 2007.
(f) Per 1,000 resident graduates.

Innovation rate of the national productive system (d)	Intellectual property products (as part of gross fixed capital formation) (e)	Cultural employment (% of total employment) (c)	Brain circulation (italians, 25-39 year-olds) (f)
2016	2018	2018	2018
50.6	....	4.0	0.0
28.3	....	3.7	-10.1
47.8	....	3.0	2.7
54.9	....	4.1	12.1
44.6	....	3.7	7.2
43.8	....	*3.2*	*3.8*
45.7	....	*4.2*	*9.9*
52.5	....	3.7	-2.3
52.0	....	3.5	-3.4
54.7	....	3.2	16.2
44.1	....	4.6	0.8
46.8	....	4.0	-7.1
46.3	....	2.9	-6.7
43.3	....	5.0	-2.5
43.8	....	3.2	-14.1
38.0	....	3.4	-22.5
41.0	....	3.1	-20.2
42.5	....	2.6	-23.9
41.1	....	2.7	-27.2
35.1	....	2.3	-31.1
37.1	....	2.5	-28.6
37.5	....	2.8	-13.3
53.0	....	3.8	7.2
44.4	....	4.6	-2.4
40.2	....	2.8	-23.2
48.7	**120.3**	**3.7**	**-4.0**