# 11. Innovation, research and creativity[1]

Innovation, research and creativity are the foundations of social and economic progress and contribute to sustainable and long-lasting development by generating spin-offs in the quality of life and access to services and by increasing the capacity to satisfy needs. Digital transition, innovation and competitiveness are the main guiding principles of *#NextGenerationEU* [2]. The indicators of this domain measure the processes of creation, application and dissemination of knowledge and give a specific focus about the dissemination of ICT technologies. This last issue is one of the main goals of European Union policies for economic progress and social and cultural inclusion[3]. ICT centrality has been highlighted by the COVID-19 emergency, which has accelerated the use of digital technology as a response strategy to the pandemic crisis, both in the organization of public and private production activities, and in the access to goods and services by individuals and families, and, more generally, in daily life[4].

The indicators related to the diffusion of digital technologies show significant progresses made by businesses and Municipalities, albeit starting from low levels; there are also great differences by region, enterprise size and business sector. The diffusion of ICT among families and individuals, which has increased in recent years, is still held back by persistent factors of exclusion (material and immaterial), which sometimes result in a mismatch between opportunities and actual use.

While many of the monitored indicators show improvements in the creation of knowledge and its application and dissemination, Italy continues to lag behind the average of European Union countries, also because of persistent and wide gaps between northern and central Italy and the southern regions.

## Women, the elderly and those who live in southern Italy lag behind in the use of the Internet

Internet use is one of the requirements for the transferability of ICT innovation in society, as well as in the economic system. In addition to the availability of infrastructure and connectivity services (monitored in the quality of services domain), individual behaviour is also important. In 2020, 69.2% of the Italian population aged 11 years and over used the Internet at least once a week in the 3 months before the interview. In 2019-2020 we saw the highest annual increase in 7 years, also driven by the pandemic crisis.

1 This chapter was edited by Stefania Taralli, with contributions from: Francesca Licari, Valeria Mastrostefano, Alessandra Nurra, Alessandra Tinto e Laura Zannella.

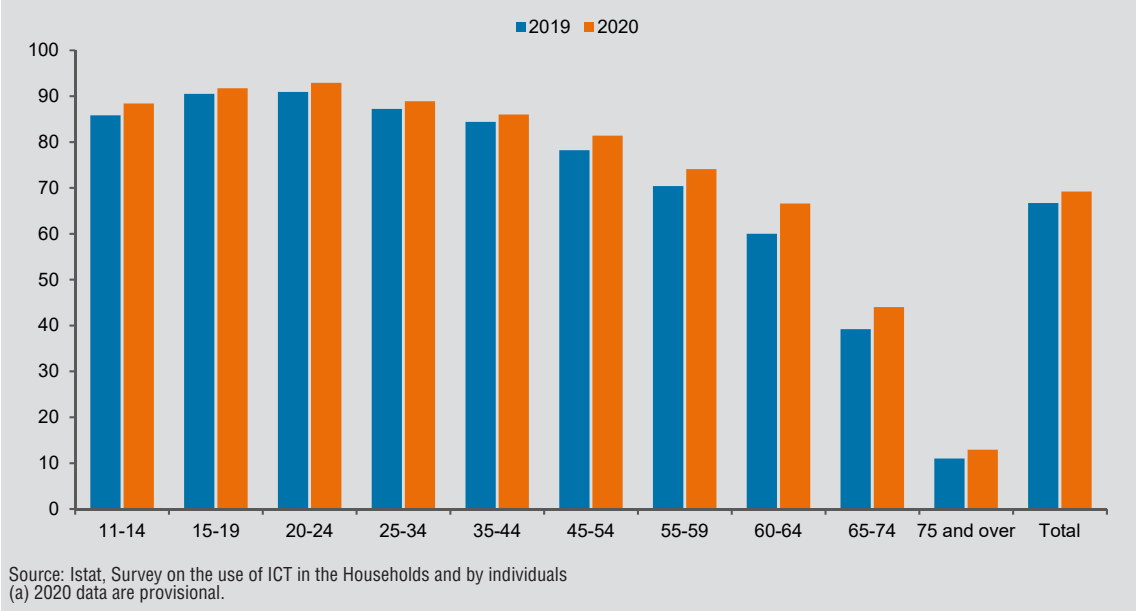
2 Europe's moment: Repair and Prepare for the Next Generation (COM(2020)0456) For the declination of the national strategy see http://www.politicheeuropee.gov.it/media/5378/linee-guida-pnrr-2020.pdf.

3 The social and economic relevance of this topic has already been clearly outlined in the Europe 2020 strategy and in the Digital Agenda for Europe 2020, and reiterated most recently in the Political guidelines of the Commission 2019-2024 and in the Digital single market strategy. The latter aims to improve online access for consumers and businesses, creating the right conditions for digital networks and services to flourish, and maximizing European digital growth through new technology investment, research and innovation.

4 In June 2020, the Commission announced in its communication "Europe's moment: Repair and Prepare for the Next Generation" (COM(2020)0456) that the digital single market will be a pillar of post-COVID-19 recovery. For an analysis of the impact of the COVID-19 pandemic on digital transformation in OECD countries, see OECD Digital Economy Outlook 2020 (https://doi.org/10.1787/bb167041-en).

Almost all 15-24-year-olds surf the net (more than 90%), while for 60-64-year-olds the proportion of Internet regular users falls to 66.6%, and it reaches 44% among 65-74-year-olds; however, these last groups of less frequent users show the higher increases over the previous year (Figure 1).

**Figure 1. Percentage of individuals aged 11 and over who used the Internet at least once a week in the 3 months prior to the interview. Years 2019 and 2020** (a)**. Percentage values**




Source: Istat, Survey on the use of ICT in the Households and by individuals
(a) 2020 data are provisional.

Internet use is still characterised by a gender gap in favour of men (72.9% against 65.8% of women) that remains stable compared to the previous year. However, among young people aged 15-19 years there is a female advantage, for the next age groups and up to 59 years, these differences are very small, while they accentuate for older people, reaching 12 percentage points in favour of men in the 65-74 age group.
Wide and unchanged territorial differences emerge in 2020 as well. The disadvantage of southern Italy (63.4%) is measured in a difference of 9 percentage points from northern and central Italy (72.3%).

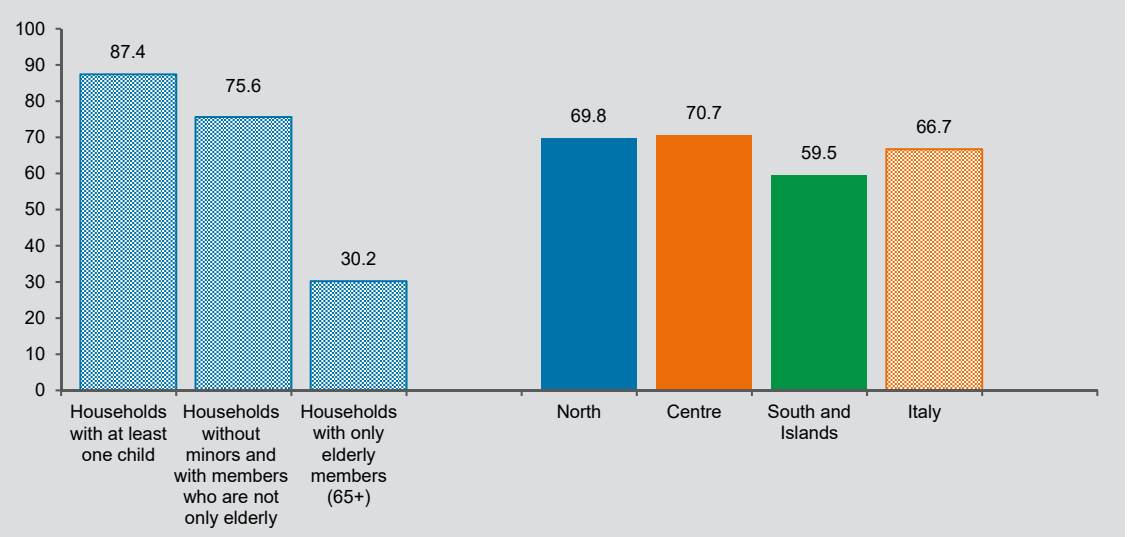
## One-third of households do not have computers and Internet access at home

The use of Internet also requires the availability by the household of an adequate connection and suitable tools (devices).
In recent years, mobile phones and smartphones have increasingly become the driving factors in accessing the web, and in many cases, they represent the only way, particularly among those groups that show a lower use of the Internet. More than half of people with low educational qualifications and a large share of residents in the South and Islands access the Internet exclusively through smartphones[5].

5 The percentages, estimated by the Istat "Aspects of Daily Life" survey for the year 2019, are precisely 51.7% for people with low educational qualifications and 40.7% for residents in the South and Islands.

Although smartphones can facilitate a wide diffusion of Internet access and an easy carrying out of some activities, on the other hand it do not guarantee the acquisition of more complex digital skills. Data on the availability in the family of at least one computer (including tablets) and Internet connection allow us to monitor situations of exclusion or difficulty in the full access to the opportunities offered by digital technology.
In 2020, in Italy, 66.7% of households have Internet access from home and at least one computer (Figure 2). Compared to 2019, there is an increase by 1.6 percentage points, all due to the increase in Internet access from home (which rise from 76.1% to 79.6%), while there are no significant changes in the households' availability of a PC.
Differences among regions continue to be high, with a general advantage for those in central and northern Italy. Trentino-Alto Adige and Friuli-Venezia Giulia are the regions with the highest percentage of households equipped with technology, at 74%.

**Figure 2. Households with Internet connection and at least one personal computer by family type, by geographic area. Year 2020** (a)**. Percentage values**



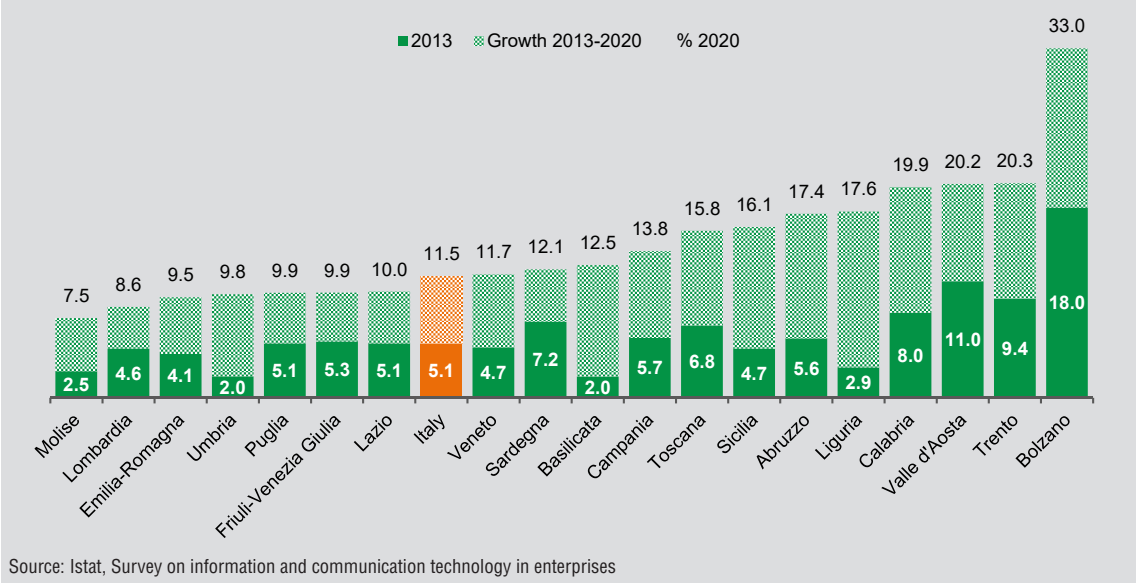

Source: Istat, Survey on the use of ICT in the Households and by individuals
(a) 2020 data are provisional.

The level of education of the family members has a very strong impact on the endowment and use of ICT, so as the presence of at least one child in the family. In fact, almost all of the more educated families (in which at least one member has a university degree) have a connection and at least one PC (92.8%), a percentage that drops to 31.7% when the highest qualification in the family is the lower secondary education diploma. A similar trend appears comparing families with at least one child (87.4%) to those composed by elderly people only (30.2%). These gaps remain stable compared to 2019.

## Just over one in ten Italian businesses sell via the web to end consumers

E-commerce is an opportunity for companies to have a greater access to the national, European and – potentially – global market. At the same time, it can affect directly the well-being of individuals, by producing greater access to goods and services, expanding supply and price competition, leading to new ways in time use and new chances of life balance[6]. The trend is growing, but levels remain low, held back by some characteristics of the Italian production system, such as the enterprises size and sector of activity.
In 2020, the share of Italian companies with at least 10 employees that in the previous year made sales to end customers (B2C) through their own web channels, digital platforms or e-commerce intermediaries[7] was 11.5%, more than doubled compared to 2013 (5.1%). The regional distribution shows wide distances among regions, from 7.5% of Molise businesses to 33% of those in the autonomous province of Bolzano, with the northern and the southern regions equally represented in both the top and bottom groups of the distribution (Figure 3). In general, the average for southern Italy (13.8%) exceeds that of northern Italy (10.6%) by more than 3 percentage points. In particular, the highest levels are in Calabria, Abruzzo and Sicilia (19.9%, 17.4% and 16.1% respectively).

**Figure 3. Enterprises with 10 or more persons employed that during the previous year sold via web to end customers (B2C) by region. Years 2013 and 2020. Percentage values**




Source: Istat, Survey on information and communication technology in enterprises

Moreover, just some regions of southern Italy – Basilicata, Sicilia, Abruzzo and Calabria – record the highest growth between 2013 and 2020 (around 11 percentage points). On the other hand, in Piemonte, Lombardia and Emilia-Romagna, the share of companies selling via web B2C does not reach 10% of the total. This can also be explained because in these regions there is a greater share of firms operating in sectors of economic activity less

6 In 2019 over half of Internet users aged 14 and older (57%) reported making online purchases in the year prior to the interview. See the link to the 2019 Aspects of Daily Life survey results for more details: https://www.istat.it/it/archivio/236920.

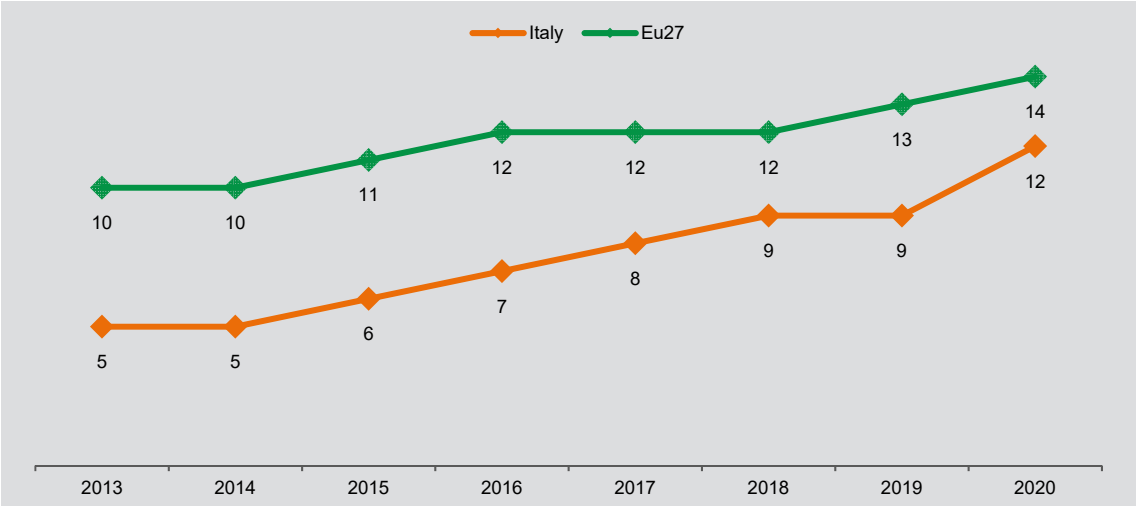
7 The indicator does not consider sales made via the web to other companies or the public administration; with whose additional contribution it reaches 13.7% in 2020 (it was 6.1% in 2013).

oriented to B2C sale. In absolute terms, however, companies in the North, led by those in Lombardia, Veneto and Emilia-Romagna, contribute to the Italian average with more than half of the total number of companies selling via web B2C in both 2020 and 2013.
The indicator, by its nature, varies greatly by sector of economic activity: in the non-financial services sector it reaches 16.3%, in manufacturing it drops to 6.6%. Over the years, the former sector has grown more than the latter (in 2013 they were 8.2% and 2.4%, respectively). As expected, the highest levels of the indicator are in those sectors which are most oriented towards sales to end consumers: hospitality (from 54.9% in 2013 to 90.4% in 2020), publishing (from 36.9% to 60.7%), travel agencies (from 21% to 39.6%) and retail (from 8.4% to 21.2%). Among manufacturing companies, stand out those active in food (16.1% in 2020) and wood products (13.9%).
Enterprise size also affects the share of firms selling via web B2C: the propensity to use this sales channel is almost double among large firms (20.4%) compared to small firms (11.3%).
The B2C web sales are small in the European Union too, involving on average just 14% of businesses in 2020[8] (Figure 4). Italy remains at the bottom of the European ranking, even if the starting gap from the Eu27 average is more than halved. Data also suggest that the acceleration observed in the last year will continue. In fact, the survey conducted in May 2020 by Istat on the situation and prospects of companies during the pandemic emergency[9] revealed that about 16% of companies with at least 10 employees, in order to respond to the COVID-19 emergency, had already adopted (or were considering adopting) changes or expansions of sales channels or supply/delivery methods, with the transition to online services, e-commerce, and multi-channel distribution models. The second edition of the survey, carried out in November 2020, shows that the expansion of ultra-wideband connectivity, already widespread in the pre-COVID period, produced a significant increase both in quality and availability, setting the preconditions for a true explosion of digital communication services with the public, primarily potential customers. Businesses – even the smallest ones – also indicate a sharp reduction, in the 2019-2020 comparison, in the percentage of revenue generated through traditional non-digital channels against an increase in the share of revenue generated by digital channels. When comparing the preliminary data for 2020 with the forecast data for 2021, the process of substitution between non-digital and digital commercial channels continues, albeit with an expected slowdown in all size classes: a perspective that does not yet allow for an understanding of whether the changes underway are temporary or structural.

8 For further information on e-commerce at EU level, see the following link https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics.

9 For further information, see the following link https://www.istat.it/it/archivio/244378. The results of the second edition of the COVID-19 Rapid Survey on Business Situation and Prospects in Emergency Health Care, and additional insights, are available at the link https://www.istat.it/it/archivio/252396.

**Figure 4. Enterprises with 10 or more persons employed that during the previous year sold via web to end customers (B2C) in Italy and in European Union. Years 2013-2020. Percentage values**




Source: Eurostat, Survey on information and communication technology in enterprises

## Municipal provision of fully online services for families is limited

Among ICT applications, those linked to e-government represent an opportunity to increase the efficiency of the Public Administration and to improve its relationships with citizens. One of the most important results for the well-being of individuals and families is certainly the possibility of completing online the entire procedure to access services, according to the user-centricity principle recalled in European and national guidelines for ICT development in Public Administration[10]. Despite the advances made over the years, the spread of municipal services that are managed entirely online is still low, especially in smaller Municipalities, and mainly limited to simpler procedures.

In 2018, only one Italian Municipality out of four managed fully online at least one service for families[11]; raising the threshold to at least two services the share drops to 10% and falls to 5% for at least three services. Considering the broader group of Municipalities managing fully online at least one fully online service, the share has more than doubled since 2012 (it was 9.9%), thanks in part to the significant acceleration in the last period (+9.4 percentage points between 2015 and 2018)[12]. The regional distribution is varied (Figure 5). In 2018, as in 2012, the highest shares are in Emilia-Romagna (45.6%), Veneto (43.4%), Lombardia (41.3%) and Toscana (39.1%).

These regions also recorded the greater increases over 2012 (by more than 20 percentage points). The size of the Municipality and the procedures complexity are further significant elements of differentiation: as a general trend, larger Municipalities, seem more aware of the opportunity represented by digitization, also in view of the greater number of files to

10 See, for example, the Three-year Plan for Information Technology in Public Administration 2020-20.

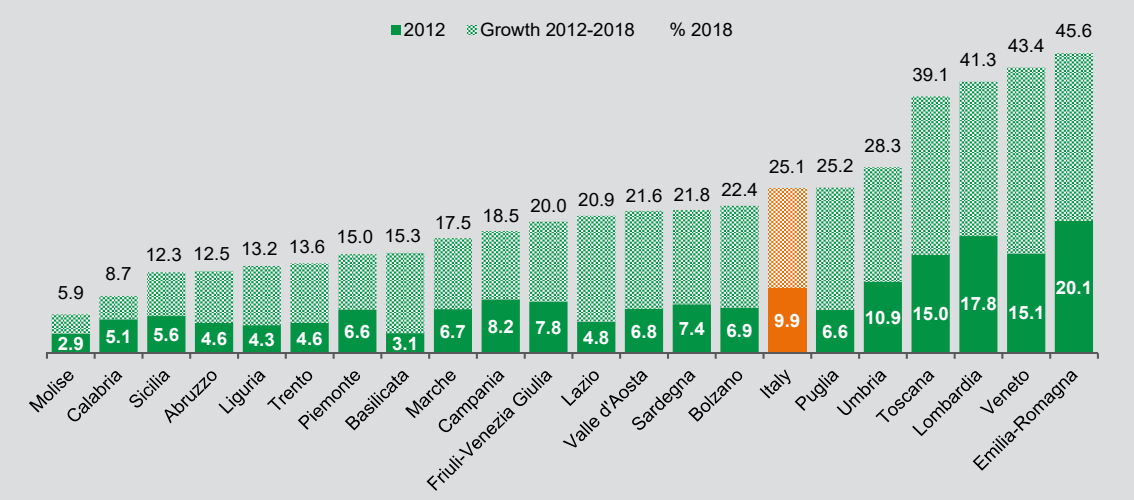
11 To calculate the indicator, a subset of 11 services is considered that a) are exclusively or prevalently addressed to families; b) are connected to the fundamental functions of the Municipalities; c) can theoretically be provided by all the Municipalities.

12 The survey on information and communication technologies in public administrations takes place every three years. The first edition is referred to the year 2012.

be processed, while the availability of fully online services decreases as their managing complexity increases, especially in smaller Municipalities. In 2018, 77.1% of Municipalities with at least 60 thousand inhabitants manage fully online one or more services; the share falls to 16.5% for small Municipalities (those up to 5 thousand inhabitants). Over time, this difference has increased simultaneously to the general growth in supply: in 2012, the same shares were 47.6% and 6.9% respectively. Small Municipalities, therefore, have found it more difficult to make the technological leap towards a greater offer of digital services. Policies already launched in Italy a few years ago[13] and those adopted more recently[14] could support them in the transition process.

The most common fully online service is, by far, that of catalogue consultation and library lending[15] which, in 2018, concerns 10% of Italian Municipalities, and is quite widespread even in small Municipalities (6.7%). More complex services, for example those whose procedures include online payment, such as payment of fines and school refectory are managed fully online just in a number of larger Municipalities (52% of Municipalities with at least 10 thousand inhabitants). Registry services, which require an upstream commitment to computerizing citizens data, are provided fully online mainly by Municipalities with over 60 thousand inhabitants (44.1%; it was 23.7% in 2012). Only in these Municipalities, fully online services related to property taxes and waste disposal taxes (IMU and Ta.Ri.) reach significant shares (18.9% and 16.2%, respectively).

**Figure 5. Municipalities that manage online at least one service for families or individuals at a level that allows the online start and conclusion of the entire procedure by region. Years 2012 and 2018. Percentage values**




Source: Istat, Survey on information and communication technology in public administrations

13 Article 17 of the Digital Administration Code obliges Public Administrations (PAs) to identify an office responsible for the digital transition that is in charge of the related activities and organizational processes necessary for the implementation of a digital administration and service delivery. The subsequent Circular No. 3 of October 1, 2018 of the Minister of PA urged the appointment of these figures.

14 In particular, the simplification measures for the support and diffusion of digital administration adopted with Law 120/2020, which envisage the launch by the end of February 2021 of the digital transformation required to make its services available on the new public services application (App IO). For further details, see the Italian Minister for Technological Innovation and Digitalization guidelines.

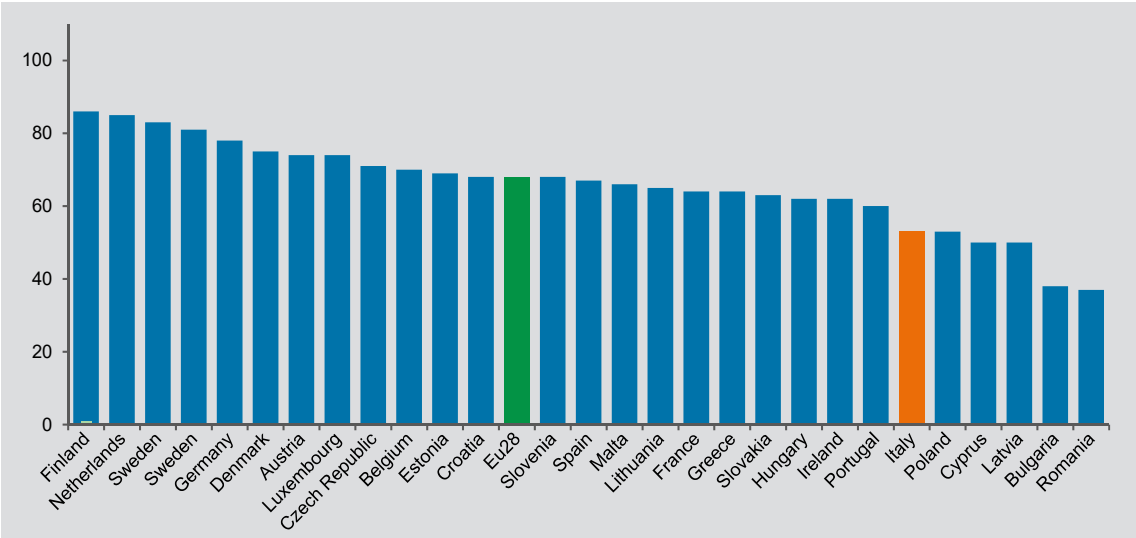
15 Online library services, beginning in the mid-1980s, have gradually expanded thanks to the OPAC - *On-line public access catalogue*.

Levels of access by users are different too. Among those Municipalities that have implemented fully online management of services, no more than 10% of the total procedures are completed online. The share rises to 20% in the case of registry certificates, but the highest rates are reached by school refectory services: in 2018 more than half of the Municipalities that have activated online management digitalized over 90% of total procedures.

## Only half of the employed have at least basic digital skills. Inequalities by education and occupational status are strong

The adoption of digital technologies and new organizational models by companies and public administrations, leads generally to a revision of the system of competencies[16]. In fact, over the years, digital skills have changed at the speed of the evolution of ICT, and the ability to develop a technical mentality capable of operating in a constantly changing digital ecosystem became increasingly important. The technical knowledge, therefore, is considered a transversal social knowledge, and for this reason it is important to monitor the digital skills of the employed by referring to the overall skills acquired in the different areas of everyday life.
In 2019, in Italy just over half of employed people aged 25-64 have basic or high digital skills (53%), 15 percentage points below the European average (68%) (Figure 6). This confirms that in our Country there is still a first-level digital divide related to Internet access. In fact, while almost all employed people aged 25-64 living in northern European countries access the Internet on a regular basis, in Italy, for the same population group, saturation levels are far to be reached (the share of employed who regularly use the Internet is 85%).

**Figure 6. Employed people (aged 20-64) who have at least basic digital competences in Italy and in European countries. Year 2019. Percentage values**

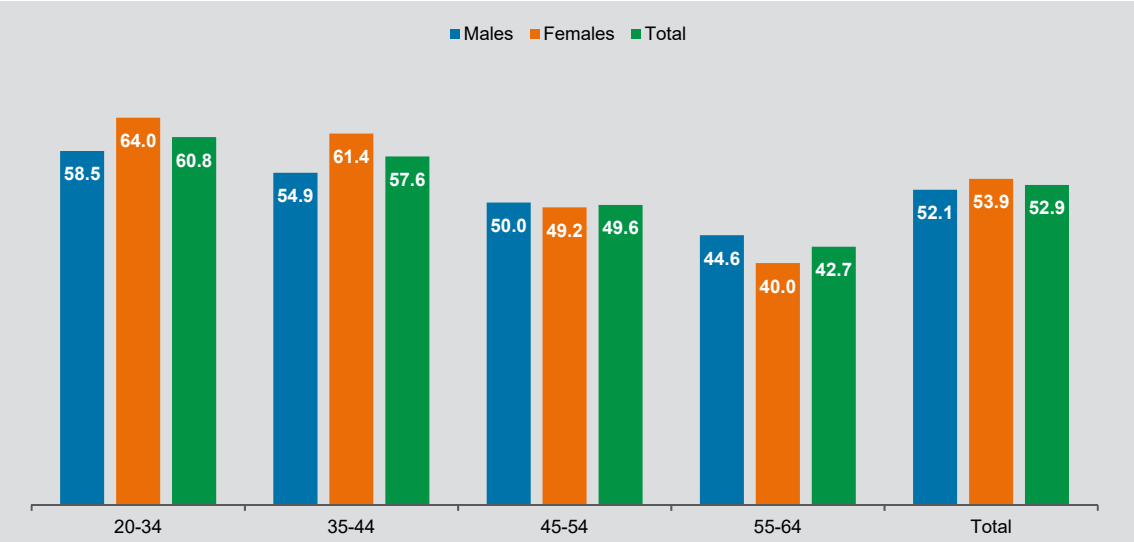



Source: Eurostat, Survey on the use of ICT in the Households and by individuals

16 The European Parliament and the European Council identify digital competencies as one of the eight key competencies for lifelong learning, describing them as the ability to use information society technologies for work, leisure and communication, with familiarity and critical thinking (Recommendation 2006/962/EC of the European Parliament and of the Council).

The indicator chosen to monitor the Italian situation considers the employed people aged 20-64, a broader aggregate than the one used at European level. The average in 2019 is 59.9%, with a great variability according to socio-demographic and territorial features (Figure 7).
60.8% of the employed in the 20-34 age group have at least basic digital skills, while among the older ones (55-64 years) the figure drops to 42.7%. There is no relevant gender gap, although it should be noted that among the young and up to 44 years of age there is a female advantage by over 5 percentage points, which changes in favour of men at later ages. This female advantage is also explained by the differences in the professional structure, given that female employment is concentrated in some higher-skilled professions, even if they are far from managerial areas.
The education level is another factor explaining the differences: 82.3% of those employed with a high educational qualification have at least basic digital skills compared to 55.9% of those with an average qualification and to 21.8% of those with a low educational qualification.

**Figure 7. Employed people (aged 20-64) who have at least basic digital competencies by gender and age class. Year 2019. Percentage values**




Source: Eurostat, Survey on the use of ICT in the Households and by individuals

Differences among regions are strong. The backwardness of southern Italy (45.8%) is particularly evident in a gap of almost 10 percentage points with respect to northern and central Italy, which are, on the other hand, not far apart (56.4% and 53.3%, respectively).
An analysis of the four skills areas[17] (information, communication, problem solving and software) considered to calculate the synthetic indicator on digital skills, shows that those employed in more qualified positions have a clear advantage in all four domains. In particular, the widest gaps refer to the software skills (that are closely related to the work activity) with a ratio of 1 to 3 between blue-collar workers (19%) and the group of managers, entrepreneurs and freelance professionals, office workers, executives and managers (60%).

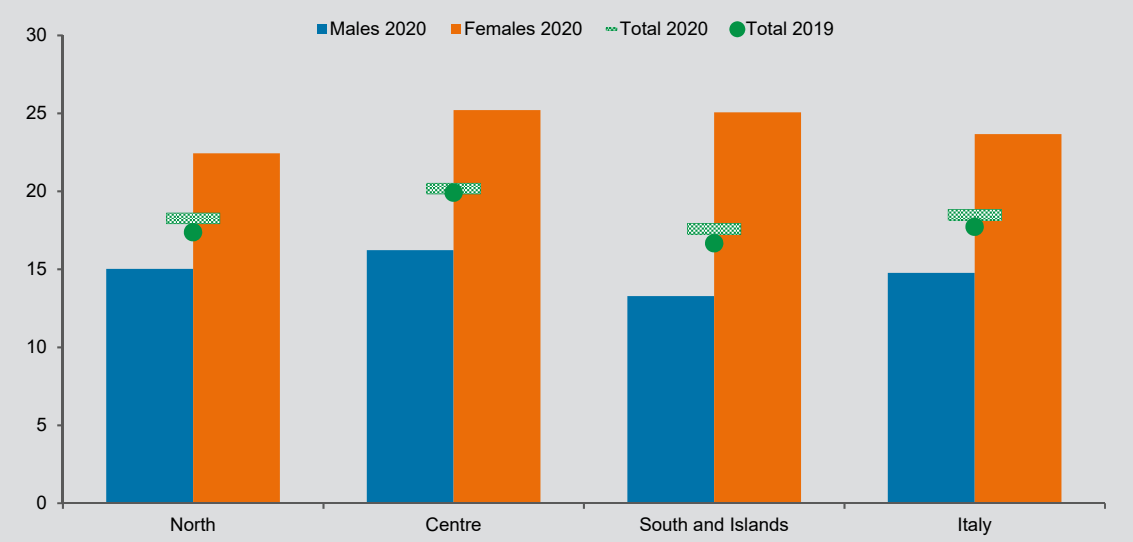
17 The areas and activities are: Information skills – searching the Internet for data, documents, etc.; Communication skills – interacting via the Internet, use of social media; Problem solving skills – solving technical problems, updating one's own and others' skills; Software skills for content manipulation – creating content through text, image and video processing, integrating and reworking already published content, producing creative forms of expression, being aware of and applying intellectual property rights.

Wide gaps, with a ratio of almost 2 to 1 between the employed in more qualified positions and blue collar workers, are also recorded for problem solving (63% compared to 32% of blue collar workers) and information (73% compared to 40% of blue collar workers), which are more associated to daily life activities.

## Knowledge workers on the rise and less vulnerable in the COVID-19 downturn

The share of knowledge workers in the total workforce, i.e. the share of those in scientific and technological professions with a university degree, has been rising steadily in recent years. The tendency appears more marked in the second quarter of 2020, when the level of the indicator reaches 18.5% (+0.8 percentage points over the same quarter of 2019).
The last variation results from a slight growth of the employed in this segment of the labour market, but above all it reflects the greater resilience of the most qualified occupations during the negative conjuncture produced by the pandemic emergency, with a contraction of general employment levels. In fact, between the second quarter of 2019 and 2020, the net loss of employed people aged 15 years and over is 841 thousand (-3.6%), while knowledge workers have grown by more than 27 thousand (+0.7%). The impact of knowledge employment is structurally higher for women than men. In the second quarter of 2020, female knowledge workers come to represent 23.7 percent of total female employment, gaining more than 1 percentage point over the same period in 2019, and increasing their advantage over men. The gender gap is close to 9 percentage points (in the second quarter of 2019 it was 8.5 percentage points; 8.4 percentage points on an annual average). This gain is all due to the more severe penalty suffered by women in terms of overall employment. In fact, the total amount of employed women aged 15 and older declined by 4.7 percent between 2019 and 2020 (second quarter, Q2), more than offsetting the simultaneous contraction suffered by the higher-skilled women employed as well (-0.4 percent).
The share of female knowledge workers reaches the maximum levels in the 25-34 and 35-44 age groups: in Q2 2020 it rises to 31.9% and 28.7% respectively, with significant gains compared to Q2 2019.
Spatial differences are wide. The highest levels are in the Centre (20.2%), the lowest in the South and Islands (17.6%), where the percentage is very low for males (13.3%) while the females' rate (25.1%) is in line with the value in the Centre and exceeds that of the North (Figure 8). Compared to Q2 2019, the distance between the Centre and the South has narrowed by 0.7 percentage points as a result of the recomposition generated by the contraction of overall employment (-5.3%), which in the South produces a gain in the value of the indicator of almost 1 percentage point, against the substantial stability of skilled employment.
Despite the growth trends, also described by the annual data, Italy's position remains behind compared to European countries. Considering the average levels for the year 2019, the gap between Italy (17.6%) and the Eu28 average (23.9%) grows by 0.3 percentage points compared to 2018.

**Figure 8. Employees with tertiary education (ISCED 6-7-8) in scientific-technological occupations (ISCO 2-3) by gender and geographic area. Years 2019 and 2020 Q2. Values per 100 employees with the same characteristics**



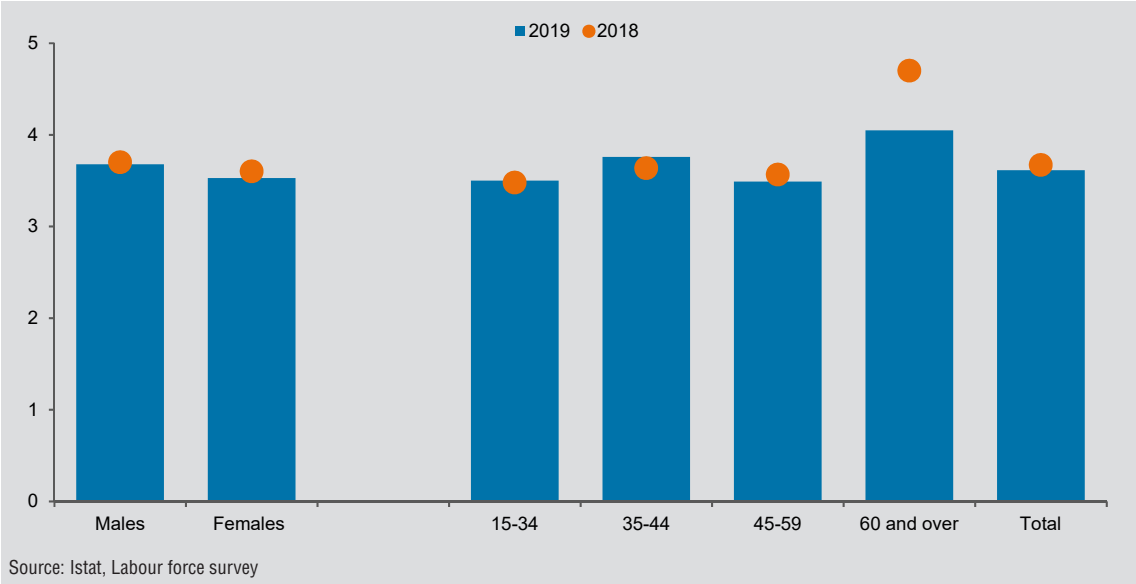

Source: Istat, Labour force survey

## Cultural and creative employment is struggling to grow, but Italy is in line with the EU average

In 2019, employed in cultural and creative sectors or professions in Italy are about 844 thousand; the weight of cultural and creative employment on the total employment (3.6%) remains stable compared to 2018. More than half (54%) are concentrated in the North, 20% are in the South. Differences among regions are wider when considering the weight of the cultural and creative sector on overall employment. The regions of central Italy reach the highest levels (4.5% in average), and in particular in Lazio and Toscana (5.1% and 4.4%, respectively), while in the southern regions they are always below the Italian average, reaching their lowest levels in Calabria and Sicilia (2.3% and 2.4%, respectively).
The difference between men (3.7%) and women (3.5%) remains small despite the reduction in the number of cultural and creative employees registered over the last year (down 3.7 thousand units). Looking at the age groups, a moderate variability appears. The 60+ age group continues to stand out from the others for higher levels (4%), particularly among men (4.3%) (Figure 9).
In the European context, Italy in 2019 remains just below the average of the 27 countries[18] (3.7%), exactly in line with Spain and slightly higher than France (3.5%). Germany is at 4%.

18 Following the United Kingdom's withdrawal from the European Union, Eurostat calculated the EU27 aggregate for the entire time series. The revised data are available at https://ec.europa.eu/eurostat/web/culture/data/database.

Figure 9. Employees in cultural and creative professions or sectors of activity by gender and age class. Years 2018 and 2019. Values per 100 employees with the same characteristics




Source: Istat, Labour force survey

## The migration of young Italian graduates continues to penalize the South of Italy

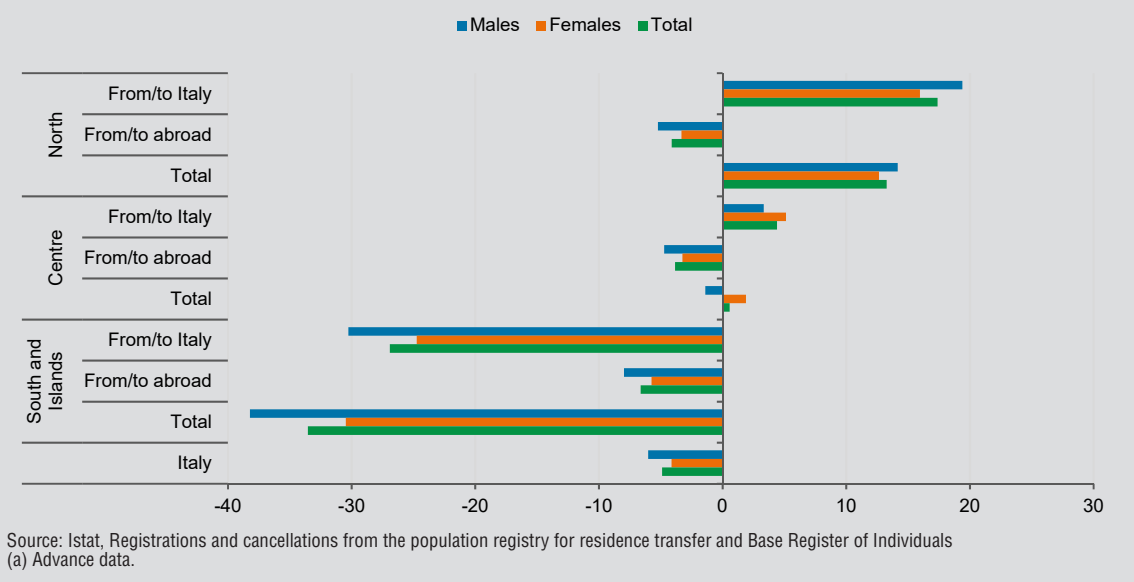
The capacity to attract and/or retain younger and more educated human resources is a further element to evaluate the processes that underlie the diffusion and application of knowledge. The indicator used to measure this aspect considers the net gain (or loss) due to the migration of young residents aged 25-39 with a university degree, and is limited to Italian citizens, since for foreign citizens the population register does not yet provide information of adequate quality[19].

The mobility of young Italian graduates follows the trend already observed in recent years[20]: during 2019 about 21 thousand young Italian graduates have established their residence abroad Italy and more than 8 thousand have transferred it in one Italian Municipality coming from a foreign country. The annual foreign migration-balance is negative and amounts to a net loss of 12,637 units. The migratory rate (calculated in relation to Italian residents with university degree of the same age) is -4.9 per 1,000, and is higher for men (-6) than for women (-4.1). Foreign migrations flows of young skilled residents are greater in southern Italy, where the rate is -6.6 per 1,000 and rises to -8 per 1,000 for men (Figure 10).

19 In particular, for the educational qualification variable. Improvements are being tested through integration of the master data source with information provided by the Integrated Registry System, which will also be able to make use of the results of the Permanent Population Census to be released in 2021.

20 In 2019, data on transfers of residence are affected by the new methods of detecting registry movement that are gradually being implemented through the national registry of the resident population - ANPR (art.62 Legislative Decree no. 82/2005). During 2019, the takeover of many Municipalities in ANPR has made it possible to simplify and speed up the exchange of information between registry offices. The increased timeliness is reflected in an increase in registrations of internal movements made during the year (+9% compared to 2018 for internal movements). Therefore, the 2019 results are comparable in sign but not in value to the historical series already disseminated for previous years. In addition, it should be noted that the indicator is disseminated as anticipatory data, as the resident population by age, citizenship and educational qualification surveyed at the population census is being validated.

**Figure 10. Net migration rate of Italian graduates (25-39 years) by origin/destination, gender and geographic area. Year 2019 (a). Values per 1,000 residents with the same characteristics**



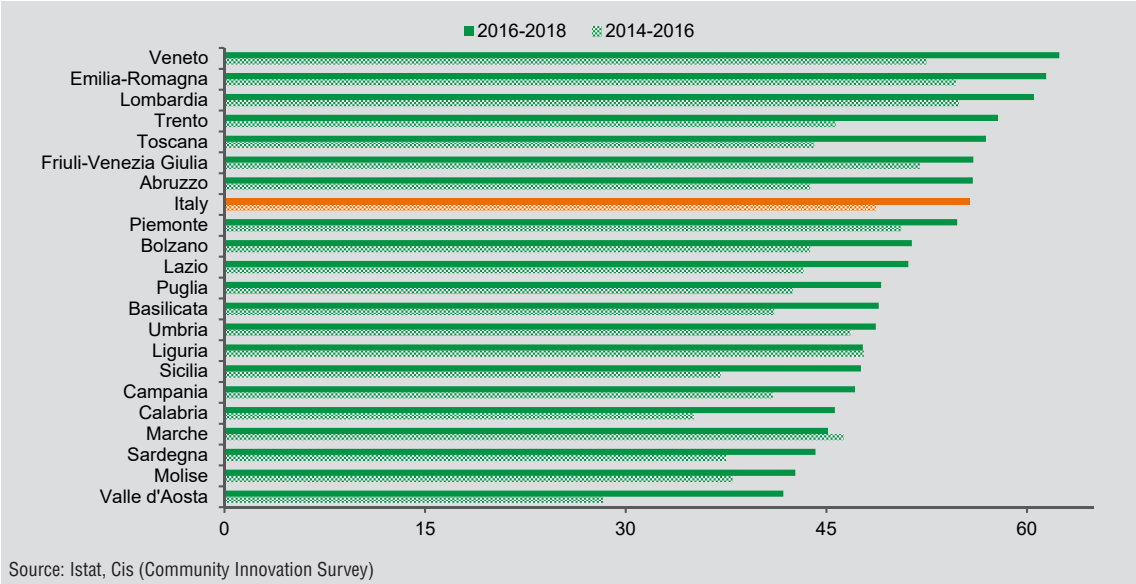

Source: Istat, Registrations and cancellations from the population registry for residence transfer and Base Register of Individuals
(a) Advance data.

The foreign balance is also negative in the North (-4.1) and in the Centre (-3.8), where, however, it is fully compensated by internal migrations, which, on the other hand, accentuate the penalization of the South and Islands, the only geographic area of Italy that maintains a negative total balance (-33.5 per 1,000). The overall balance is essentially break-even in the Centre (+0.6 per 1,000) and largely positive for the North (+13.3 per 1,000), which confirms to be the most attractive area of the country, having acquired during 2019 about 16 thousand more young Italian graduates by transfer of residence.

## Growing propensity for innovation in small businesses and in southern Italy

In 2016-2018 in Italy, 55.7% of industrial and service companies with at least 10 employees carried out activities aimed at introducing product, process, organizational or marketing innovations (Figure 11). At a national level, the indicator increased by 7 percentage points compared with the previous three-year period, with the most significant gains in central and southern Italy (+7.8 percentage points and +7.9 percentage points, respectively). As a result, the gap between the North and the South narrows, falling from 12.8 percentage points in 2014-2016 to 11.3 percentage points in the latest three-year period. Companies in the North continue to show the highest innovation propensity for (59.4%), while in the South and Islands the indicator value is 48.1%. The three regions with the absolute highest levels are Veneto, Lombardia and Emilia-Romagna, which exceed 60%, while Valle d'Aosta, Molise and Sardegna do not reach 45%. The improvement concerns all regions, with varying degrees of intensity, with the only exception of Marche, that register a significant contraction (-1.2 percentage points; 45.1%) and falls back several positions from the previous three-year period. The most significant progresses are in Toscana (+12.8 percentage points; 56.9%) and Abruzzo (+12.2 percentage points; 56%), the only two regions in central and southern Italy that – for the first time – exceeded the national average.

**Figure 11. Enterprises with 10 or more persons employed with innovative activities by region. Years 2014-2016 and 2016-2018. Values per 100 enterprises with at least 10 employees**




Source: Istat, Cis (Community Innovation Survey)

The differences among regions outlined by the indicator also reflect the sectoral and dimensional features of the local economies. In fact, the innovation rate grows as company size increases and it varies across the sectors of economic activity: it reaches its absolute minimum in construction (34.9%), while in industry it is higher (65.7%), reaching 90.3% in large industrial enterprises. Regardless of the sectors of economic activity, in 2016-2018 the share of innovative companies varies between 53.3% of the 10-49 employees' class and 81% of the 250+ employees' class. However, there is a reduction in these differences as well, thanks to the lively dynamics shown by small innovative companies, that in 2016-2018 express an above-average growth (+7.6 percentage points), compared to the more moderate trend of medium-sized companies (+3.1 percentage points) and to the substantial stability recorded for large companies. The greatest advances are made by small businesses in industry (+9.4 percentage points; 62.6%) and services (+7 percentage points; 49.5%).

## Weak growth in investments in intangible capital and R&D. Italy remains far from Europe

According to national accounts estimates, in 2019 in Italy investment in intellectual property products (IPR), which includes research and development (R&D), software, mineral exploration and evaluation, and originals of artistic, literary or entertainment works, amounted to 55 billion euros[21].Compared to the previous year, R&D investment remains at a similar share both to total investment (17.1%) and to GDP (3.1%). Set to 100 the 2007 value (42.8 billion euros), the index in 2019 reaches 128.6 and gains 1.3 points compared to 2018 (127.3). In the last year, therefore, the growth of investment in IPR has a new slowdown (between 2017 and 2018 the same index gained 3.6 points) and Italy moves further away from both the average of the 28 European countries and the average of the

21 Chained values with base year 2015.

19 countries of the Euro Area, where the dynamics were decidedly livelier. In the Union, investment in IPR grew by 13.2% compared to 2018 (+1.1% in Italy), and in 2019 is 21.6% of total investment and 4.6% of GDP. In the Eurozone, the same ratios are worth 22.4% and 4.9%, respectively, against a growth in IPR investment of 16.4%.

The 2018 results of the research and development (R&D) survey confirm the Italian weakness in investments in intangible capital, also highlighted by the European comparison.

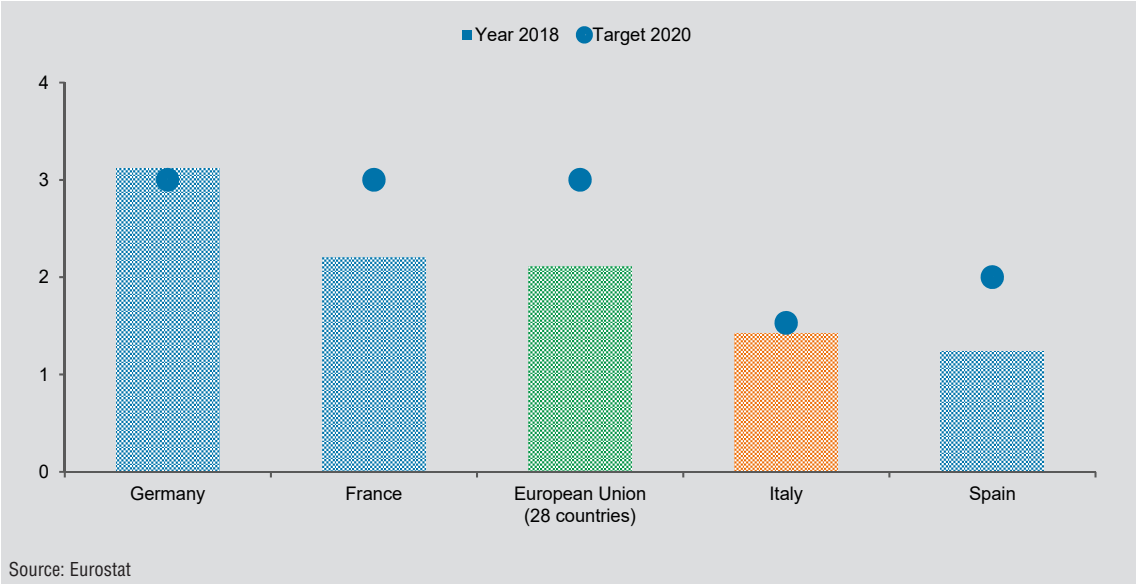
The expenditure incurred in 2018 by the Italian Public Administration, Universities, Businesses and Non-Profit Institutions to carry out research and development activities with their own personnel and with their own equipment (so-called intra muros R&D activities) amounts to a total of 25.2 billion current euros, 1.4 more than in 2017. Compared to 2017, research intensity, measured as the percentage ratio of R&D expenditure to GDP, is stable at 1.42%, (+0.05 percentage points). Regional heterogeneity remains high, with Piemonte and Emilia-Romagna placed above 2%, and close to the European average, and Calabria and Valle d'Aosta lagging around 0.5% of regional GDP.

Instead, the increases recorded in the South are even more modest, and thus southern regions accentuate their distance from the rest of the country. The average of the southern area in 2018 stops at 0.93% of GDP, 0.64 percentage points below the levels of the North and Centre.

Regional differences also reflect the different weight of institutional sectors of expenditure. Considering the destination of resources, the growth of R&D spending between 2017 and 2018 was strongly concentrated on private companies, which recorded an increase of 1.09 billion euros compared to 2017 (76.0% of the total increase). In 2018, total R&D spending by businesses accounted for 63.1% of the total, compared to 22.8% by public and private universities and 12.5% by public institutions. However, R&D spending by public institutions increased in the last year (+0.2 billion, +7.1%) more than that of universities (+0.14 billion euros, +2.6%), while the nonprofit sector contracted. For almost two-thirds, the highest R&D spending in 2018 was concentrated in the North (+0.92 billion euros; 64% of the total increase), and for more than half in the private business sector in the same area of the country (+0.75 billion euros). The share of the latter in total R&D expenditure is 46.1% in 2018.

Research intensity in Italy is still well below the average of the 28 EU countries (2.11%) and far from the "Europe 2020" target set at national level (1.53%), which, however, in 2018 was reached by the North and the Centre. The national position in the European context has not changed substantially (Figure 12): the distances from Germany – which has more than double levels (3.12%) – and France (2.2%) remain large, and the advantage over Spain (1.24%) is contained. If looking at the labour input, Italy's position is less disadvantaged. The share of R&D employment on the total (estimated in full-time equivalent units) is 1.53% in 2018 against the EU28 average of 1.48%, and the distances from Germany (1.74%) and France (1.70%) are smaller.

**Figure 12. Intramural R&D expenditure (GERD) in Italy and in other European countries and Europe 2020 target. Year 2018. Percentage of GDP**




Source: Eurostat

# Indicators

1. **R&D intensity:** Percentage of expenditure for intramural research and development activities performed by business enterprise, government, higher education (public and private) and non-profit sector on GDP. Expenditure and GDP are considered in current prices, million euro.
   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 2015 (millions of euro), Indexed 2007 = 100.
   Source: Istat, National Accounts.
6. **Cultural employment (% of total employment):** Percentage of employees in cultural and creative professions or sectors of activity (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 population registry for residence transfer and Base Register of Individuals.
8. **Regular Internet users:** Percentage of individuals aged 11 and over who used the Internet at least once a week in the 3 months prior to the interview.
   Source: Istat, Survey on the use of ICT in the Households and by individuals.
9. **Availability of at least one computer and Internet connection in the household:** Percentage of households with Internet connection and at least one personal computer (including desktop computers, laptops, notebooks, tablets; excluding smartphones, PDAs with phone functions, e-book readers and game consoles).
   Source: Istat, Survey on the use of ICT in the Households and by individuals.
10. **Municipalities with online services for families:** Percentage of Municipalities that provide online at least one service for families or individuals at a level that allows the electronic start and conclusion of the entire process (including any online payment).
    Source: Istat, Survey on information and communication technology in public administrations.
11. **Enterprises with at least 10 persons employed with web sales to end customers:** Percentage of enterprises with 10 or more persons employed that during the previous year sold via web to end customers (B2C).
    Source: Istat, Survey on information and communication technology in enterprises.
12. **Employed persons with basic or above basic overall digital skills (20-64 years):** Percentage of employed people (aged 20-64) who have at least basic digital competences in all the four specific areas (information, communication, problem solving, and software competences) identified by the "digital competence framework". For each area, a number of activities related to the use of the Internet or software (from 4 to 7) were selected and, depending on the number of activities carried out, a rating is attributed to the area, ranging from 0= no competence, 1= basic level, 2= above basic level.
    Source: Istat, Survey on the use of ICT in the Households and by individuals.

## Indicators by region and geographic area

| REGIONS AND GEOGRAPHIC AREAS | R&D intensity (a) 2018 | Patent propensity (b) 2016 | Impact of knowledge workers on employment (c) 2020-22 | Innovation rate of the national productive system (d) 2018 | Intellectual property products (e) 2019 | Cultural employment (c) 2019 |
|---|---|---|---|---|---|---|
| Piemonte | 2.17 | 112.0 | 16.9 | 54.8 | .... | 3.8 |
| Valle d'Aosta/Vallée d'Aoste | 0.49 | 39.3 | 15.2 | 41.8 | .... | 4.0 |
| Liguria | 1.36 | 61.4 | 21.4 | 47.7 | .... | 3.4 |
| Lombardia | 1.32 | 132.5 | 18.7 | 60.5 | .... | 4.1 |
| Trentino-Alto Adige/Südtirol | 1.15 | 107.8 | 16.9 | 54.1 | .... | 3.7 |
| *Bolzano/Bozen* | *0.83* | *84.5* | *14.0* | *51.4* | .... | *3.1* |
| *Trento* | *1.54* | *130.4* | *20.0* | *57.8* | .... | *4.3* |
| Veneto | 1.39 | 122.3 | 16.2 | 62.4 | .... | 3.6 |
| Friuli-Venezia Giulia | 1.65 | 148.5 | 18.2 | 56.0 | .... | 3.6 |
| Emilia-Romagna | 2.03 | 196.1 | 20.3 | 61.4 | .... | 3.2 |
| Toscana | 1.55 | 98.9 | 17.0 | 56.9 | .... | 4.4 |
| Umbria | 1.01 | 42.8 | 17.3 | 48.7 | .... | 3.3 |
| Marche | 1.09 | 79.1 | 16.9 | 45.1 | .... | 3.2 |
| Lazio | 1.74 | 33.9 | 23.6 | 51.1 | .... | 5.1 |
| Abruzzo | 0.94 | 37.6 | 18.3 | 56.0 | .... | 3.2 |
| Molise | 1.28 | 7.1 | 16.3 | 42.7 | .... | 3.1 |
| Campania | 1.29 | 14.1 | 18.4 | 47.1 | .... | 2.8 |
| Puglia | 0.79 | 12.7 | 16.6 | 49.1 | .... | 2.5 |
| Basilicata | 0.61 | 9.8 | 15.4 | 48.9 | .... | 2.5 |
| Calabria | 0.54 | 8.6 | 17.6 | 45.6 | .... | 2.3 |
| Sicilia | 0.83 | 8.2 | 17.3 | 47.6 | .... | 2.4 |
| Sardegna | 0.82 | 7.7 | 18.7 | 44.2 | .... | 2.9 |
| North | 1.57 | 132.9 | 18.3 | 59.4 | .... | 3.7 |
| Centre | 1.57 | 60.5 | 20.2 | 52.2 | .... | 4.5 |
| South and Islands | 0.93 | 12.6 | 17.6 | 48.1 | .... | 2.6 |
| **Italy** | **1.42** | **77.5** | **18.5** | **55.7** | **128.6** | **3.6** |

(a) Percentage of R&D expenditure on GDP.
(b) Per million of inhabitants.
(c) Per 100 in employment.
(d) Per 100 enterprises with at least 10 employees.
(e) Chain linked values, reference year 2015 (million Euro), index-linked 2007=100.

| Brain circulation (italians, 25-39 year-olds) (f) 2019 (*) | Regular Internet users (g) 2020 (**) | Availability of at least one computer and Internet connection in the household (h) 2020 (**) | Municipalities with online services for families (i) 2018 | Enterprises with web sales to end customers (c) 2020 | Employed persons with basic or above basic overall digital skills (20-64 years) (l) 2019 |
|---|---|---|---|---|---|
| .... | 70.3 | 65.7 | 15.0 | 7.9 | 54.4 |
| .... | 68.7 | 67.4 | 21.6 | 20.2 | 58.1 |
| .... | 69.4 | 64.4 | 13.2 | 17.6 | 56.0 |
| .... | 72.4 | 70.7 | 41.3 | 8.6 | 58.5 |
| .... | 75.6 | 74.1 | 17.1 | 27.8 | 57.4 |
| .... | *78.2* | *73.5* | *22.4* | *33.0* | *56.5* |
| .... | *73.0* | *74.7* | *13.6* | *20.3* | *58.3* |
| .... | 72.5 | 70.5 | 43.4 | 11.7 | 53.6 |
| .... | 71.1 | 74.0 | 20.0 | 9.9 | 58.3 |
| .... | 74.5 | 71.1 | 45.6 | 9.5 | 56.0 |
| .... | 72.1 | 69.2 | 39.1 | 15.8 | 55.3 |
| .... | 69.7 | 63.6 | 28.3 | 9.8 | 52.1 |
| .... | 66.8 | 67.4 | 17.5 | 7.8 | 50.5 |
| .... | 73.7 | 73.4 | 20.9 | 10.0 | 53.0 |
| .... | 66.1 | 65.2 | 12.5 | 17.4 | 50.6 |
| .... | 63.6 | 61.9 | 5.9 | 7.5 | 51.3 |
| .... | 64.3 | 62.0 | 18.5 | 13.8 | 45.1 |
| .... | 61.9 | 59.8 | 25.2 | 9.9 | 44.7 |
| .... | 60.7 | 53.3 | 15.3 | 12.5 | 44.4 |
| .... | 61.0 | 53.4 | 8.7 | 19.9 | 44.8 |
| .... | 63.0 | 55.4 | 12.3 | 16.1 | 44.5 |
| .... | 66.9 | 66.5 | 21.8 | 12.1 | 50.3 |
| 13.3 | 72.3 | 69.8 | 30.4 | 10.6 | 56.4 |
| 0.6 | 72.0 | 70.7 | 25.9 | 11.8 | 53.3 |
| -33.5 | 63.4 | 59.5 | 15.6 | 13.8 | 45.8 |
| **-4.9** | **69.2** | **66.7** | **25.1** | **11.5** | **52.9** |

(f) Per 1,000 inhabitants aged 25-39 with tertiary education (bachelor's degrees, AFAM, PhD).
(g) Per 100 persons aged 11 and over.
(h) Per 100 households.
(i) Per 100 Municipalities.
(l) Per 100 employed aged 20-64.
(*) Advance data.
(**) Provisional data.