

Tema Económico

89

Outubro de 2021



Digitalisation, Skills and Cybersecurity in Portugal – Critical Factors in a Digital Economy driven by Covid-19

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Digitalisation, Skills and Cybersecurity in Portugal – Critical Factors in a Digital Economy driven by Covid-19^{† ‡}

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Abstract

The evolution of information and communication technologies and the transition to an increasingly digital society have made progress in recent years but had a particularly relevant boost due to the Covid-19 pandemic. The rapid digital transition that has taken place since then has allowed stakeholders, both public and private, to quickly find solutions to many of the challenges, for example in terms of improving the digital tools that have enabled telework and learning. In this context, the Covid-19 pandemic strongly boosted the digital transformation.

This Economic Theme is published following the papers on “The Economics of Cybersecurity” and “Cybersecurity in Portugal” and seeks to provide an assessment of the digital area in Portugal, considering the different stakeholders (families/citizens, enterprises and the state/public administration) and key themes in discussion in this area (digital adoption, e-commerce, innovation, artificial intelligence, cybersecurity and skills), benchmarking with other countries. Additionally, although there is still little information available, the study includes data on the impact of the Covid-19 pandemic in the digital area.

Considering the current situation in Portugal and the importance of digitalisation for the growth of the economy, the document points to five main challenges that the country faces on the path to the digital transformation of the economy and society: (i) adequate digital skills and literacy, (ii) combat to digital inequality/gap (regarding geography, gender, age, level of literacy or income), (iii) future of telework, (iv) cybersecurity and privacy, and (v) investment in innovation and in research and development.

The document also highlights the main public policy measures to address digital transition challenges and the need to ensure an efficient use of European funds, in particular concerning the Recovery and Resilience Plan. The Recovery and Resilience Plan is transversal and is associated with other main programs such as the Multiannual Framework Programme 2021-27 (including Portugal 2030), the action plan of the European Pillar of Social Rights and the strategy included on the Digital Decade.

Note: This article is sole responsibility of the author and do not necessarily reflect the positions of the Office for Strategy and Studies (GEE) or the Portuguese Ministry of Economy and Digital Transition.

[†] The author is thankful to Joana Almodovar and Rita Bessone Basto for the valuable comments and suggestions. Responsibility for any errors and omissions lies solely with the author.

[‡] Data collection was completed in March 2021 (with some exceptions, for example, in the context of public policies).

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Gabriel Osório de Barros ††

Resumo

A evolução das tecnologias de informação e comunicação e a transição para uma sociedade cada vez mais digital registaram progressos nos últimos anos, mas tiveram um impulso particularmente relevante devido à pandemia da Covid-19. A rápida transição digital que ocorreu desde então permitiu que os atores, públicos e privados, encontrassem rapidamente soluções para muitos dos desafios, por exemplo, em termos de melhoria das ferramentas digitais que possibilitaram o trabalho e a aprendizagem remotos. Nesse contexto, a pandemia Covid-19 impulsionou fortemente a transformação digital.

Este Tema Económico é publicado na sequência dos anteriores sobre “A Economia da Cibersegurança” e a “Cibersegurança em Portugal” e procura fazer uma avaliação da área digital em Portugal, tendo em conta os diferentes atores (famílias/cidadãos, empresas e Estado/administração pública) e os principais temas em discussão nesta área (adoção digital, comércio eletrónico, inovação, inteligência artificial, cibersegurança e qualificações), comparando as informações, quando possível, com outros países. Além disso, embora ainda haja pouca informação disponível, o estudo inclui dados sobre o impacto da pandemia da Covid-19 na área digital.

Considerando a situação atual de Portugal e a importância da digitalização para o crescimento da economia, o documento aponta 5 principais desafios que o país enfrenta no caminho da transformação digital da economia e da sociedade: (i) competências e literacia digitais adequadas, (ii) combate à desigualdade digital (quanto à geografia, sexo, idade, nível de literacia ou rendimento), (iii) futuro do teletrabalho, (iv) cibersegurança e privacidade, e (v) investimento em inovação e em investigação e desenvolvimento.

O documento também destaca a necessidade de garantir uma utilização eficiente dos fundos europeus, em particular do Plano de Recuperação e Resiliência. O Plano de Recuperação e Resiliência é transversal e está associado a outros programas principais como o Quadro Financeiro Plurianual 2021-27 (incluindo o Portugal 2030), o plano de ação do Pilar Europeu dos Direitos Sociais e a estratégia incluída na Década Digital.

Nota: Este estudo é da exclusiva responsabilidade do autor e não reflete necessariamente as posições do Gabinete de Estratégia e Estudos (GEE) do Ministério da Economia e Transição Digital.

** O autor agradece a Joana Almodovar e Rita Bessone Basto os valiosos comentários e sugestões. A responsabilidade por quaisquer erros e omissões é exclusivamente do autor.

†† A recolha de dados foi concluída em março de 2021 (com algumas exceções como, por exemplo, no âmbito das políticas públicas).

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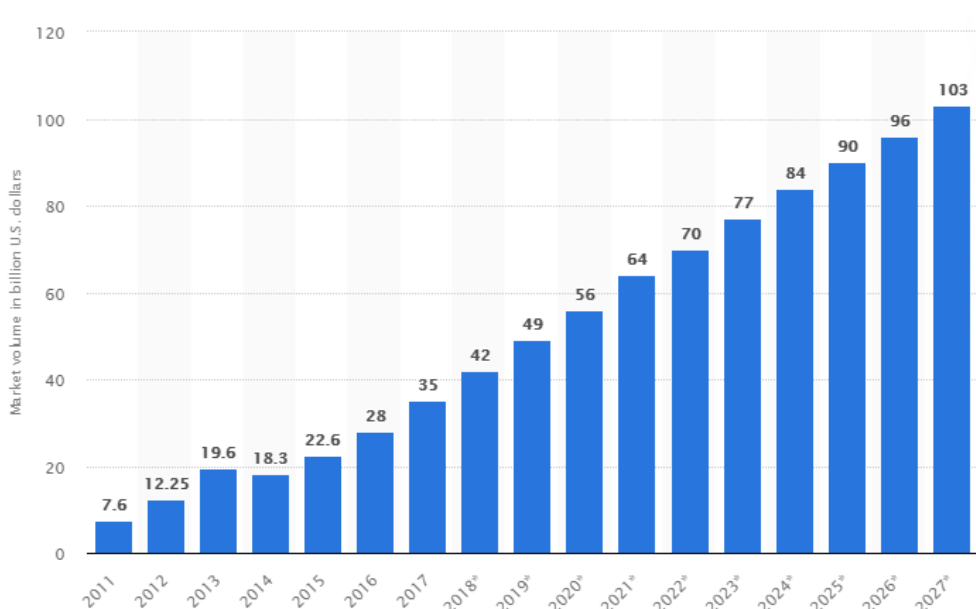
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1. Introduction

The digital revolution is a reality that has changed the world and is transforming social relations and business models in numerous ways. The evolution of information and communication technologies and the transition to an increasingly digital society have made progress in recent years but had a particularly relevant boost due to the Covid-19 pandemic.

An increasingly digital world influences all areas of life in society, from people's routines to enterprises, and implies massive processing of data, both personal and non-personal, which poses enormous challenges to organizations and governments.

Big Data market size revenue forecast worldwide from 2021 to 2027
(in billion U.S. dollars)



Source: Statista, 2020 (<https://www.statista.com/statistics/254266/global-big-data-market-forecast/>)

Although Digital Economy has great potential for the growth of the Economy and for the well-being of citizens, this new paradigm poses challenges that can have high economic impacts. If, on the one hand, it is increasingly important to guarantee the rapid digital transition of enterprises and society, on the other hand, this represents enormous challenges for people's lives and for information security and privacy.

It was within this framework that, in August 2018, GEE published two Economic Themes:

- Economic Theme No. 54, entitled "The Economics of Cybersecurity", presenting an overview of the economic theory associated to Cyberspace and, in particular, with Cybersecurity;
- Following the aforementioned study, Economic Theme No. 56, entitled "Cybersecurity in Portugal", presents an analysis of Portugal's position in the area of Cyberspace and the public policies implemented in terms of Cybersecurity, comparing the country with its main partners.

From March 2020 onwards, the Covid-19 pandemic posed major challenges in terms of public health and it was necessary to take confinement and social distancing measures that had high economic and social impacts. The rapid digital transition that has taken place since then has allowed stakeholders, both public and private, to quickly find solutions to many of the challenges, for example in terms of improving the digital tools that have enabled telework and learning. In this context, the Covid-19 pandemic strongly boosted the digital transformation.

This Economic Theme is published following the studies already mentioned and seeks to make an assessment of the digital area in Portugal, taking into account the different stakeholders (families/citizens, enterprises and the state/public administration) and the main themes in discussion on this area (digital adoption, e-commerce, innovation, artificial intelligence, cybersecurity and skills), comparing information, when possible, with other countries. Additionally, although there is still little information available, the study includes data on the impact of the Covid-19 pandemic in the digital area. Finally, the study presents the main strengths and weaknesses, as well as the main challenges that Portugal faces on the path to the digital transformation of the economy and society.

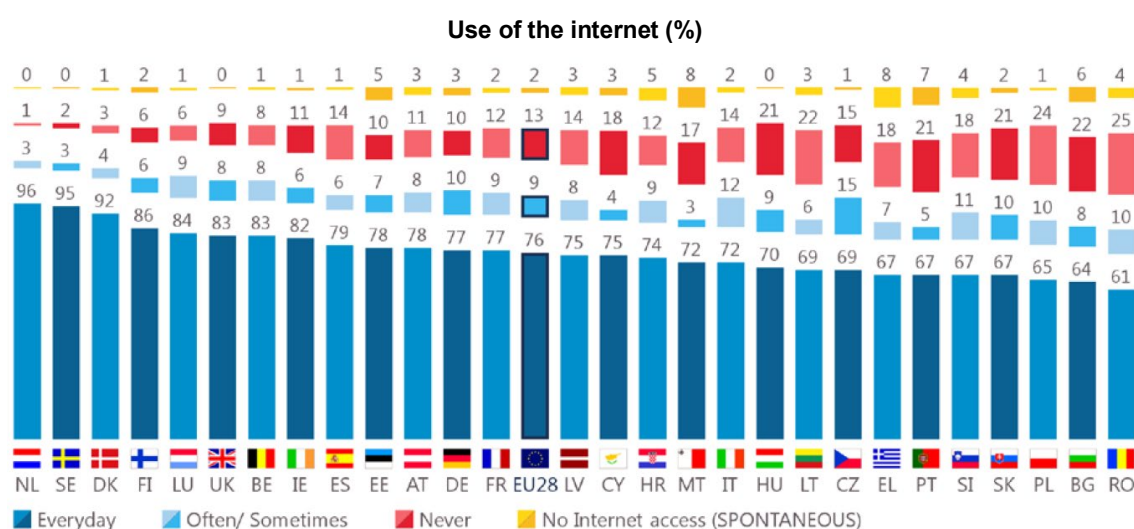
Among the sources used are:

- Eurostat (<https://ec.europa.eu/eurostat/web/digital-economy-and-society>) – provides information for internet access and security, social media use, e-commerce, digital skills, among other information;
- OECD (<https://www.oecd.org/digital/>) – provides information regarding Artificial intelligence, Broadband and telecom, Consumer policy, digital economy, digital government, among other information;
- We Are Social and Hootsuite – provides the latest insights on how people around the world use the internet, social media, mobile devices and ecommerce (<https://wearesocial.com/digital-2020> and <https://wearesocial.com/digital-2021>);
- GWI (formerly Global Web Index) - the target audience provides consumer insight across 47 countries (<https://www.globalwebindex.com/>);
- Statista – the online statistics database provides forecasts, detailed market insights and key indicators on 90 digital markets (<https://www.statista.com/>);
- GSMA Intelligence – a database of mobile operator statistics, forecasts and industry reports (<https://www.gsmainelligence.com>).

2. Digital adoption and Information and Communication Technologies

In January 2021, according to We Are Social and Hootsuite (2021), the world has approximately 7.8 thousands of millions of citizens, 56.4% of which live in urban areas. Mobile communications, internet as social media use have evolved significantly, with 5.22 thousands of millions (66.6%) of unique mobile phone users (more 1.8% than in January 2020), 4.66 thousands of millions (59.5%) of internet users (more 7.3% than in January 2020) and 4.20 thousands of millions (53.6%) of active social media users (more 13.2% than in January 2020).

Regarding the use of internet, at least occasionally, Portugal has one of the lowest values. In fact, only 67% of individuals use the internet every day, below the EU28 average (76%).

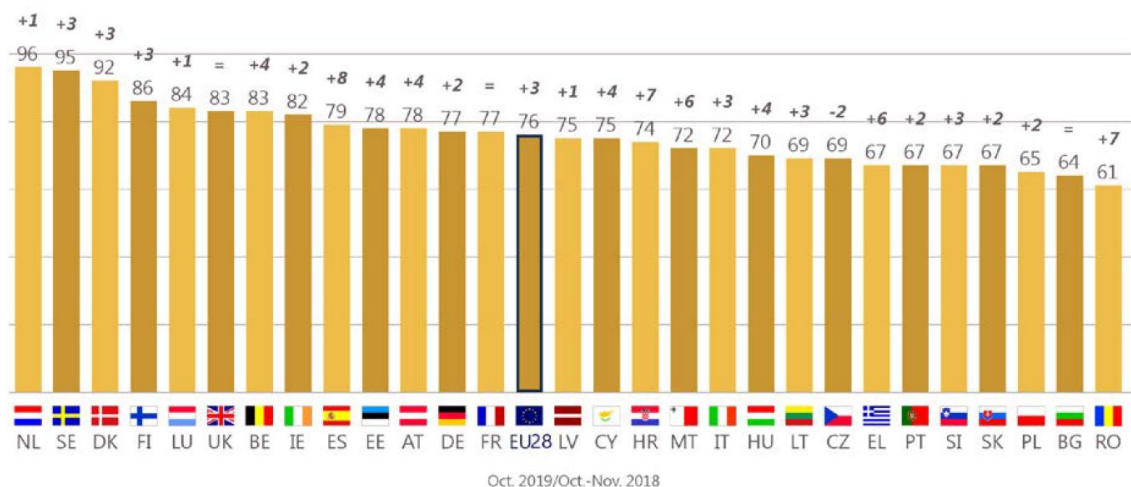


Base: all respondents (N=27,609)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In 2019, compared to 2018, respondents in Portugal are more likely to use the Internet every day but there is only a slight change (+2 p.p.).

Use of the internet - Everyday (%)

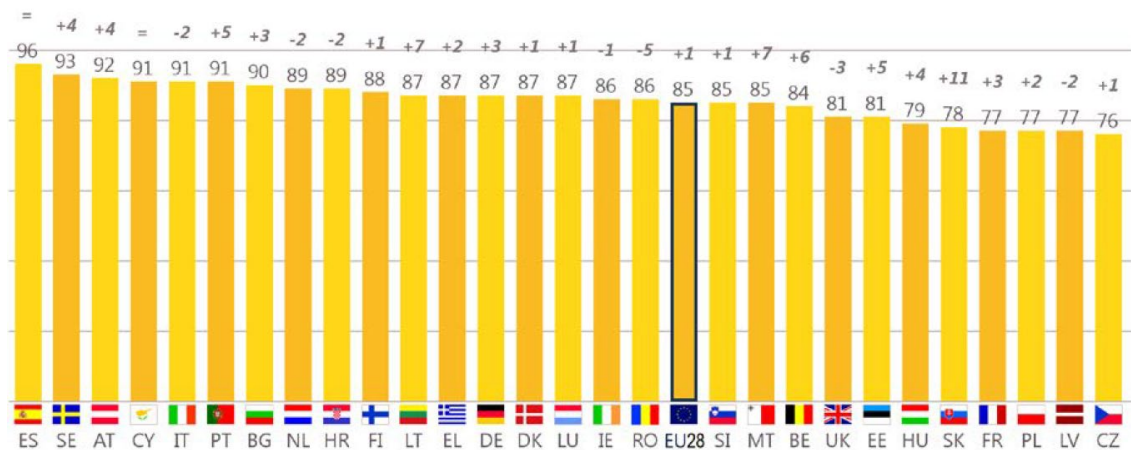


Base: all respondents (N=27,609)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

To access the internet, Portugal is one of the countries where the smartphones are more used, with a considerable growth from 2018 to 2019 (+5 p.p.).

Devices used to access internet – Smartphones (%)

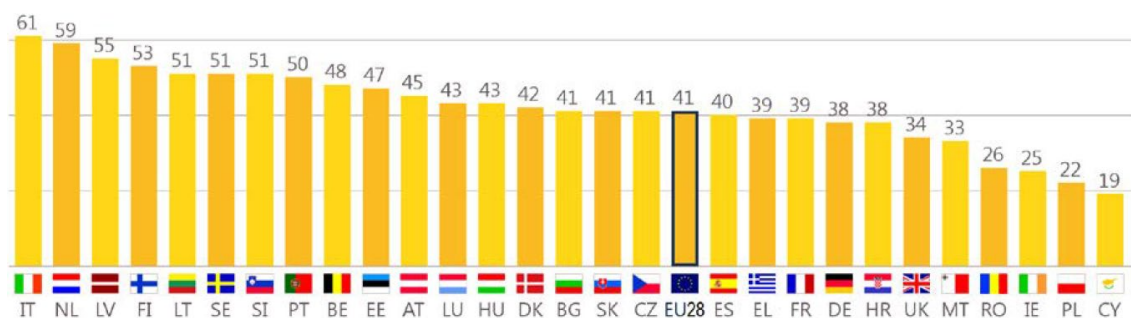


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Portugal is also one of the countries with a higher proportion of users who access the Internet via a home computer.

Devices used to access internet - Home computer
(%, any computer that is located and used only at home)

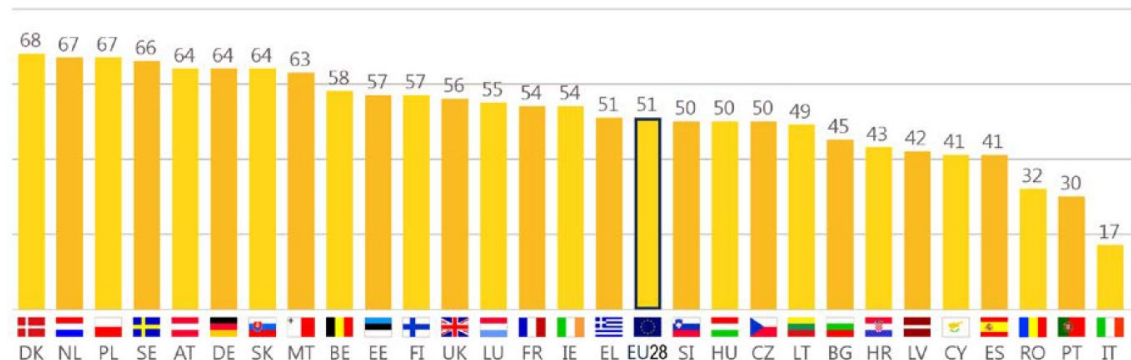


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In contrast, Portugal presents some of the lowest values in the use of internet in a laptop, a tablet or on the TV.

Devices used to access internet - Laptop (% , other than a home computer)



Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

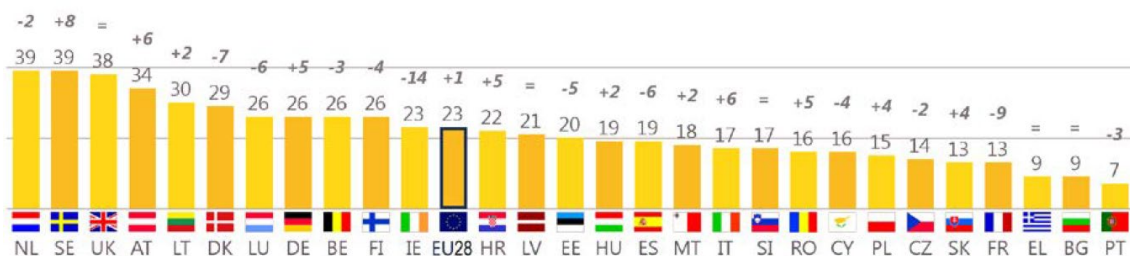
Devices used to access internet - Tablet (%)



Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Devices used to access internet - TV (%)

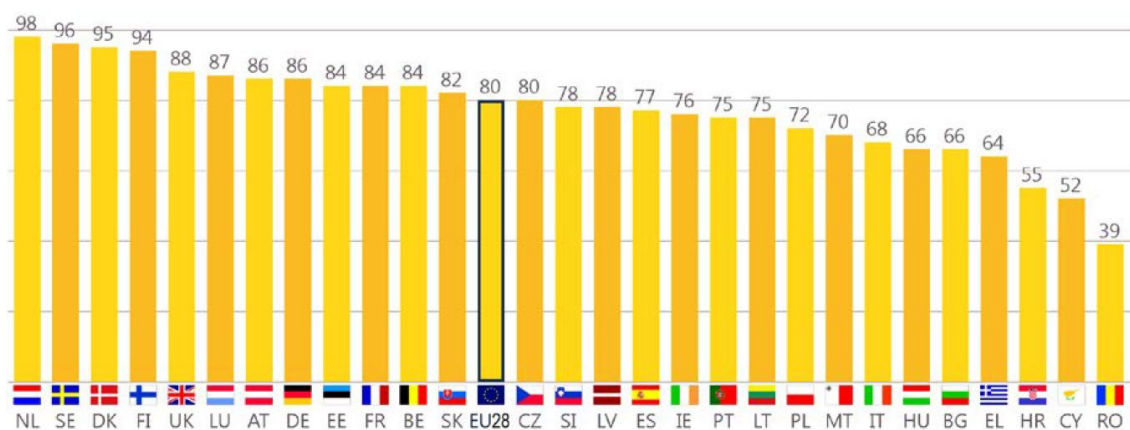


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In Portugal, 75% of respondents report having emailed in the past 12 months, under EU average (80%).

Activities done in the last 12 months - Email (%)

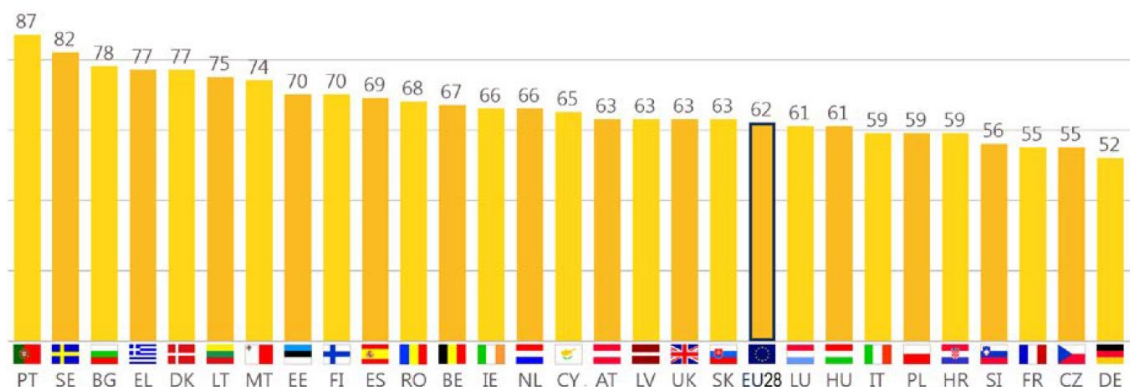


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In the past 12 months, about 87% of Portuguese respondents refer having used online social networks, placing the country at the top of the list.

Activities done in the last 12 months - Online social networks (%)

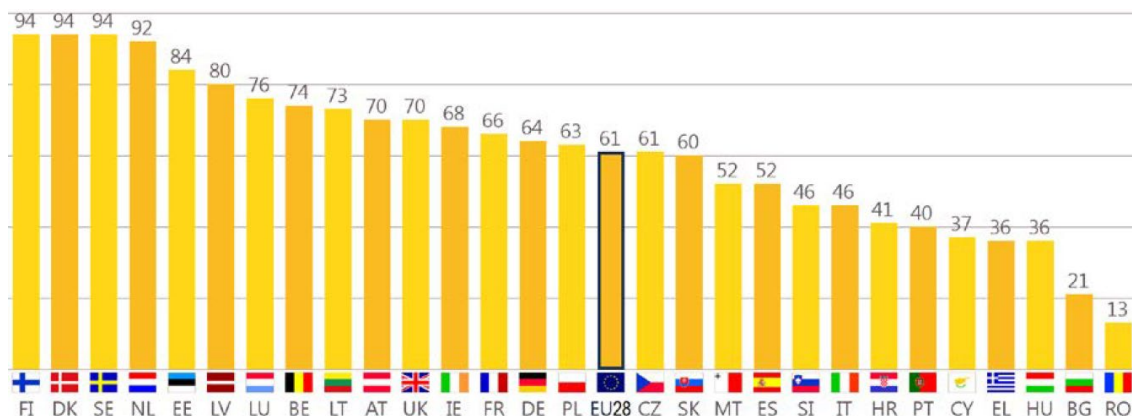


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In contrast, only 40% of Portuguese respondents referred having used online banking and only 36% referred having bought goods or services online, well under the EU28 Average (61% and 55%, respectively).

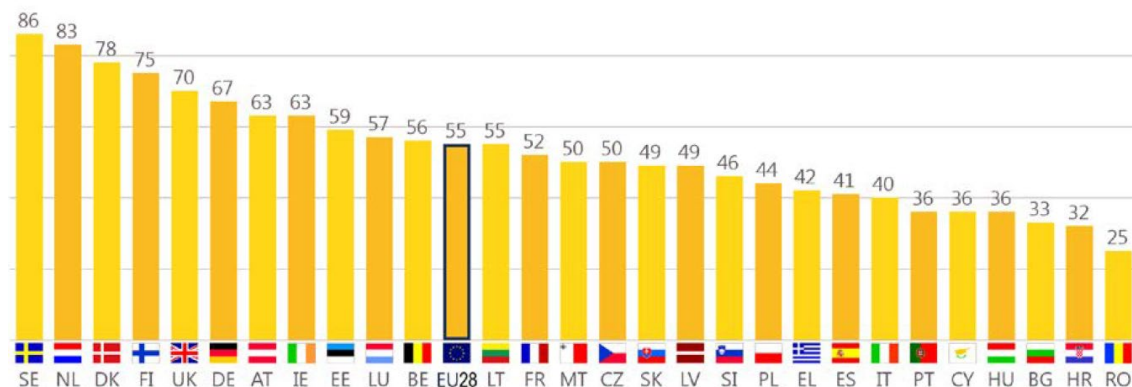
Activities done in the last 12 months - Online Banking (%)



Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Activities done in the last 12 months - Buying goods or services (%, e.g. concert tickets, train tickets)

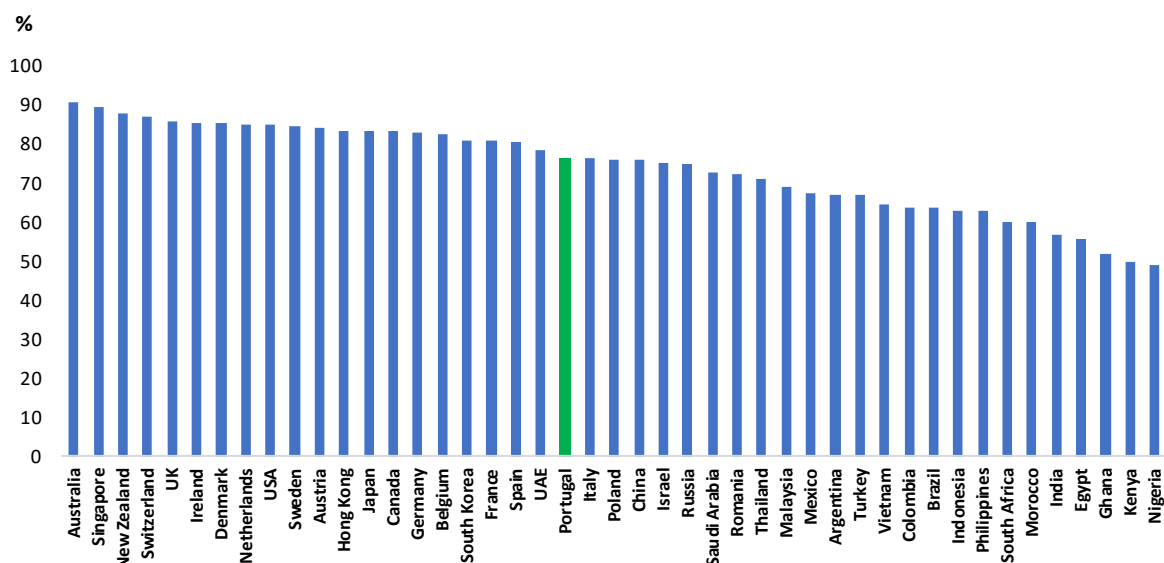


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Portugal is in the 21st position (with a score of 76.55 out of 100.00) among 45 countries regarding the mobile connectivity index, which measures countries' performance against key enablers of mobile internet adoption.

GSMA Intelligence's mobile connectivity index (Assessment of mobile connectivity drivers and enablers by country or territory)

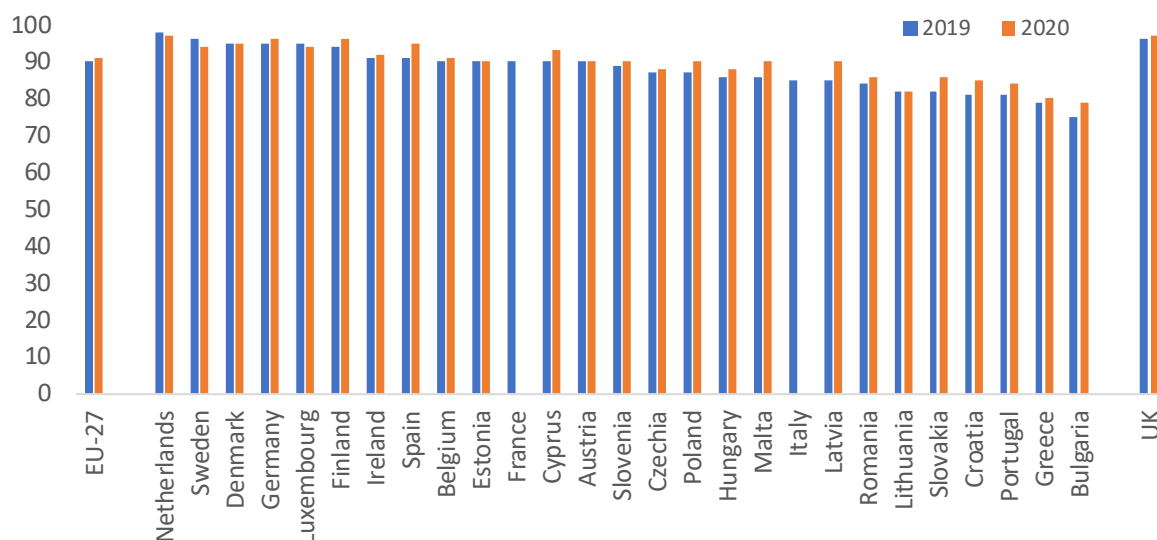


Notes: Scored within a range of 0 to 100 across a number of indicators, with a higher score representing higher performance in delivering mobile internet connectivity.

Source: Digital 2021 – GSMA Intelligence's Mobile Connectivity Index (accessed January 2021), We Are Social/Hootsuite, 2021

In Portugal, the percentage of households with internet access is one of the lowest among EU countries, although with a slight increase from 2019 to 2020 (81% to 84%) – information for the 1st quarter of reference years.

Households with internet access (Percentage of households)

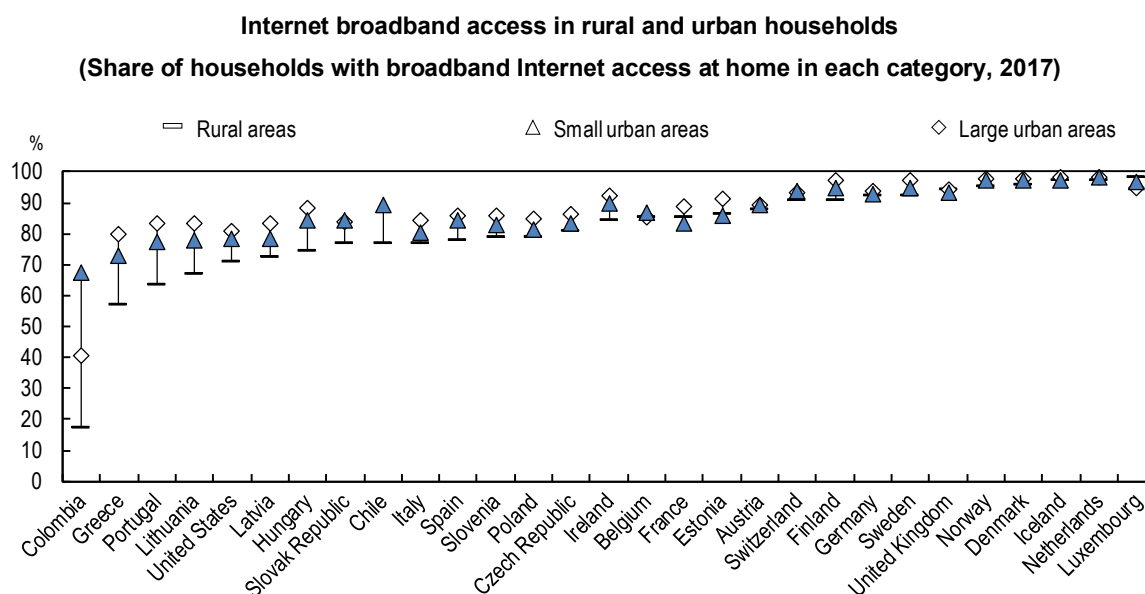


Note: data refers to the first quarter of the reference year.

Source: Broadband and connectivity – households, Eurostat, 2021 (isoc_bde15b_h)

In Portugal, as in most countries, remains a gap in the internet broadband access in rural areas and is 3rd country in OECD with a higher connectivity gap between households in rural areas and both small and large urban areas (20.1 and 14.2 percentage points, respectively).

It is important to reduce this gap, in particular to foster the effects of the Covid-19 pandemics, because digital inclusion is essential to promote economic and social equality.

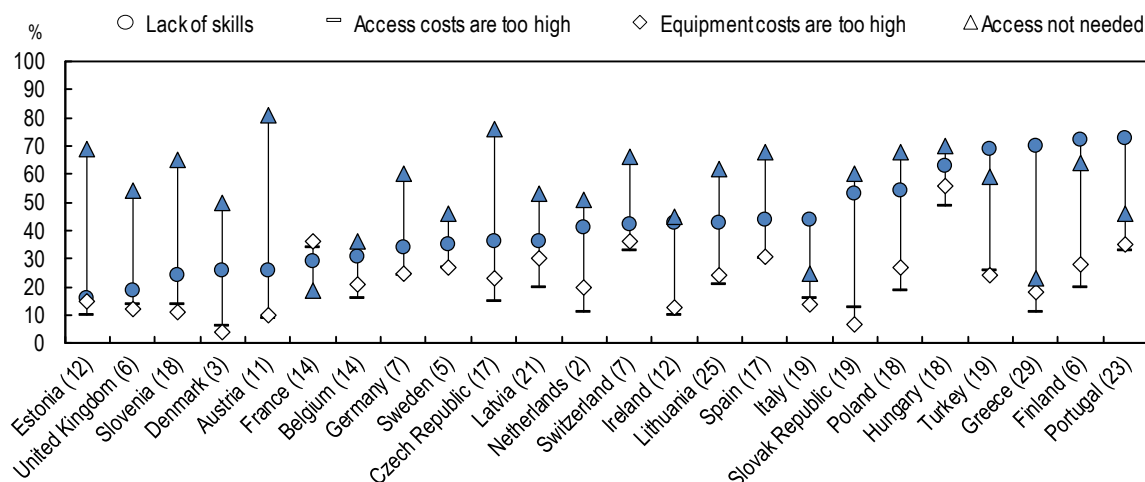


Source: OECD Skills Outlook 2019, OECD, 2019 ["OECD (2017), ICT Access and Usage by Households and Individuals
Database, <http://oe.cd/hhind>.]

The lack of skill/knowledge (not knowing how to use the internet or considering it too complicated) is the main reason referred to justify the absence of internet access in Portugal and the country is the one with more prevalence of this justification (73% of the households which compare to 43% of households among OECD countries with available data).

This is particularly relevant considering that, as referred previously, about one in seven households are not connected to the internet.

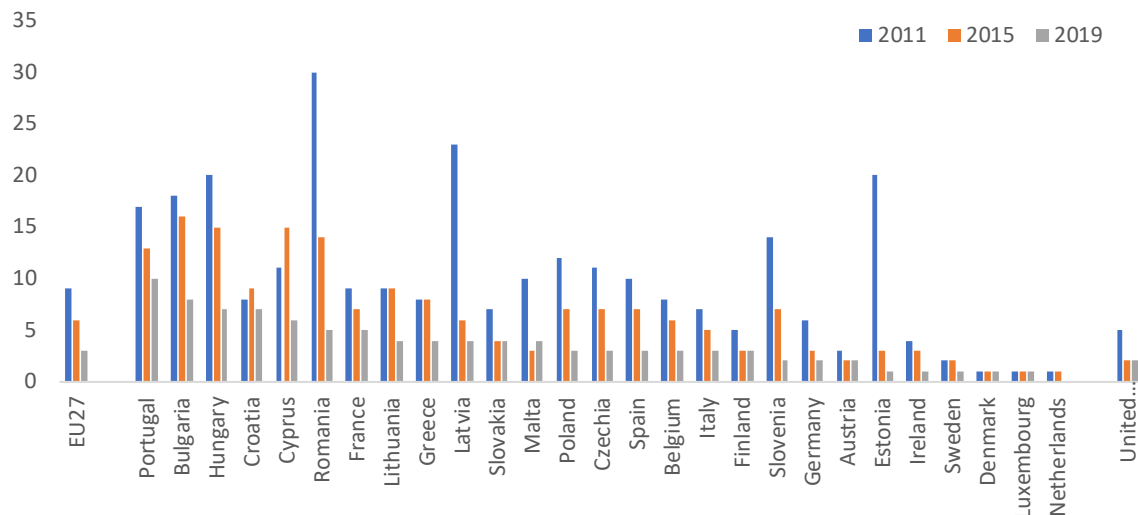
Reasons for not having Internet access at home (Share of households without Internet at home reporting a given reason for not having Internet access, 2017)



Source: OECD Skills Outlook 2019, OECD, 2019 [Eurostat (2017), European Community Survey on ICT Usage in Households and by Individuals.]

In 2019, Portugal was the country of the EU27 with a higher percentage of households without access to internet at home because the access and equipment costs are too high (10%), notwithstanding the positive evolution in recent years (17% in 2011 and 13% in 2015).

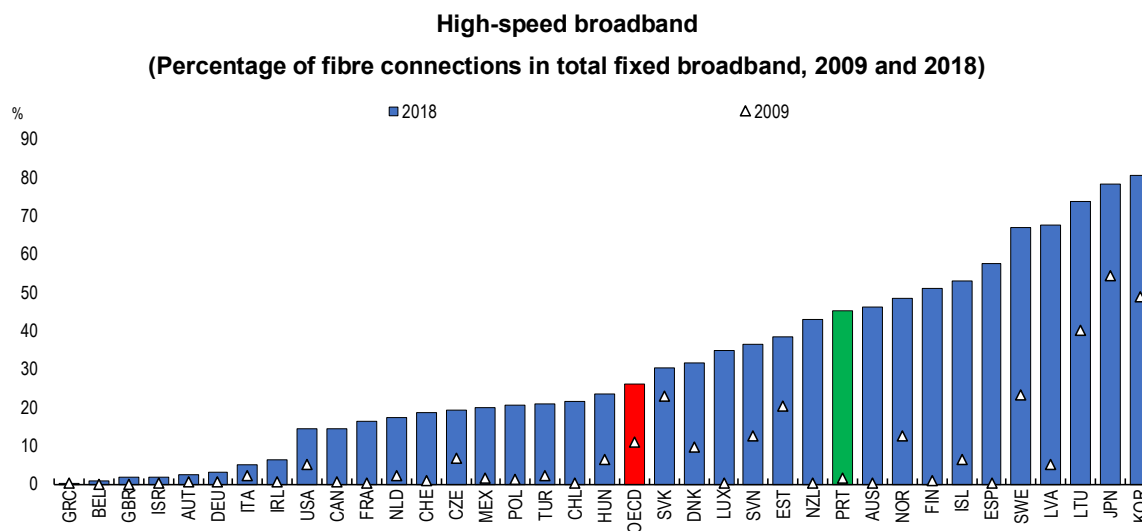
Households without access to internet at home, because the access and equipment costs are too high (Percentage of households, 2011, 2015 and 2019)



Source: Eurostat (ISOC_PIBI_RNI)

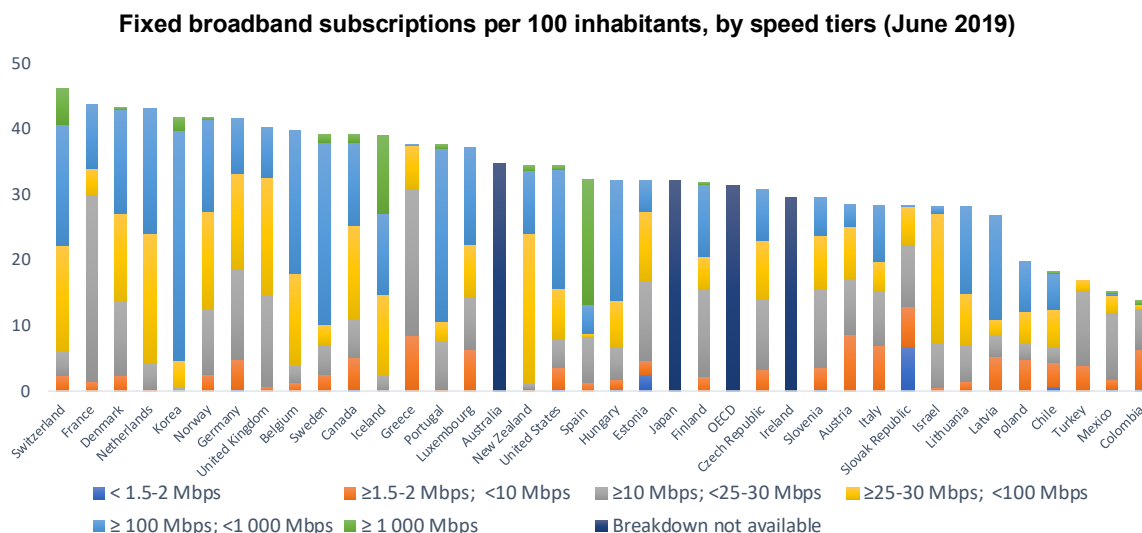
In contrast, Portugal has progressed significantly regarding both fixed and mobile broadband subscriptions.

The growing share of fibre in fixed broadband allows higher speeds for high bandwidth online. Portugal faced significant progresses on this subject, evolving from the 19th position in 2009 to the 11th position in 2018 (among 37 OECD countries), with an increase in the percentage of fibre connections in total fixed broadband of about 43.6 percentage points.



Source: OECD Broadband Database (<https://www.oecd.org/sti/broadband/broadband-statistics/>)

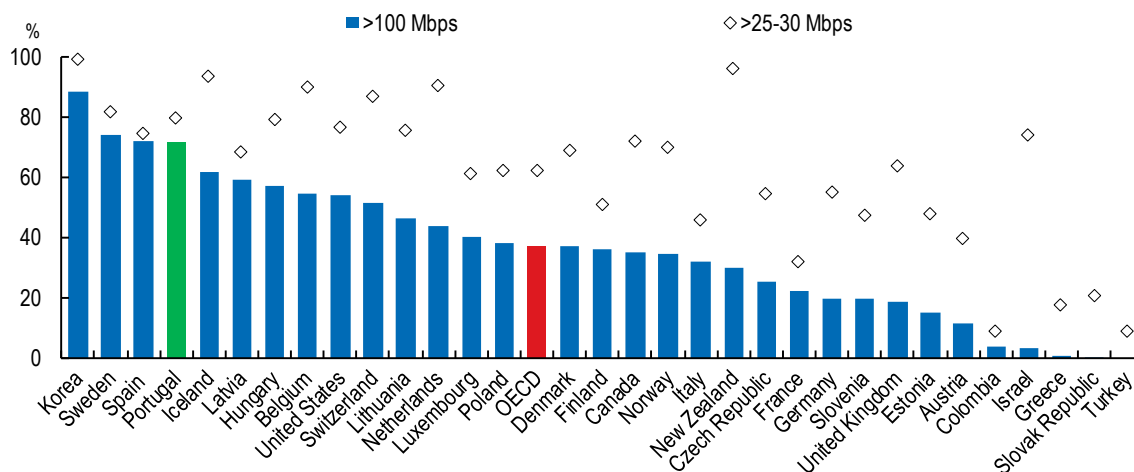
According to Ookla Speedtest Global Index, download speeds in the OECD area increased from 24.1 Mbps in April 2014 to 40.9 Mbps in July 2019. Portugal ranks 14th among the 37 OECD countries with information on this indicator, with about 70% of the connections with more than 100 Mbps of download speed (OECD average was about 37% in 2018).



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database), www.oecd.org/sti/broadband/oecd-broadband-portal.htm]

In the same way, considering only higher speeds, Portugal was on the 4th position among 32 OECD on fixed broadband subscriptions with contracted speeds higher than 100 Mbps.

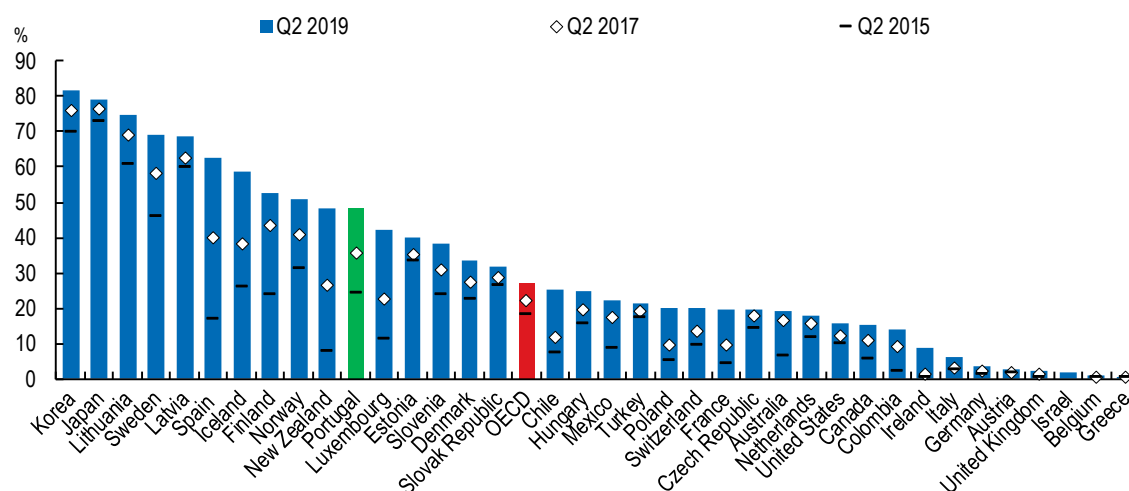
Fixed broadband subscriptions with contracted speed faster than 25/30 Mbps and 100 Mbps, 2018



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database), www.oecd.org/sti/broadband/oecd-broadband-portal.htm]

Fibre broadband connections in Portugal grew significantly in the last years and the country is above de OECD, although it lost one position (10th position in Q2 2015 and Q2 2017; 11th position in Q2 2019).

Fibre broadband connections (As a percentage of total fixed broadband subscriptions, June 2019)

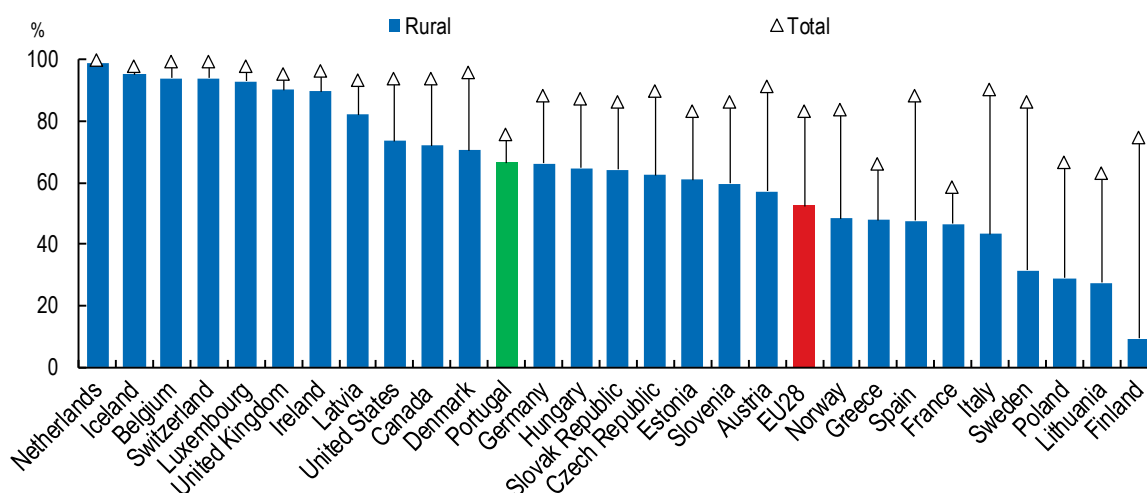


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database), www.oecd.org/sti/broadband/oecd-broadband-portal.htm]

There is also a gap between rural and urban areas regarding households with minimum 30 Mbps of fixed broadband coverage. For Portugal, the difference is 66.6% of access to this minimum speed in rural areas,

against 75.6% in total. Although Portugal registers a lower percentage of households in this situation comparing to the EU28 average (75.6% vs 83.2%), the country has a higher percentage in rural areas (66.6% vs 52.3%).

**Households with minimum 30 Mbps of fixed broadband coverage
(As a percentage of all households in total and rural areas, 2018)**

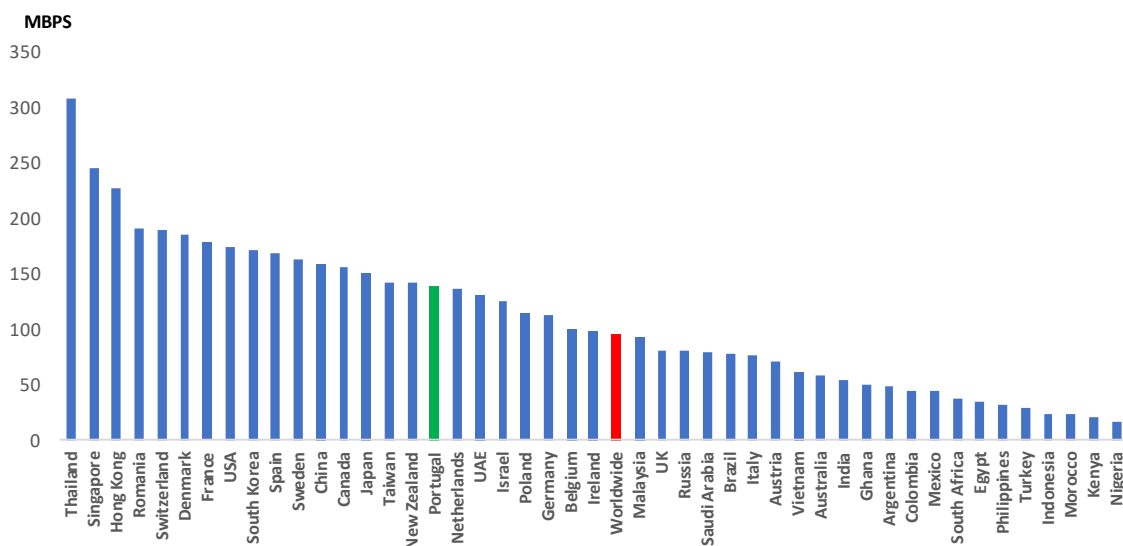


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on CRTC (2019), Communications Monitoring Report 2019 (Canada), European Commission (2019), Study on Broadband Coverage in Europe 2018 (European Union) and FCC (2019), 2019 Broadband Deployment Report (United States).]

Fibre is important not only for fixed broadband, but also to permit mobile networks, such as 5G deployment that depend significantly on a strong fibre infrastructure to provide capacity for increasing data traffic in the global network infrastructure (increased in bandwidth, more connected devices, network coverage, among other goals).

For a broader set of countries and with more recent information including the pandemic period, Portugal stands above on the average fixed internet connection speed.

Average fixed internet connection speed (Average download speed of fixed internet connections, in MegaBits Per Second (MBPS))

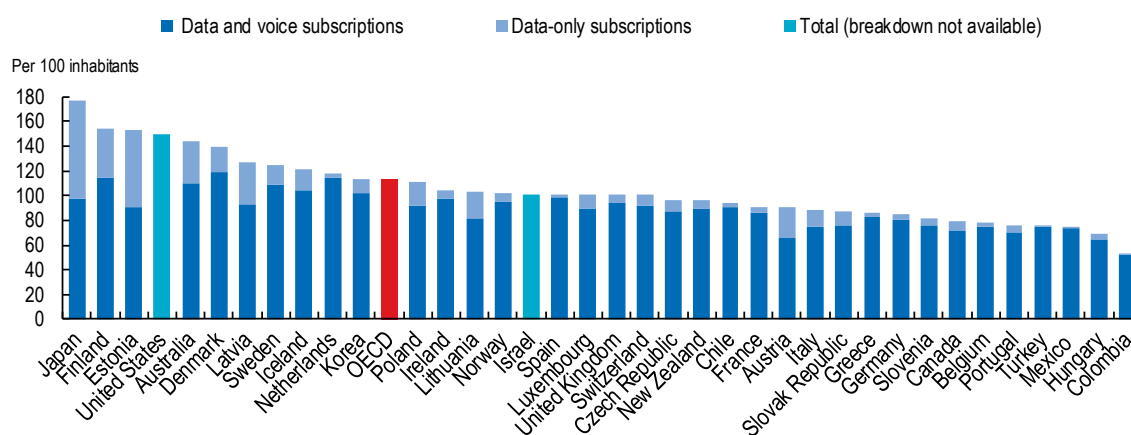


Note: Figures represent average download speeds for fixed internet connections in December 2020.

Source: Digital 2021 – Ookla (January 2021), We Are Social/Hootsuite, 2021

The mobile broadband subscriptions per 100 inhabitants is an area to improve as Portugal is in one of the lowest positions among OECD countries on this subject (33rd position among 37 OECD countries). It is important to emphasize that mobile broadband is important to fill connectivity gaps due to low levels of fixed broadband infrastructure.

Mobile broadband subscriptions (per 100 inhabitants, June 2019)

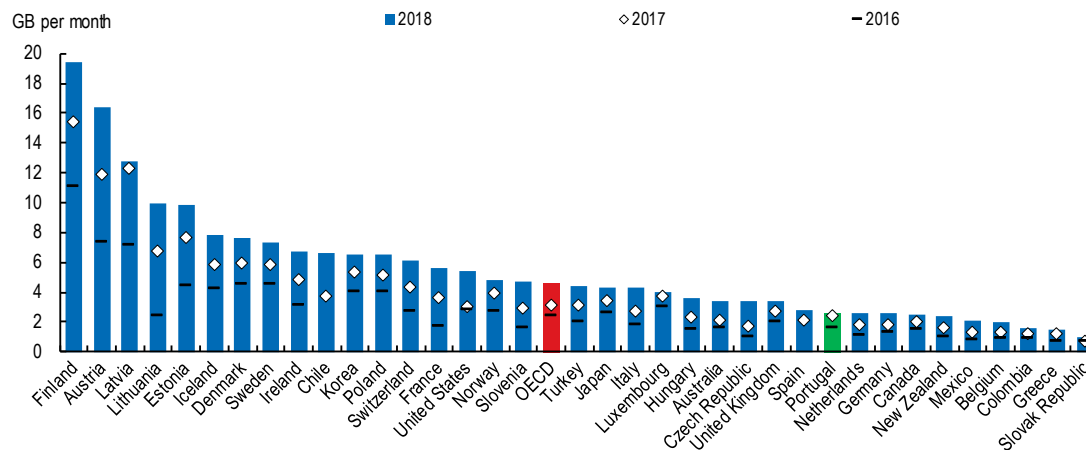


Source: Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database),

www.oecd.org/sti/broadband/oecd-broadband-portal.htm]

Similarly, mobile data usage per mobile broadband subscription in Portugal is lower than OECD average, although the significative evolution due to growing demand for mobile which became even more important for living and working during Covid-19 pandemic.

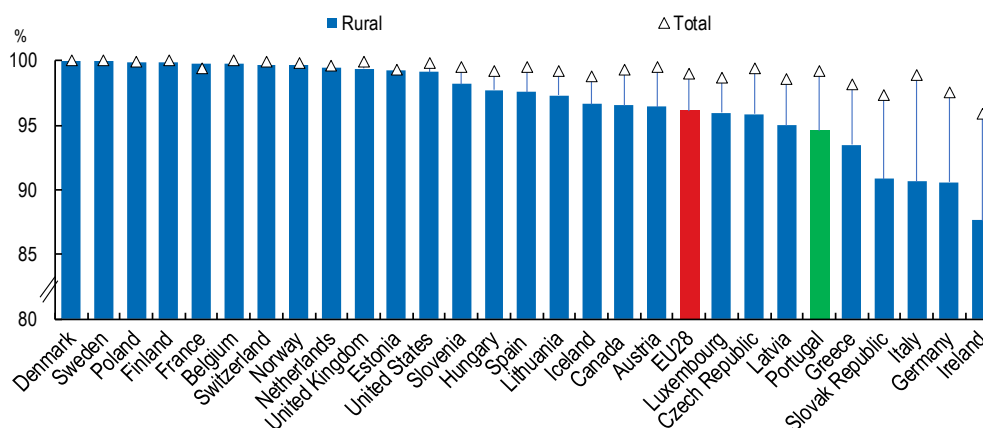
Mobile data usage per mobile broadband subscription (GB per month, 2016-18)



Source: Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm.]

The availability of 4G/LTE mobile services in the rural areas of the European Union reached 96.1% of the households in 2018. Portugal has 99.2% of Households with 4G/LTE mobile coverage and is above the EU28 countries average (18th position) but ranks under the EU28 average in rural areas with 94.6% of Households with 4G/LTE mobile coverage (23rd position).

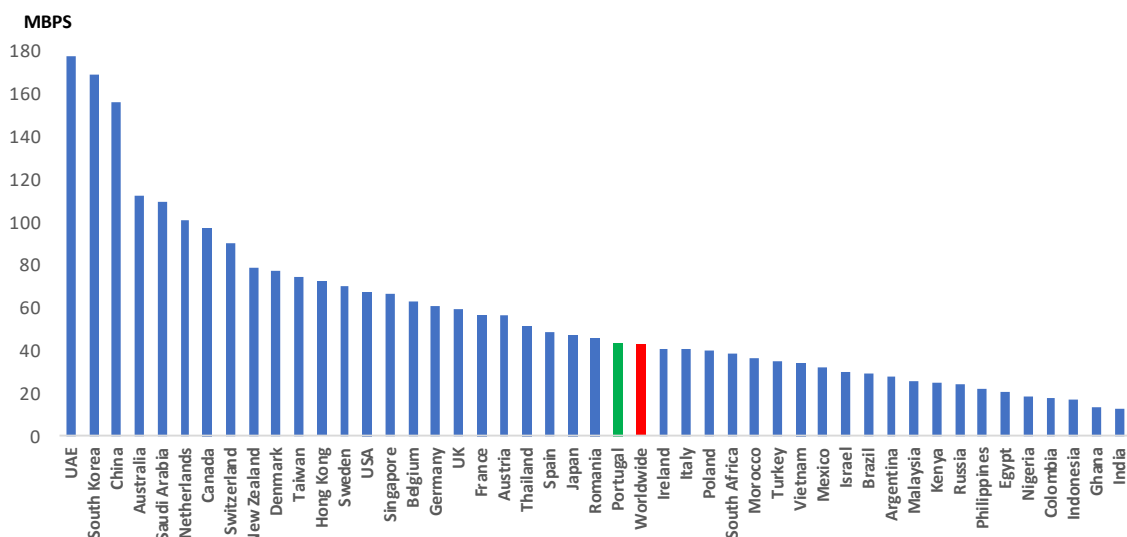
Households with 4G/LTE mobile coverage (As a percentage of all households in total and rural areas, 2018)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on CRTC (2019), Communications Monitoring Report 2019 (Canada), European Commission (2019), Study on Broadband Coverage in Europe 2018 (European Union) and FCC (2019), 2019 Broadband Deployment Report (United States).]

Considering data for the pandemic period, average mobile internet connection speed in Portugal is sharply above the world's average.

Average mobile internet connection speed
(Average download speed of mobile internet connections, in MegaBits Per Second (MBPS))

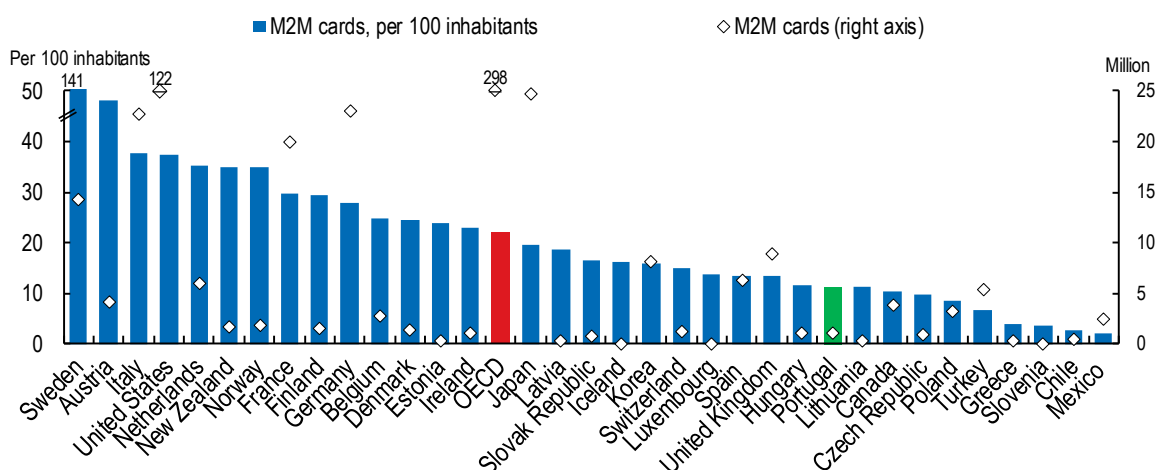


Note: Figures represent average download speeds for mobile internet connections in December 2020.

Source: Digital 2021 – Ookla (January 2021), We Are Social/Hootsuite, 2021

Concerning machine-to-machine (M2M) SIM cards (i.e. SIM cards registered on the mobile network enabling mobile data transmission), Portugal is significantly under the OCDE average on the number for cards in use per 100 inhabitants in June 2019.

M2M (machine to machine)/embedded mobile cellular subscriptions
(per 100 inhabitants, June 2019)



Source: Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal (database), www.oecd.org/sti/broadband/oecd-broadband-portal.htm]

As most of broadband services are based on bundled offers, namely broadband, telephone and television, the table below shows which type of bundles are offered in each OECD country. Although some countries have a limited number of bundled offers, in Portugal there are offers for all bundle types.

Availability of bundle types by country

# Countries	FBB-FV	FBB-TV	FBB-FV-TV	FBB-FV-MVD	FBB-FV-MVD-TV	FBB-FV-MVD-MBB-TV
Australia	36	36	36	16	16	6
Austria						
Belgium						
Canada						
Chile						
Colombia						
Czech Republic						
Denmark						
Estonia						
Finland						
France						
Germany						
Greece						
Hungary						
Iceland						
Ireland						
Israel						
Italy						
Japan						
Korea						
Latvia						
Lithuania						
Luxembourg						
Mexico						
Netherlands						
New Zealand						
Norway						
Poland						
Portugal						
Slovak Republic						
Slovenia						
Spain						
Sweden						
Switzerland						
Turkey						
United Kingdom						
United States						

 Bundled offer available (exact)

FBB: Fixed Broadband. FV: Fixed Voice. MVD: Mobile Voice/Data/SMS. MBB: Mobile Broadband (e.g. dongle). TV: Television

Note: 1) Israel is not included as Teligen is still in the process of analysing bundled pricing for Israel. 2) Based on basic bundles, with an exact service match.

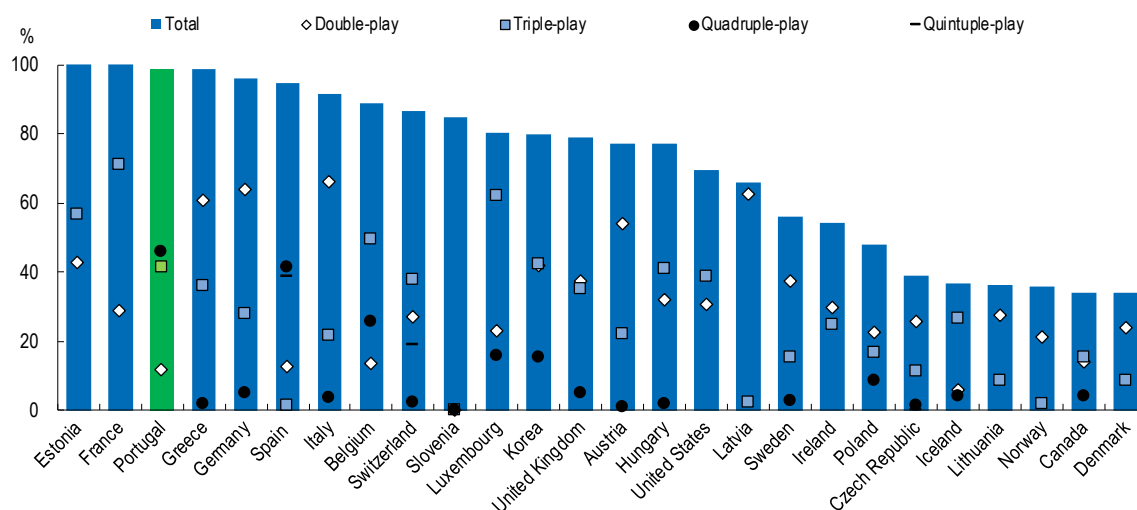
Source: OECD Bundled Communication Price Baskets [based on Strategy Analytics (Teligen)],

OECD Digital Economy Papers, December 2020, No. 300

Although mobile connections are growing faster than fixed broadband connections, fixed networks remain complementary and are particularly important namely for core infrastructure. Bundled communication services offers represent most fixed broadband offers in many OECD countries. In Portugal, bundles in 2018 accounted for almost 100% of fixed broadband subscriptions.

Bundled communication services subscriptions

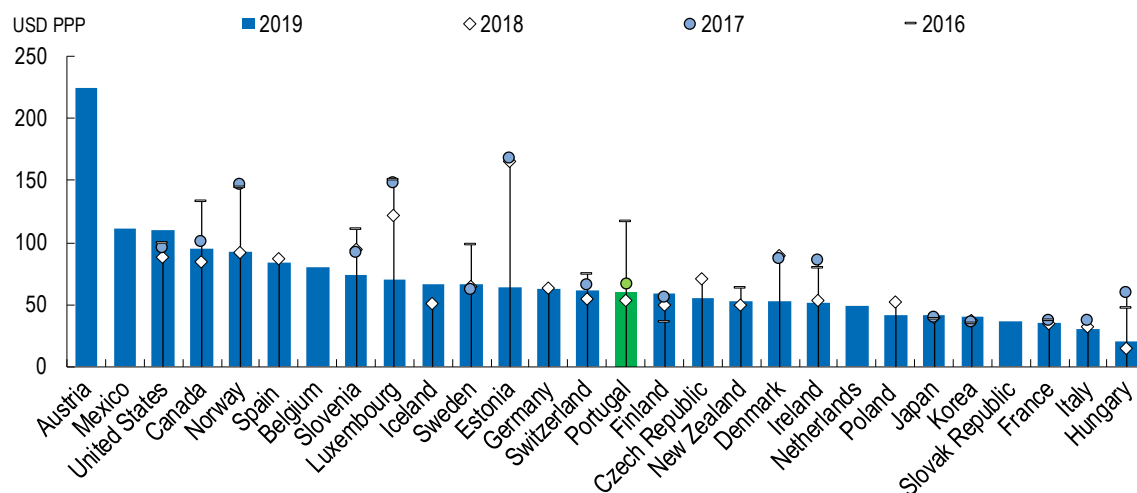
(Percentage of fixed broadband subscriptions that are bundled communication services, 2018)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), Broadband Portal, webpage, www.oecd.org/sti/broadband/oecdbroadbandportal.htm.]

The price of the basket of fixed broadband offers for 1 Gbps decreased from 2016 to 2018 but slightly increased in 2019, placing Portugal in the 15th position among 28 OECD countries with information for this indicator.

Baskets of fixed broadband offers for 1 Gbps (USD PPP, 2019)

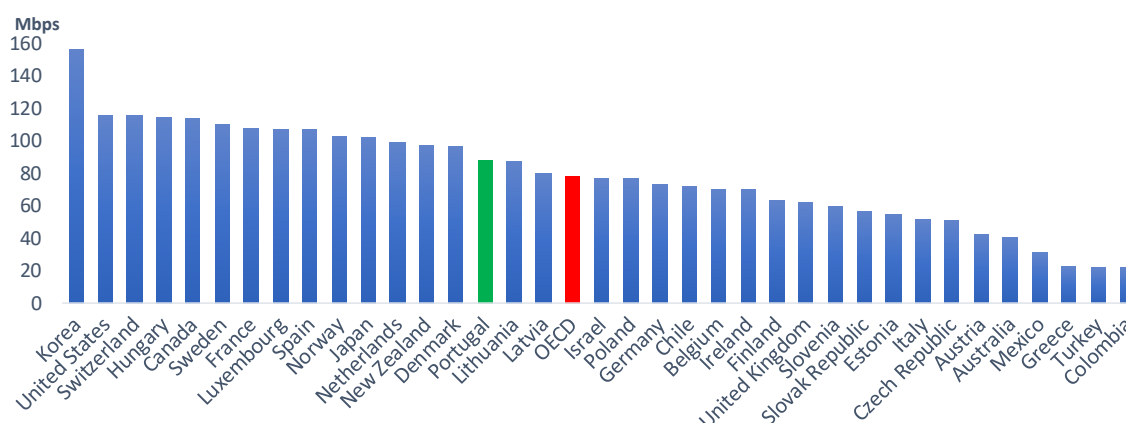


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on Teligen/Strategy Analytics (2020), "Teligen tariff & benchmarking market data using the OECD methodology", <https://www.strategyanalytics.com/access-services/service-providers/tariffs---mobile-and-fixed/>.]

Concerning average experienced download speed of fixed broadband connections, we will use as reference Ookla's data which compile results from tests to the speed of access to the internet actively executed by users (similar to M-Lab). We did not consider Steam's data because they reflect a specific type of applications: online games.

According to Ookla's data, the average fixed broadband download speed in OECD countries was 78.3 Mbps in July 2019. Portugal occupies the 15th position among the 36 OECD countries considered, above OECD's average.

Average experienced download speed of fixed broadband connections (Mbps, July 2019)



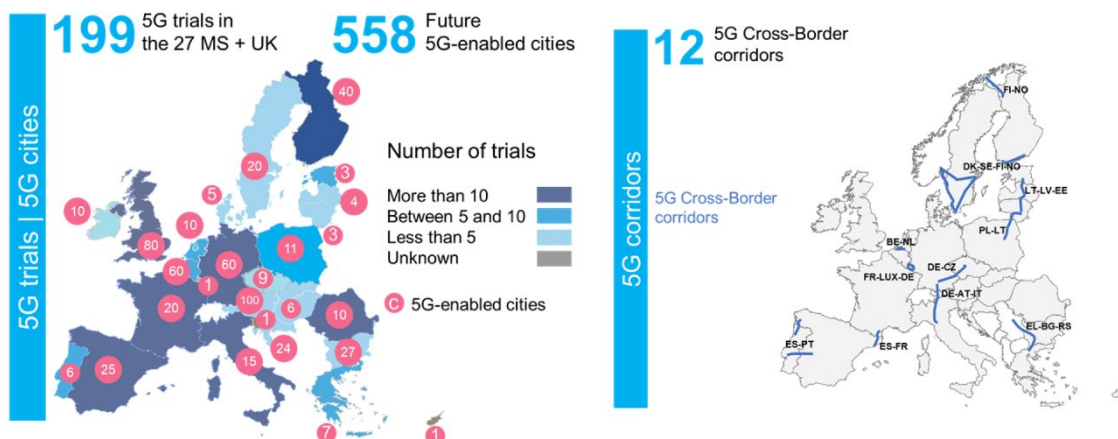
Source: OECD Digital Economy Outlook 2020, OECD, 2020 [Ookla (2019), "Speedtest Global Index", www.speedtest.net/global-index, M-Lab (2019), "Worldwide Broadband Speed League", www.cable.co.uk/broadband/speed/worldwide-speed-league; and Steam (2019) "Steam Global Traffic Map", <https://store.steampowered.com/stats/content>.]

About 5G deployment, networks are shaping in many countries since the beginning of 2019. Portugal is one of the two EU countries that haven't launched 5G services (alongside with Lithuania - <https://econews.pt/2021/06/07/portugal-and-lithuania-are-the-only-eu-countries-without-5g/>)

The auction in Portugal began in mid-January 2021 and is still taking place (<https://www.anacom.pt/render.jsp?categoryId=416483>). The multi-band auction initially scheduled for the first semester of 2020 was postponed due to the Covid-19 pandemic.

In the end of 2020, Portugal had six 5G-enabled cities and was among the top 10 countries (EU-27 plus the UK) in terms of 5G trials organized.

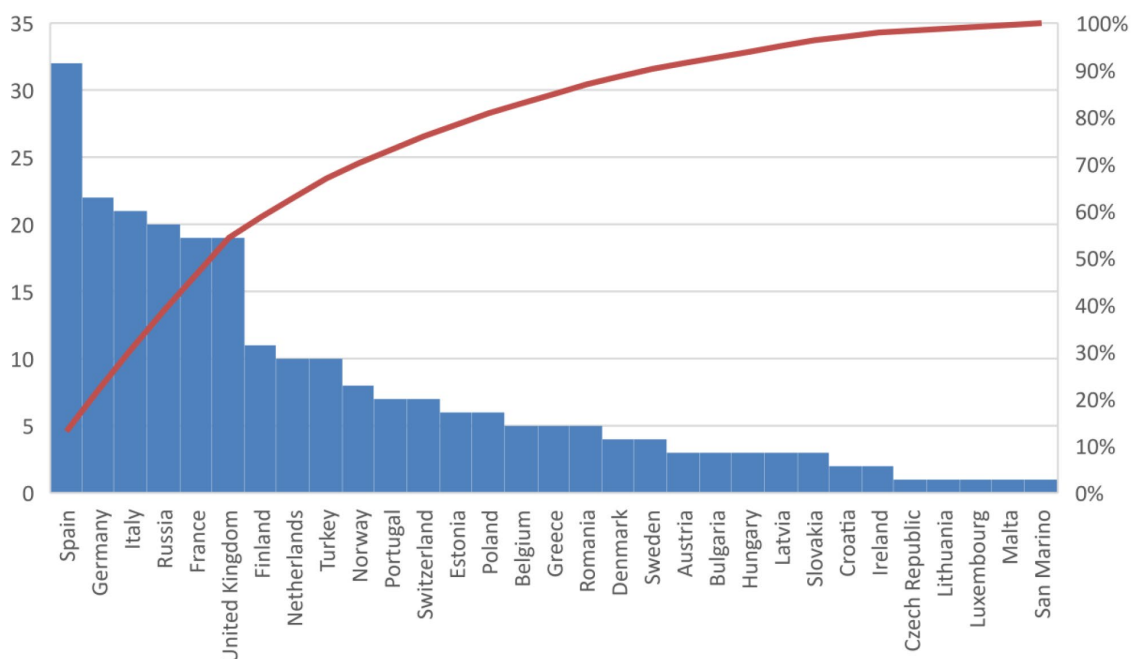
5G scoreboard – EU-27 plus the UK (December 2020)



Source: European 5G Observatory, European Commission/IDATE DigiWorld, December 2020 (<http://5gobservatory.eu/wp-content/uploads/2021/01/90013-5G-Observatory-Quarterly-report-10.pdf>)

Portugal has five 5G activities – 5G Private Trials & Pilots, Aveiro5GCity, 5G test Corridors, 5G Infrastructure PPP, 5G-live cities – has six key cities – Parts of Aveiro, Cascais, Evora, Porto, Matosinhos, Lisbon – and is the 7th country of EU27 with more trials.

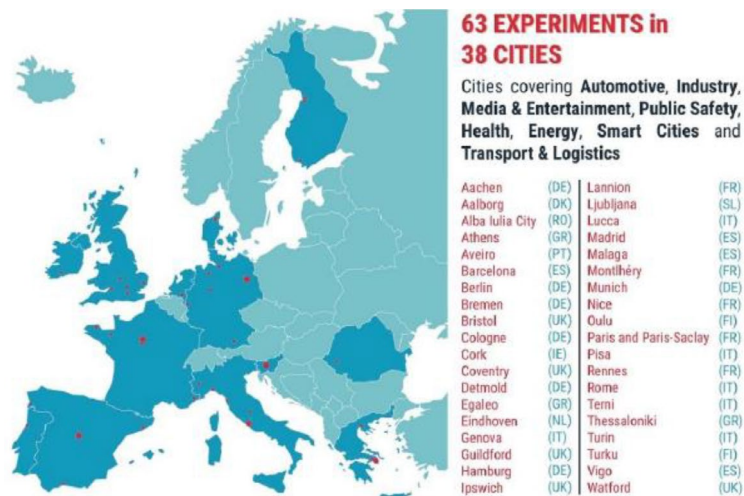
5G trials (number of tests and trials by country)



Source: European 5G Observatory, European Commission/IDATE DigiWorld, December 2020 (<http://5gobservatory.eu/wp-content/uploads/2021/01/90013-5G-Observatory-Quarterly-report-10.pdf>)

Some 5G Public-Private Partnerships have kicked-off in 38 cities, namely Aveiro – Portugal, trying to promote hardware innovation and to support ecosystems.

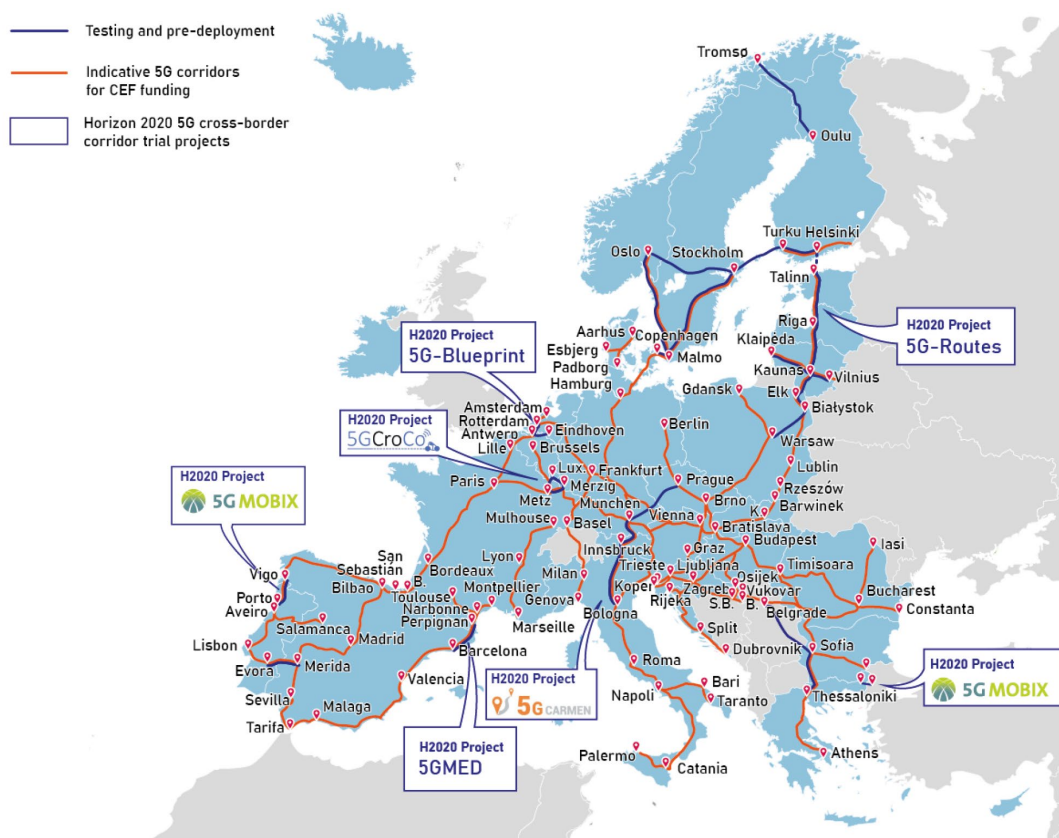
5G Infrastructure Public-Private Partnership



Source: European 5G Observatory, European Commission/IDATE DigiWorld, December 2020 (<http://5gobservatory.eu/wp-content/uploads/2021/01/90013-5G-Observatory-Quarterly-report-10.pdf>)

Moreover, the country had already two 5G cross-border corridors with Spain.

5G Cross-border Corridors for Connected and Automated Mobility (Main public-private initiatives in Europe)

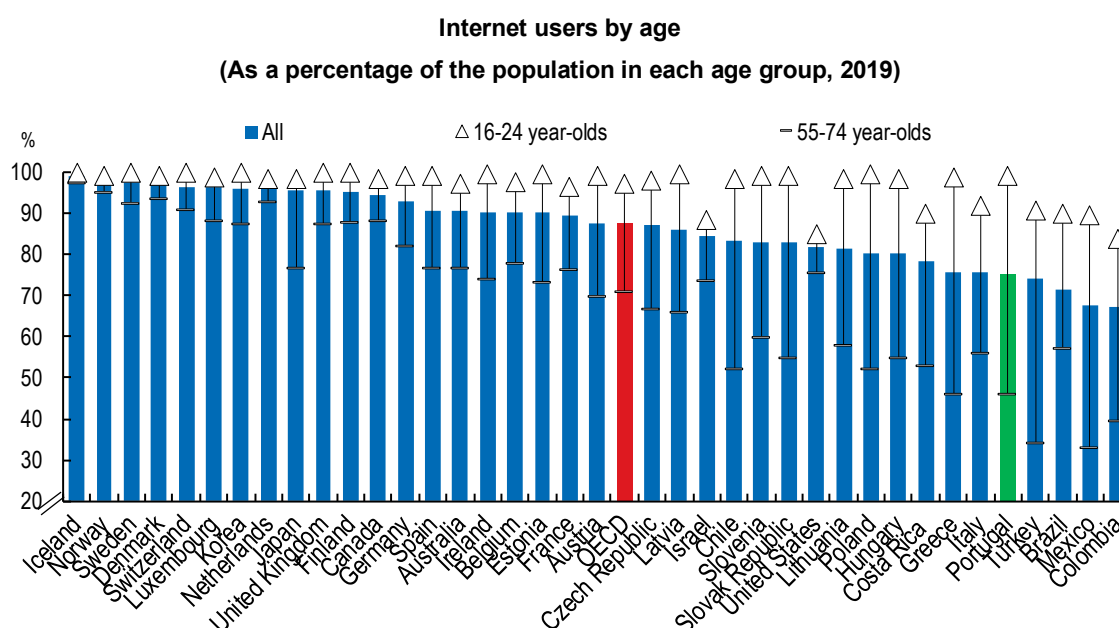


Source: European 5G Observatory, European Commission/IDATE DigiWorld, March 2021 (<http://5gobservatory.eu/wp-content/uploads/2021/04/90013-5G-Observatory-Quarterly-report-11-2.pdf>)

3. Individuals and Households

Portugal faces the challenges of an ageing population, being the third EU27 country with the highest median age, after Italy and Germany ([Eurostat](#)).

The percentage of population in Portugal that uses internet (75.3%) is the 34th lowest among 38 OECD countries. That is mostly due to older population as Portuguese population between 55 and 74 years rank in the 35th position among 38 OECD countries (with 45.8% of internet users). Much differently, Portuguese population between 16 and 24 years rank in the 10th position (with 99.5% of internet users).



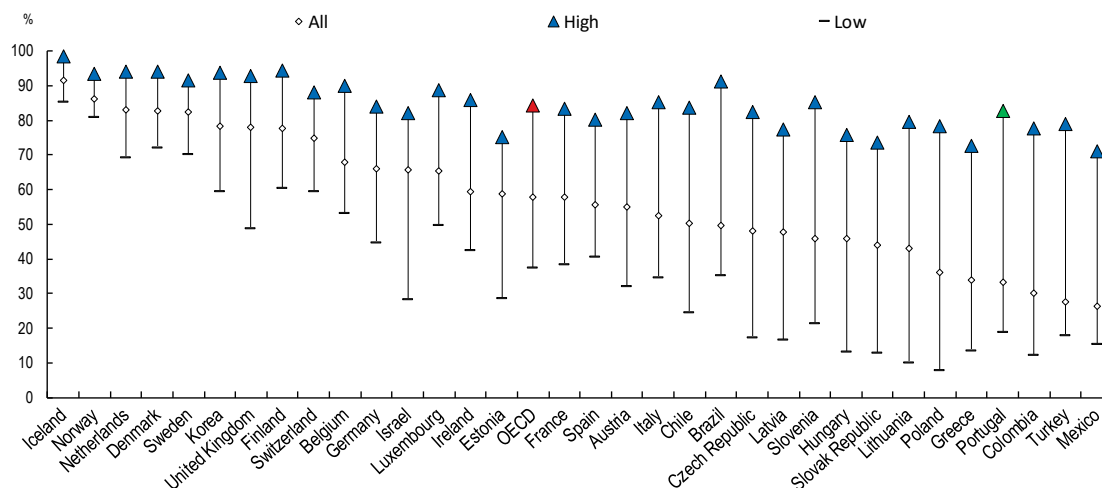
Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>.]

Regarding frequent internet use by age and educational attainment, the disparity is narrow among the population between 16 and 24 years. However, concerning the population between 55 and 74 years, the frequency of internet usage varies between 82.6% for the population with high educational attainment and 18.6% for those with low educational attainment - a gap of 63.9 percentual points (the 6th higher gap among the 33 OECD countries considered).

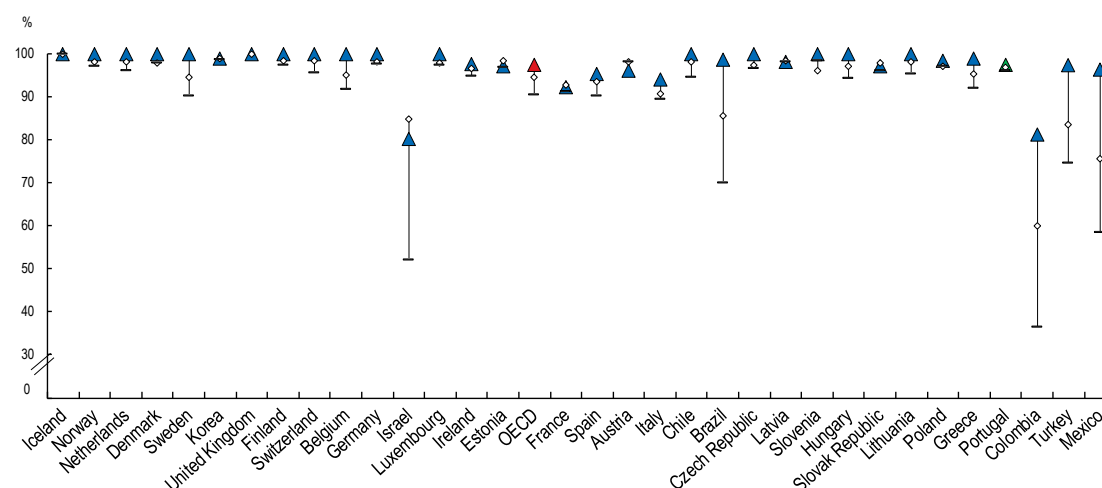
Given Portugal's a large gap in internet use concerning educational attainment, people with lower educational attainment are a potential focus for strategies to promote digital inclusion.

**Frequent Internet use by age and educational attainment
(As a percentage of the population in each age group, 2019)**

A. Among individuals aged 55-74



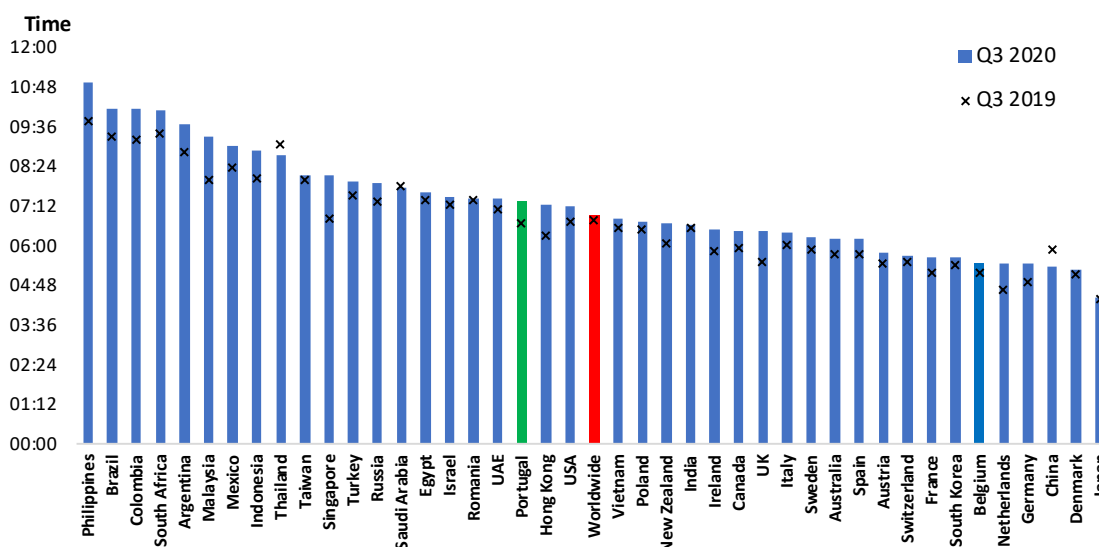
B. Among individuals aged 16-24



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind> and Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

In the 3rd quarter of 2020, Portuguese internet users aged 16 to 64 years that use internet daily spent in average 7 hours and 20 minutes per day using the internet, more 42 minutes than in the same quarter of 2019 and above the average for 42 countries worldwide (6 hours and 54 minutes). The information for Portugal for 2019 is in line with the data published by OECD on the OECD Digital Economy Outlook 2020, which is based on Datareportal (Digital 2019: Global Digital Overview, January 2019 – <https://datareportal.com/reports/digital-2019-global-digital-overview>).

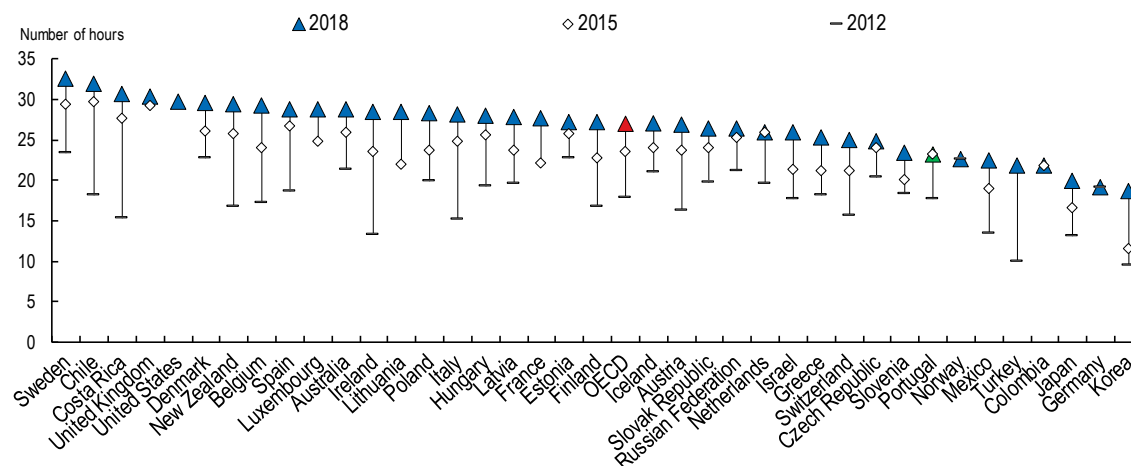
Daily time spent using the Internet (Average amount of time (in hours and minutes) that internet users aged 16 to 64 spend using the Internet each day of any device)



Source: Digital 2020 and 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2020 and 2021

Interestingly, Portuguese students aged 15-16 spend one of the lowest time period on the internet (23.2 hours) among 38 OECD countries, ranking in the 31st position.

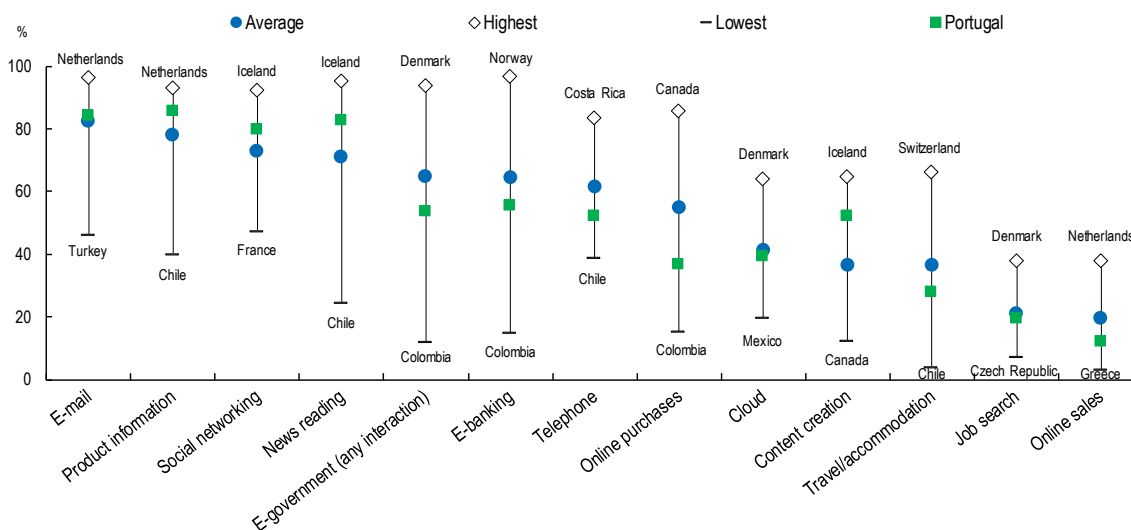
Weekly hours spent by students aged 15-16 on the Internet outside of school (2012-18)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on OECD (2019), PISA 2018 Results (Volume III): What School Life Means for Students' Lives, OECD publishing, Paris, <https://dx.doi.org/10.1787/acd78851-en>.]

The internet users perform different online activities. Portugal ranks significantly above the average in the areas of content creation, product information, news reading and social networking. Oppositely, Portugal ranks significantly under the average in the areas of online sales, travel/accommodation, e-banking, telephone, e-government and online purchases.

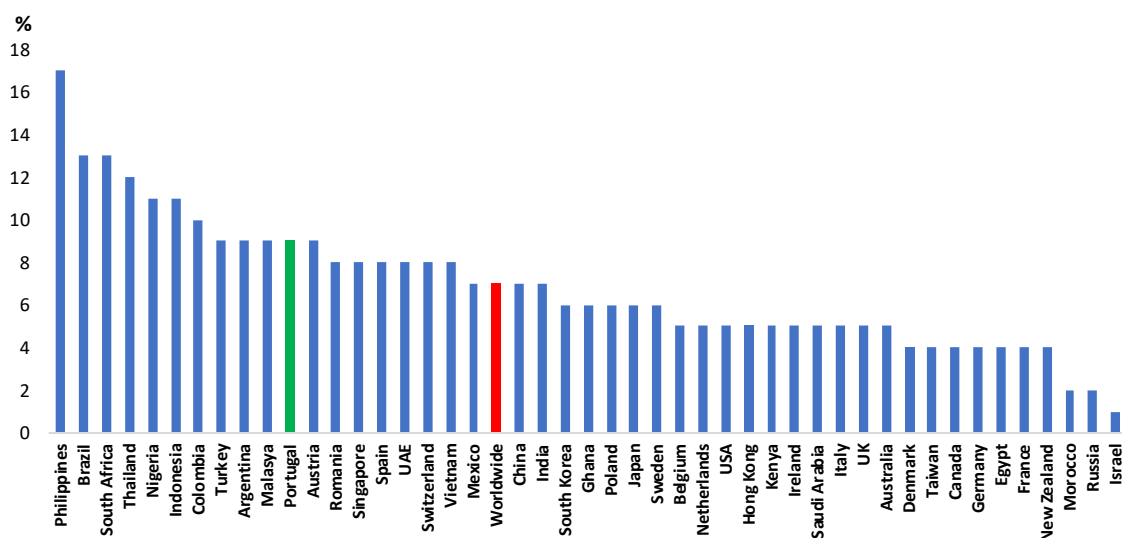
Diffusion of selected online activities among Internet users in OECD countries, Brazil and Costa Rica (Percentage of Internet users performing each activity, 2019)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>.]

Considering ownership of cryptocurrencies, in Portugal, in 2019, 9% of internet users aged 16 to 64 years reported owning any form of cryptocurrency.

Ownership of Cryptocurrency (Percentage of internet users aged 16 to 64, Q3 2019)

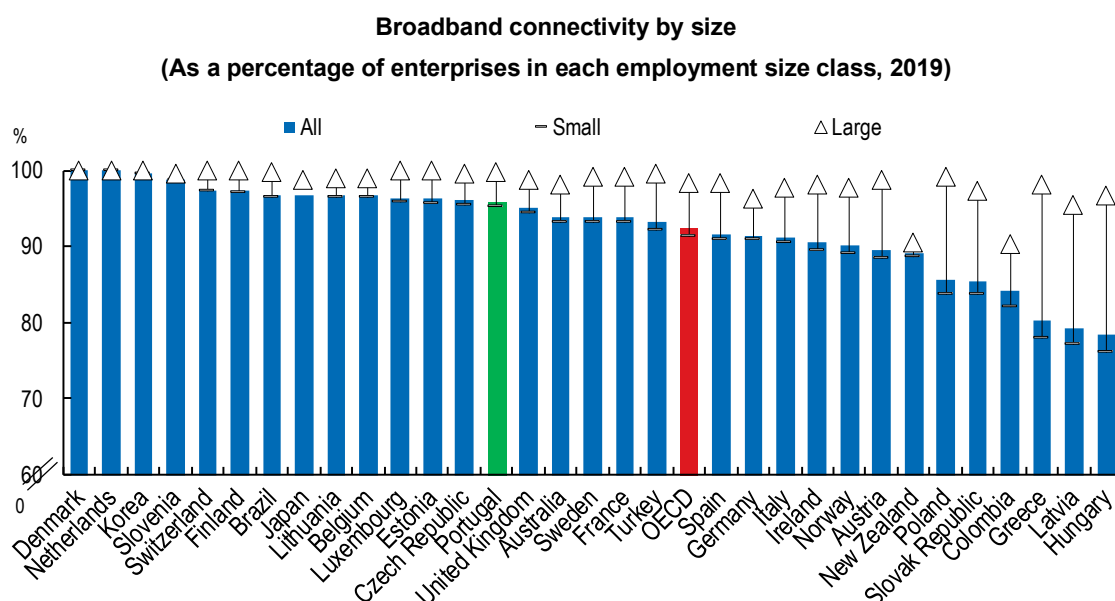


Source: Digital 2020 - Global Web Index (survey), We Are Social/Hootsuit, 2020

4. Enterprises

In Portugal, in 2019, the large majority of enterprises use broadband connectivity (95.8%), above the OECD average (92.4%), representing more about 13 p.p. when comparing with 2010 (and an OECD average of 85.3% in that year). Portugal rose from the 23rd position among 31 OECD in 2010 countries to the 14th position among 32 OECD countries in 2019.

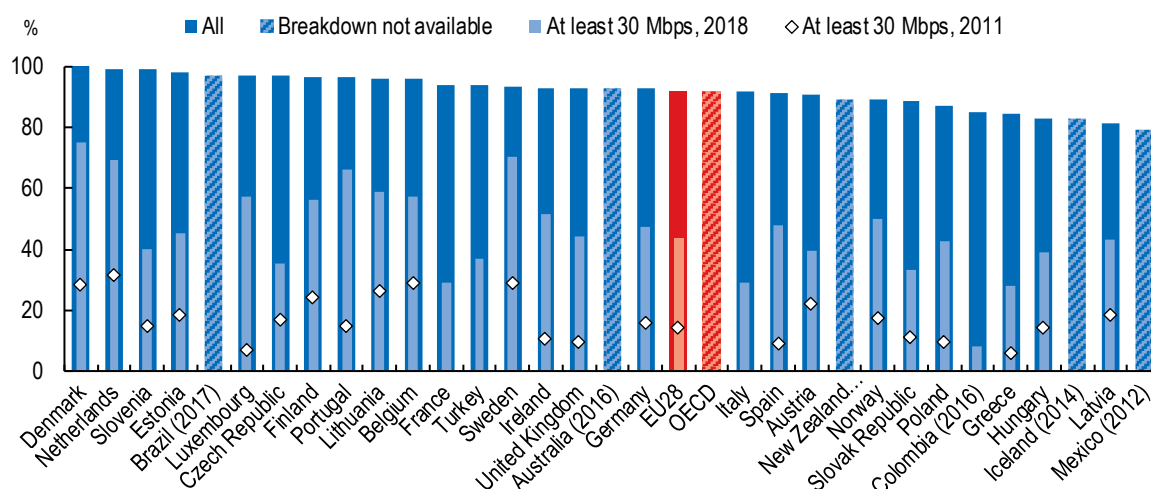
This percentage is higher in larger enterprises (99.7% - 8th position among 32 OECD countries) than in medium (98.4% - 13th position among 32 OECD countries) or small (95.3% - 13th position among 31 OECD countries). Although the gap between large and small enterprises remains significant among some OECD Countries (the gaps in Hungary, Greece, Latvia, Poland, Slovak Republic and Austria are between 10.4 and 20.4 percentage points), the gap in Portugal (4.5 percentage points) is below the OECD average (6.8 percentage points).



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Businesses Database, <http://oe.cd/bus.>]

Considering broadband connections contracted by enterprises, Portugal ranked well in 2018 (96.5%) compared both to the EU28 and OECD averages (both 91.9%), occupying the 9th position among 31 countries. Also considering connections with speeds of at least 30 Mbps, Portugal, with 66.1%, occupies in 2018 the 4th position among the 26 countries with information for this indicator, a notable increase when comparing with 2011 when Portugal, with only 14.9%, occupied the 13th position among the 22 countries with comparable information.

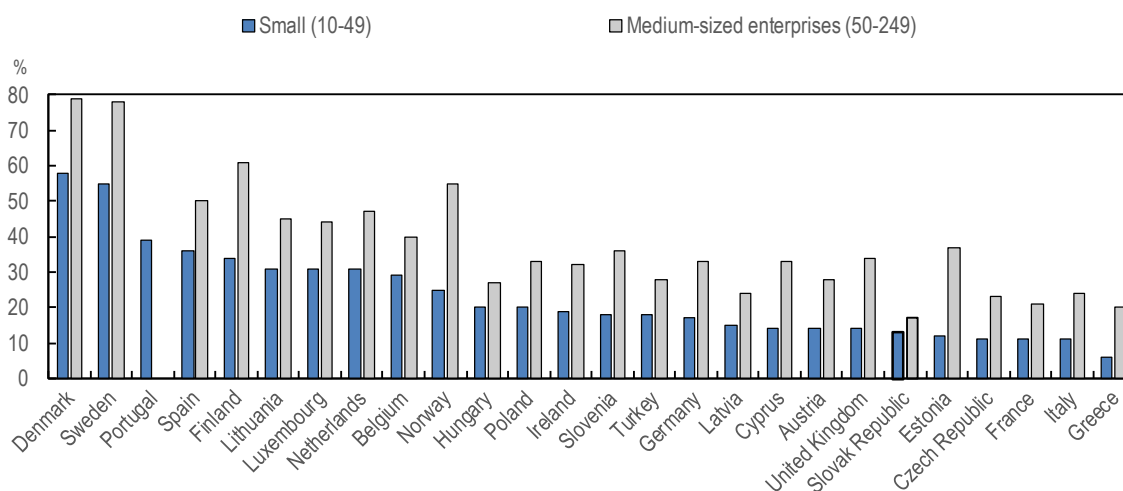
Enterprises with broadband connections, by speed (As a percentage of all enterprises, 2018)



Source: OECD, ICT Access and Usage by Businesses Database (<http://oe.cd/bus>), December 2018.

Considering small enterprises, Portugal is the 3rd country among 26 OECD countries with a higher share of enterprises with contracted download of at least 100Mb/s in 2019.

Enterprises with fast internet connection by size (Share of enterprises with contracted download speed of the fastest fixed internet connection is at least 100Mb/s, 2019)

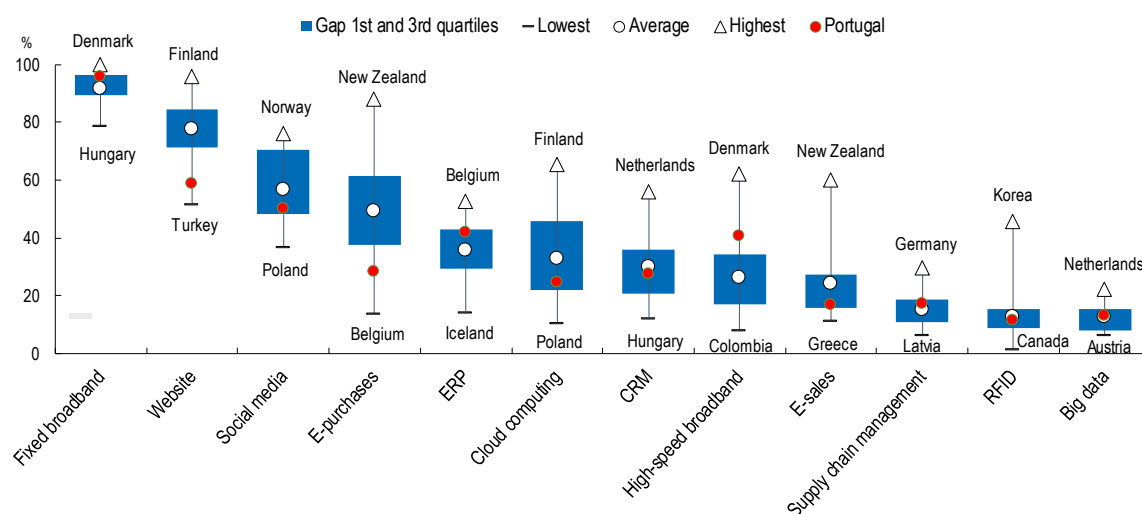


Note: Only enterprises from the non-financial sector are considered.

Source: Eurostat Digital Economy and Society: ICT Usage in Enterprises database (<https://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database>)

Considering sophisticated digital technologies adoption by enterprises, although Portugal ranks well regarding fixed and high-speed broadband and in enterprise resource planning, some areas require further action, in particular the use of websites and e-purchases by these enterprises. Cloud computing is also an area where Portugal needs to improve its use, as it is important for enterprises to access more software, storage capacity and processing power to face digital transition with lower costs in hardware and maintenance.

Diffusion of selected ICT tools and activities in enterprises
(As a percentage of enterprises with ten or more persons employed, 2019)



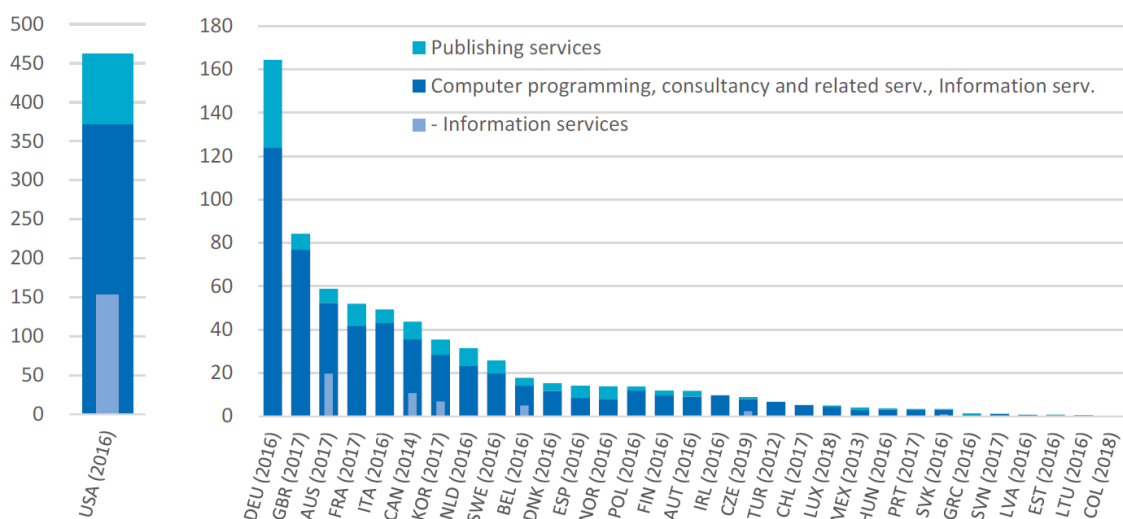
Notes: CRM = customer-relationship management. Enterprise resource planning (ERP) systems are software-based tools that can integrate the management of internal and external information flows, from material and human resources to finance, accounting and customer relations. Here, only sharing of information within the enterprises is considered. Cloud computing refers to ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on. Supply-chain management refers to the use of automated data exchange applications. Big data refers to the use of techniques, technologies and software tools for analysing big data. This, in turn, relates to the huge amount of data generated from activities that are carried out electronically and from machine-to-machine communications. Social media refer to applications based on Internet technology or communication platforms for connecting, creating and exchanging content online with customers, suppliers or partners, or within the enterprise. Radio frequency identification (RFID) is a technology that enables contactless transmission of information via radio waves. For country exceptions, see endnote 2. StatLink contains more data.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Businesses Database, <http://oe.cd/bus> and Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

In 2020, considering data by size of the enterprises, the use of cloud computing in Portugal was higher among large enterprises than among medium or small enterprises (Cloud computing services, Eurostat [online data code: isoc_cicce_use]).

In Portugal, the intermediate consumption of broad cloud-containing product categories is very small in all the categories considered.

Intermediate use of broad cloud-containing product categories (USD billion, Purchasers' prices, latest available year)

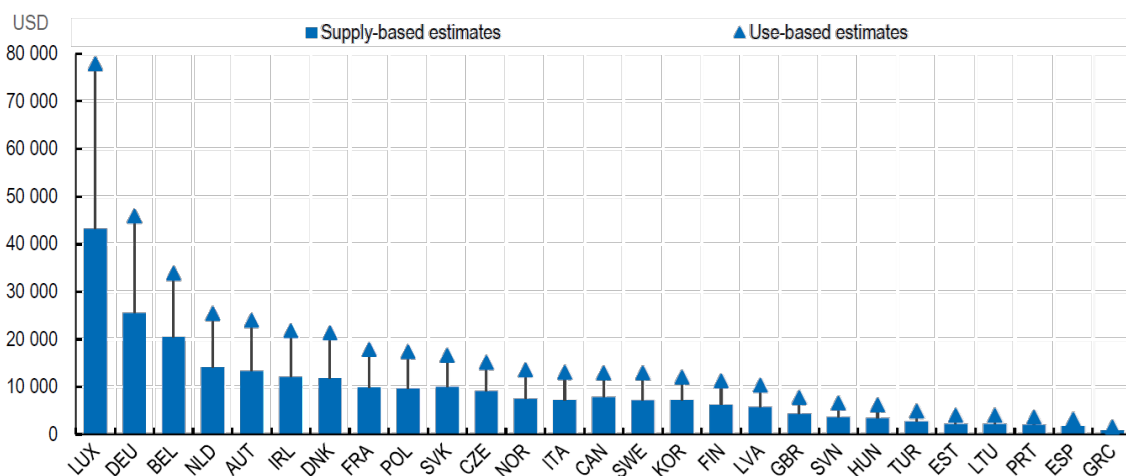


Note: Publishing services unavailable for Ireland.

Source: Measuring Cloud Services Use by Businesses, OECD Digital Economy Papers, January 2021, No. 304 [OECD Supply-Use Tables Database, July 2020.]

In Portugal, the average expenditure per business on specific cloud-containing product categories is very low, which may be influenced by the prevalence of micro enterprises that have less capacity to spend than larger enterprises and that are less likely to use cloud services.

Estimated average expenditure on cloud services per active employer enterprise (USD, purchasers' prices, current prices, latest available year)

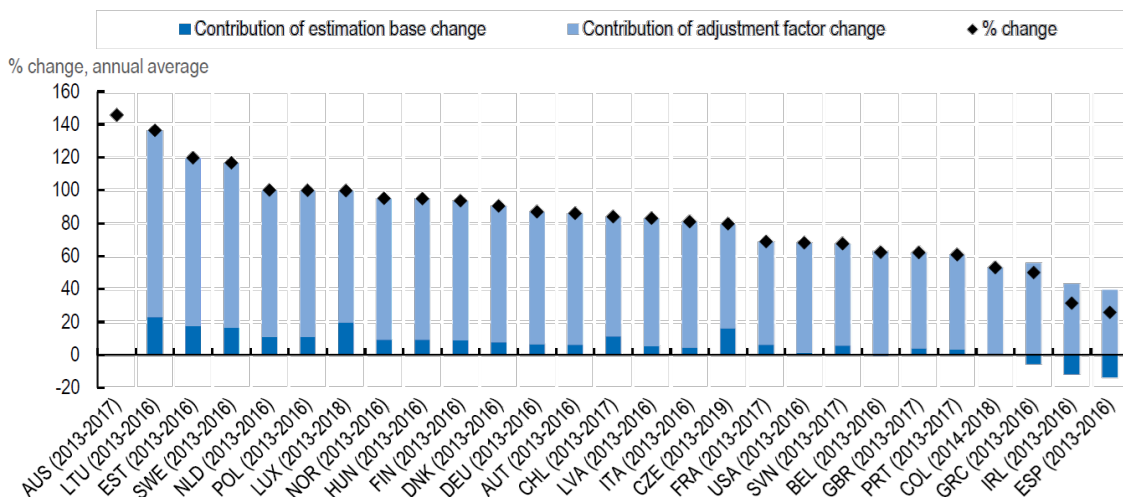


Note: Based on the number of active employer enterprises in ISIC rev.4 sectors 05_82_LESS_642: Total industry, construction and market services except holding enterprises. Population of active employer enterprises unavailable for AUS, USA, MEX, which are therefore excluded from this analysis.

Source: Measuring Cloud Services Use by Businesses, OECD Digital Economy Papers, January 2021, No. 304 [OECD based on OECD supply-use database, OECD business ICT usage database, OECD structural business demography statistics database, and national sources.]

The use of specific cloud containing product classes by enterprises in Portugal is among those that exhibit lower annual average growth from 2013 until the latest year available (2013-2017 for Portugal).

**Nominal annual average growth rate of business use of specific cloud containing product classes
(Showing contributions to the estimated change, 2013-latest)**



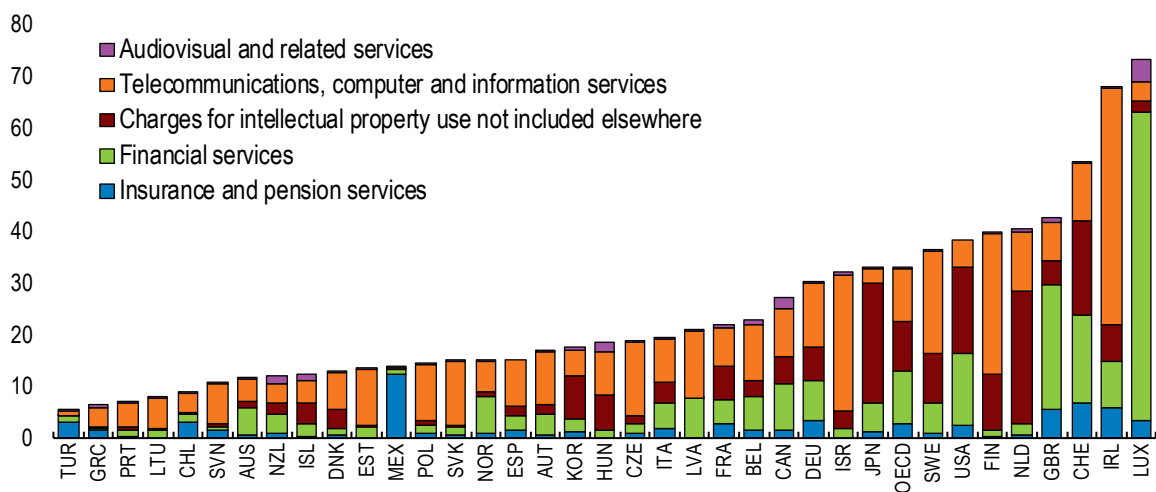
Note: "Annual average growth rates" are derived by calculating the percentage change in the estimated use of specific cloud-containing products between the first and latest periods available for each country (shown in brackets) and dividing the result by the number of years covered. Calculated using figures in national currency to avoid distortions from exchange rate fluctuations.

Source: Measuring Cloud Services Use by Businesses, OECD Digital Economy Papers, January 2021, No. 304 [OECD based on OECD supply-use database and national sources.]

The uptake of more sophisticated technologies is more limited to certain types of enterprises, but this is an important area for future developments as it is an important tool for enterprises to control their data and to help them in identifying new business strategies and solutions.

Nowadays, enterprises have new ways to trade their services using digital technologies. In 2017, in Portugal, exports of predominantly digitally deliverable services were weak and represented only 7.2% of total services exports, much below the OECD average (33.1%).

**Exports of predominantly digitally deliverable services
(As a percentage of total services exports, 2017)**

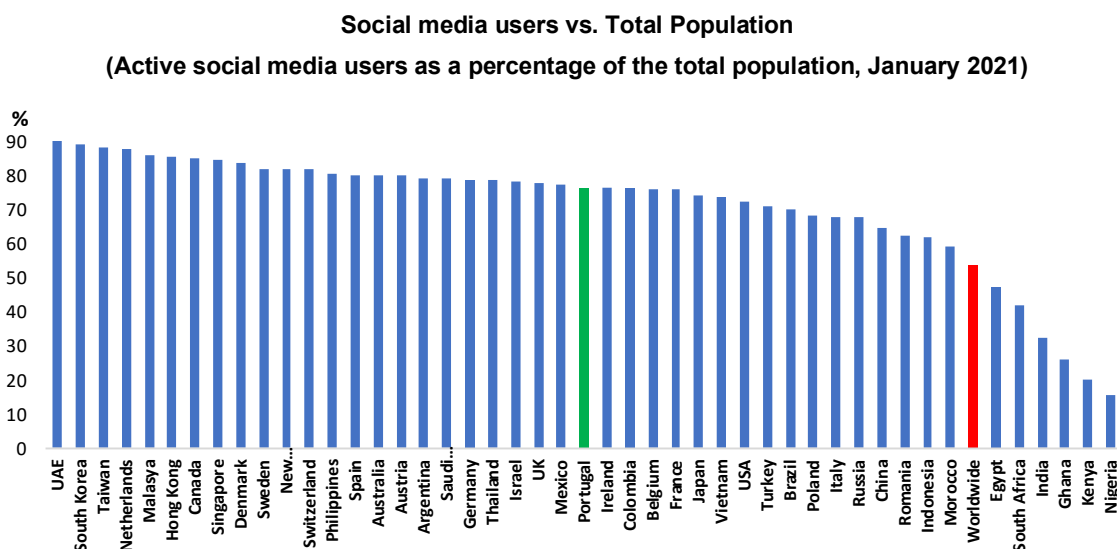


Source: OECD, calculations based on EBOPS 2010 (<https://www.oecd.org/sdd/its/EBOPS-2010.pdf>), WTO, Trade in Commercial Services, October 2018

5. Social Media

Social media significantly increased its importance in the daily life of many citizens, in particular during the current pandemic of Covid-19, mainly to enhance social and political engagement.

According to Kepios (January 2021), in Portugal, the number of social media users represents 76.6% of the population (the data consider active social media users but user figures may not represent unique individuals).

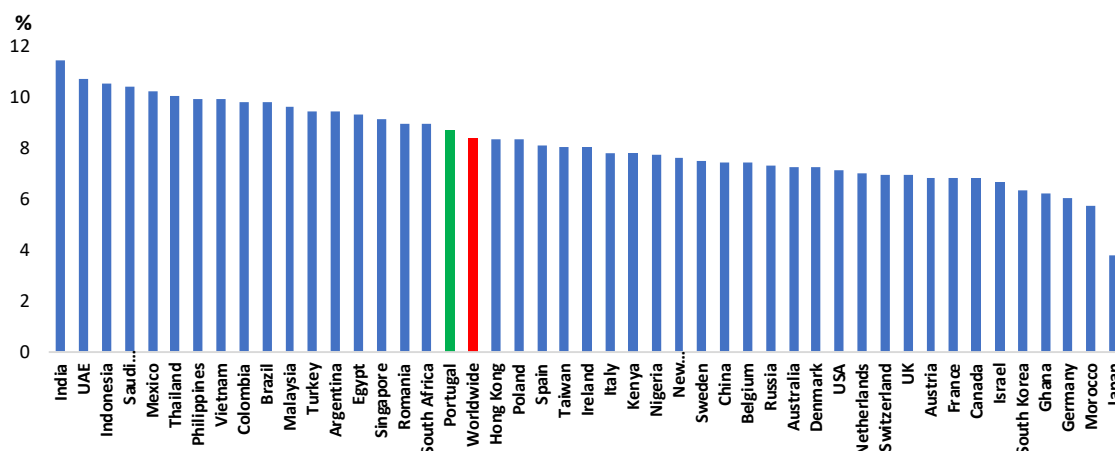


Notes: User figures may not represent unique individuals. Difference in local data availability mean country figures may not correlate with global totals.

Source: Digital 2021 – Kepios, We Are Social/Hootsuite, 2021

In Portugal, in the third quarter of 2020, internet users (not necessarily active users) aged 16 and 64 years had, in average, 8.7 social media accounts.

Average number of social media accounts (Average number of social media platforms on which internet users aged 16 to 64 have accounts (not necessarily active users), Q3 2020)

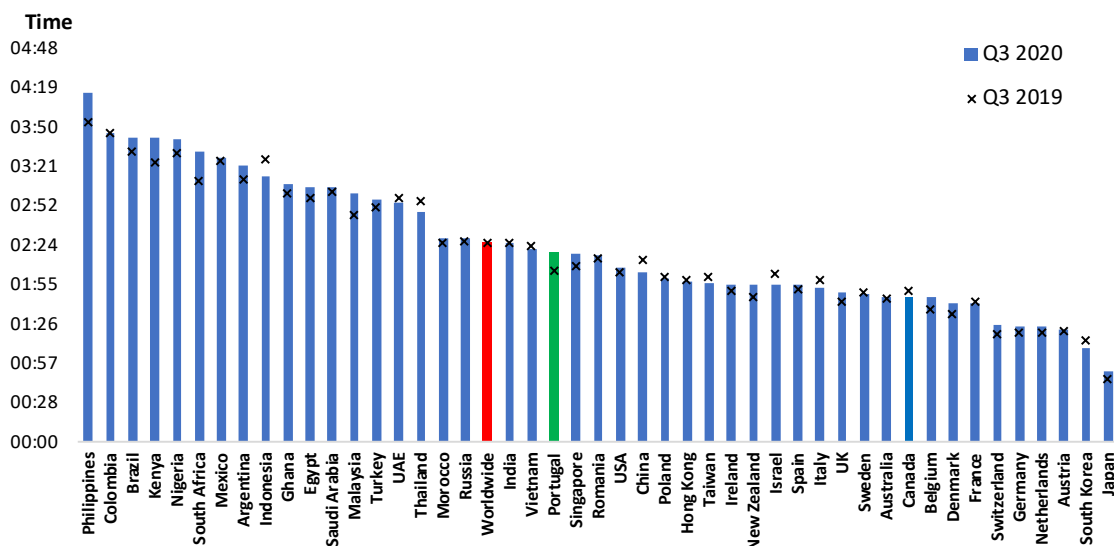


Note: Figures represent the average number of social media platforms on which survey respondents report having an account and do not necessarily indicate active use across all accounts or platforms each month.

Source: Digital 2021 – Global Web Index (Survey), We Are Social/Hootsuite, 2021

In the third quarter of 2020, internet users aged between 16 and 64 years, in Portugal, spent two hours and 18 minutes using social media, 14 minutes more than in the same period of 2019, and similar to the worldwide average (2 hours and 25 minutes).

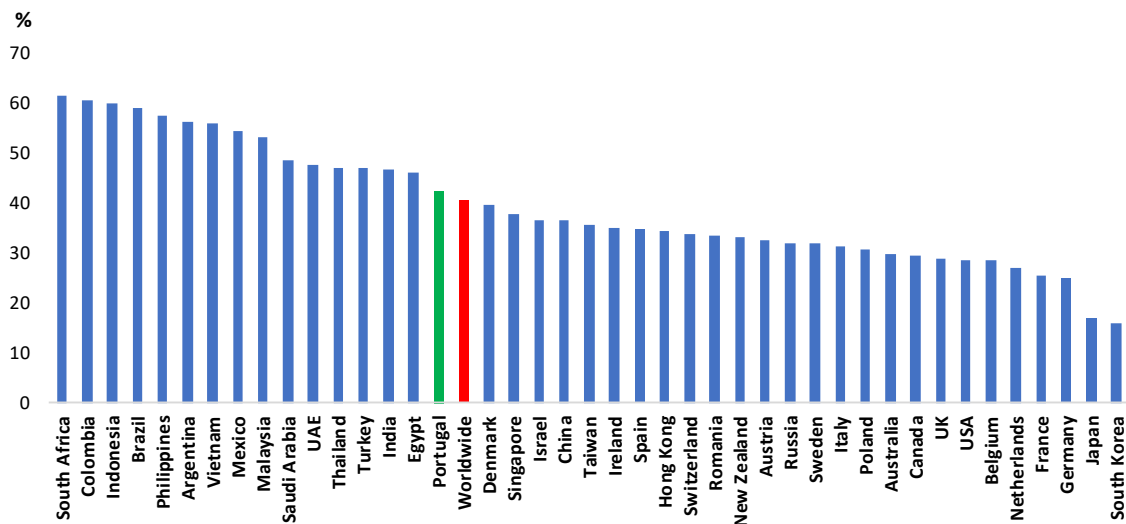
Daily time spent using social media (Average amount of time (in hours and minutes) that internet users aged 16 to 64 spend using Social Media each day, Q3 2019/2020)



Source: Digital 2020 and 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2020 and 2021

About 42.5% of internet users in Portugal used social media for work purposes in the third quarter of 2020, slightly above the worldwide average (39.7%).

Individual use of social media for work
(Percentage of internet users aged 16 to 64 who use social media for work purposes, Q3 2020)

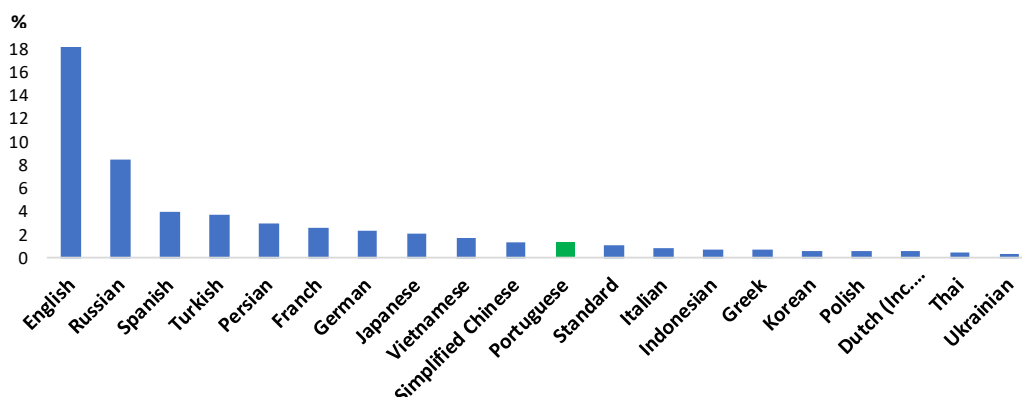


Note: Includes people who use social media to network for work, to follow work contacts, or to follow entrepreneurs and/or business people

Source: Digital 2020 and 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

Considering the top 10 million websites, in January 2020, the Portuguese language was the 11th most common language used for web content and was the 7th with a higher percentage of the world's total population identifying as a speaker (3.2%).

Most common languages for web content
(Based on the languages used on the world's top 10 million websites, January 2020)

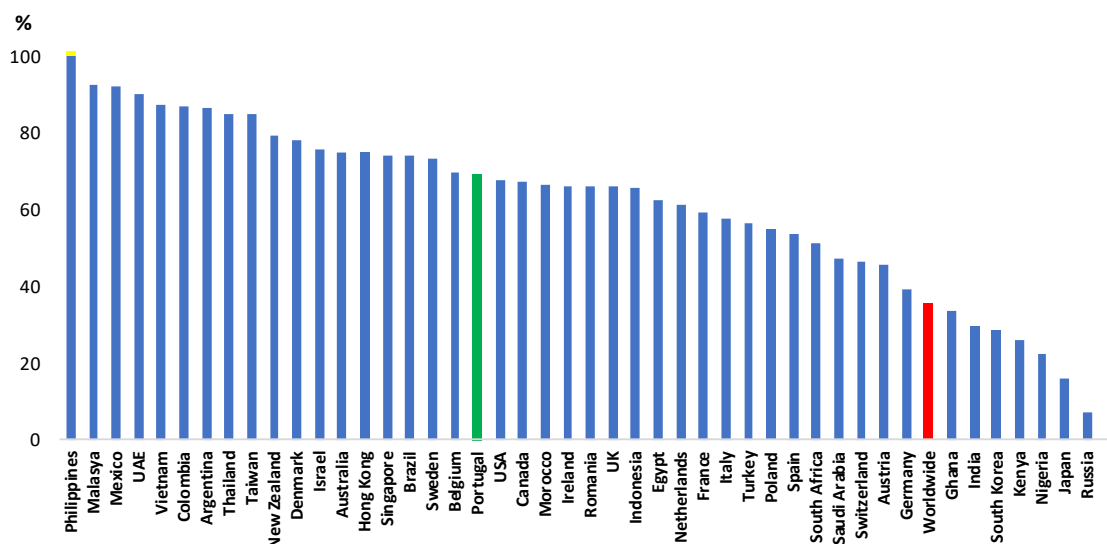


Note: Share of population column show the percentage of the world's total population that identifies as a speaker of each language (either as their native tongue or as a second language).

Source: Digital 2021, We Are Social/Hootsuite, 2021

The percentage of population in Portugal, in January 2021, that advertisers can reach through Facebook is 40.9% and through LinkedIn is 69.5%.

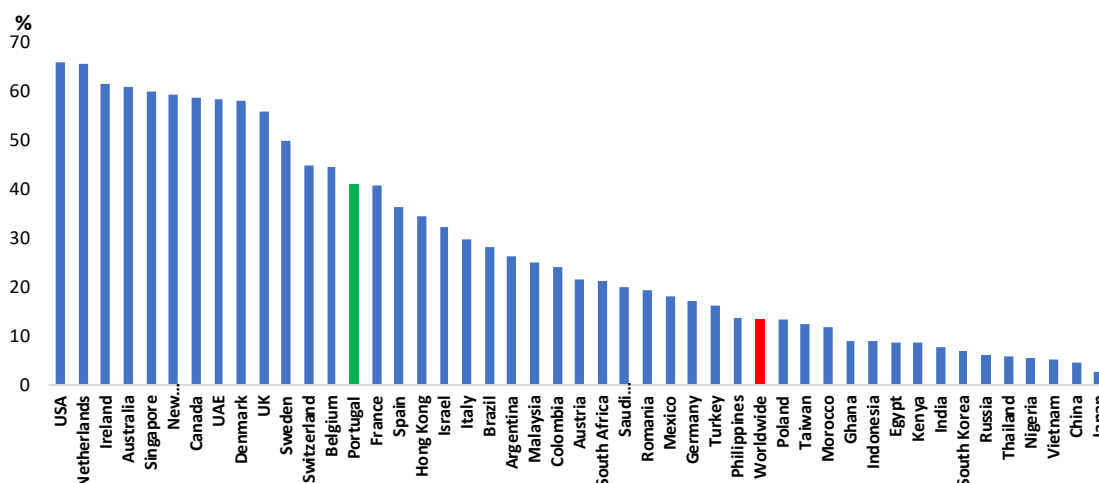
Eligible audience reach rate: Facebook (The number of users that advertisers can reach on Facebook compared to the population aged 13+, January 2021)



Note: Users may not represent unique individuals. Values should not exceed 100% but data are shown "as-is" to enable readers to make their own judgments.

Source: Digital 2020 and 2021, We Are Social/Hootsuite, 2021

Eligible audience reach rate: LinkedIn (The number of members that advertisers can reach on LinkedIn compared to the population aged 18+, January 2021)

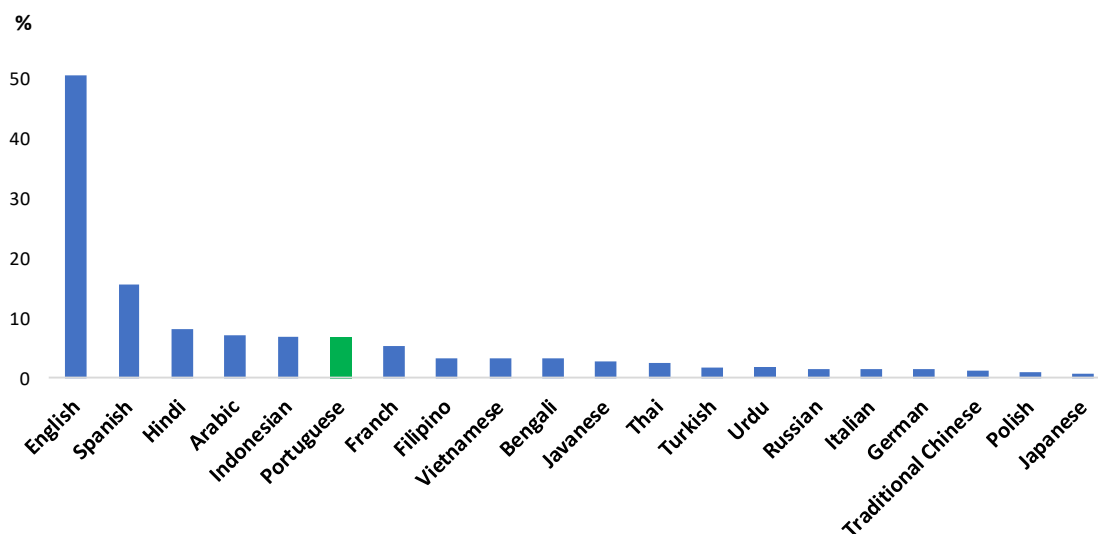


Note: Members may not represent unique individuals or monthly active users.

Source: Digital 2020 and 2021, We Are Social/Hootsuite, 2021

In January 2021, Portuguese was the 5th most common language spoken by Facebook's advertising audience (6.9%), with the English language in the first place (50.4%)

Facebook users by language (Facebook users as share of total advertising audience who speak each language, January 2021)



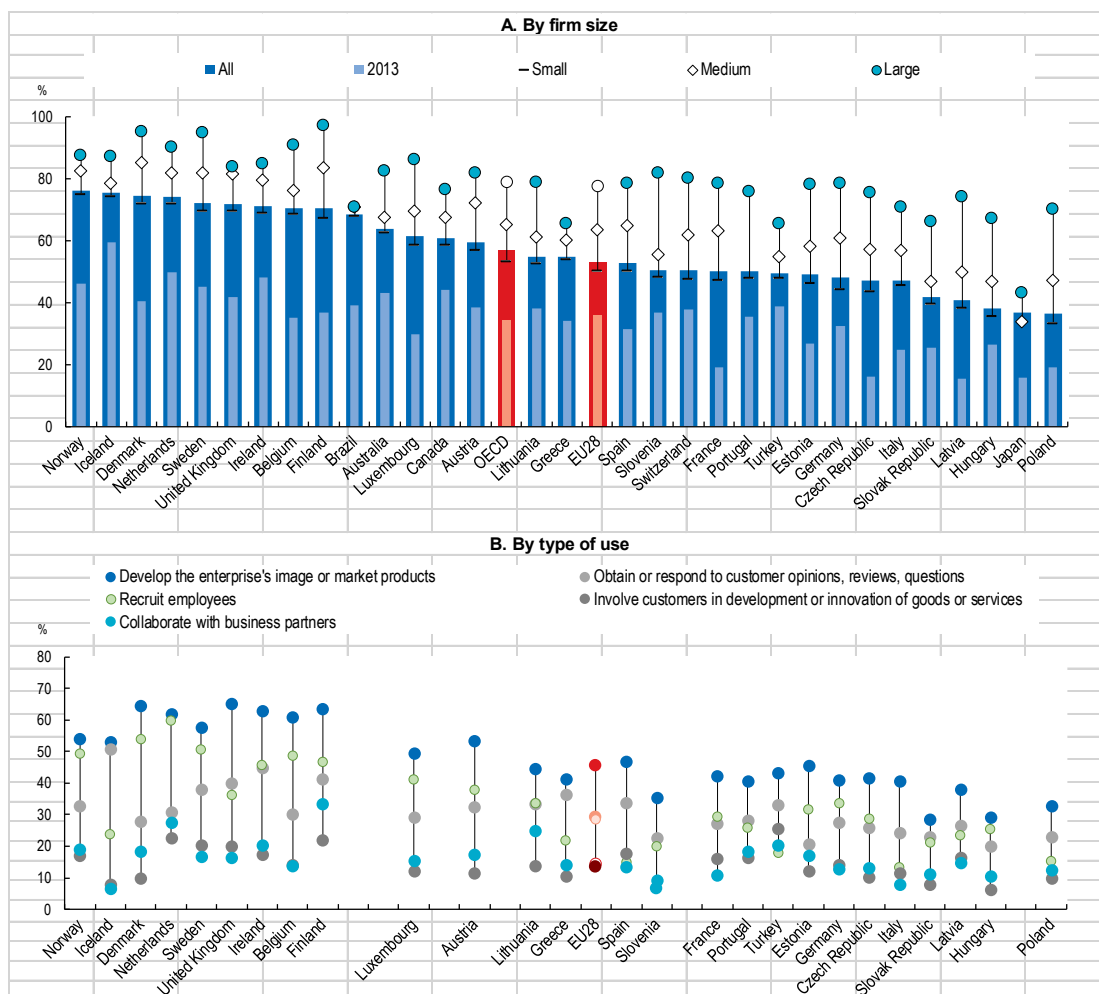
Notes: Share represents the numbers of active Facebook users who speak each language as a percentage of Facebook's total global advertising audience. Users may not represent unique individuals.

Source: Digital 2021 – Kepios, We Are Social/Hootsuite, 2021

With the increasing use of social media, the diffusion of information using this resource became more important. Hence, enterprises and institutions are using social media to communicate with citizens and to advertise their activities, integrating the digital transformation. Nevertheless, there is still a significative difference between countries.

In Portugal, from 2013 to 2019, the percentage of enterprises that use social media increased from 35.5% to 50.0% but remained under the OECD (56.7%) and EU28 (53.0%) averages. The use is higher among larger enterprises (76.2%) than in small enterprises (47.9%), and mainly with the purpose of developing the enterprise's image or market products (40.3%), obtaining or responding to customer opinions, reviews and questions (28.1%) and recruiting employees (25.9%). The use of social media to exchange views, opinions or knowledge within the enterprise (17.6%) or to involve customers in the development or innovation of goods or services (16.1%) are less frequent.

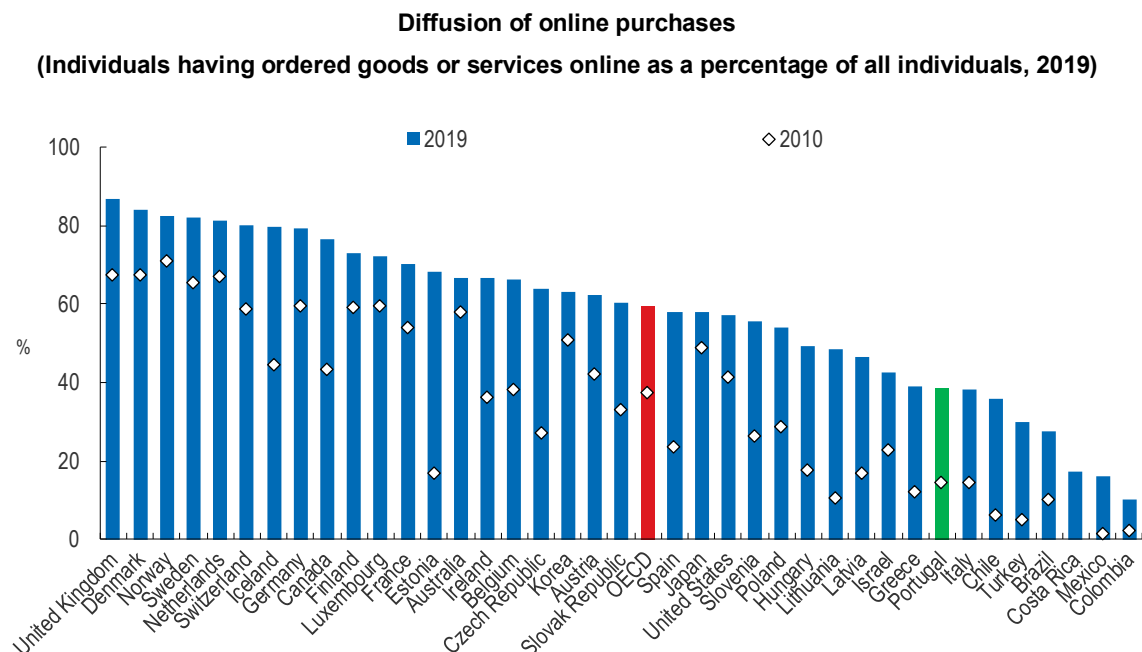
Enterprises using social media (As a percentage of enterprises in each group, 2019)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Businesses Database, <http://oe.cd/bus> and Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

6. E-Commerce

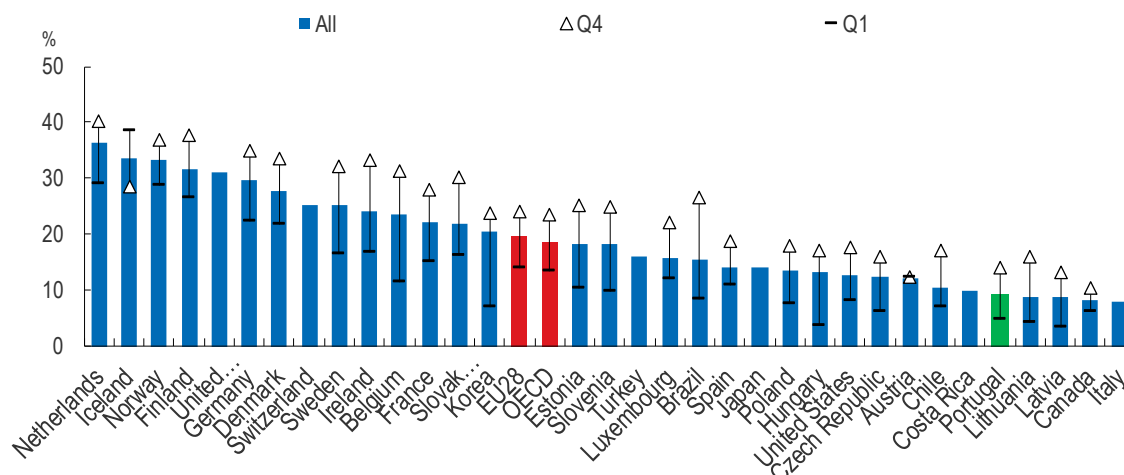
In Portugal, in 2019, only 38.7% of individuals ordered goods or services online for private use in the 12 months preceding the survey. Even so, the country progressed positively compared to 2010 (14.6%), with an increase of 24.1 percentage points.



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>.]

The internet also offers individuals the opportunity to sell goods and services online. Nevertheless, in 2019, only 9.2% of individuals in Portugal sold goods or services on the internet, under the average of both OECD (18.5%) and EU28 (19.7%), and the propensity to sell online is greater among households with higher incomes (4.0%) than with lower incomes (4.8%).

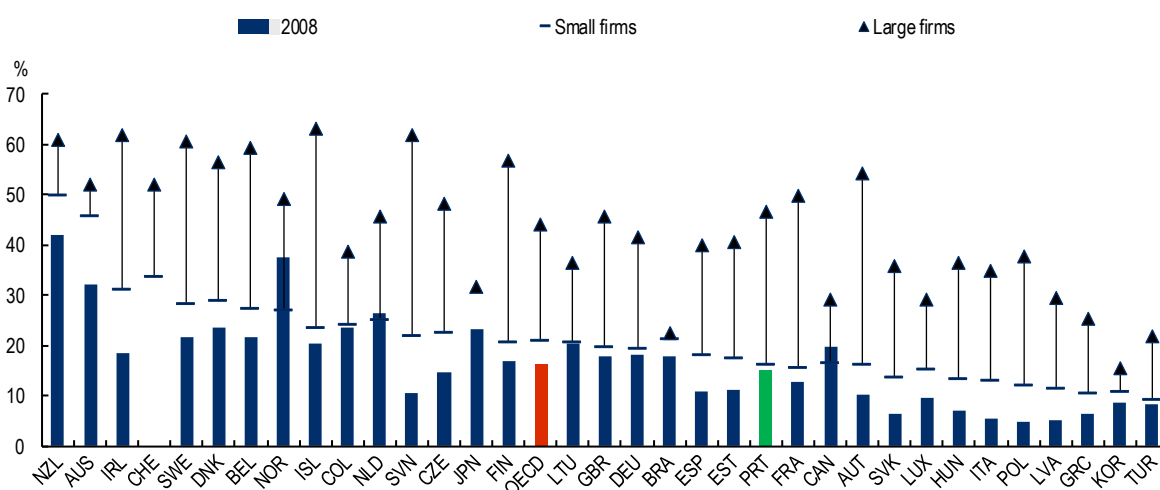
Individuals who sold goods or services on the Internet, by income
(As a percentage of individuals in each quartile, 2019)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind> and Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

Business participation in e-commerce increased significantly since 2008 but smaller enterprises are lagging behind larger ones.

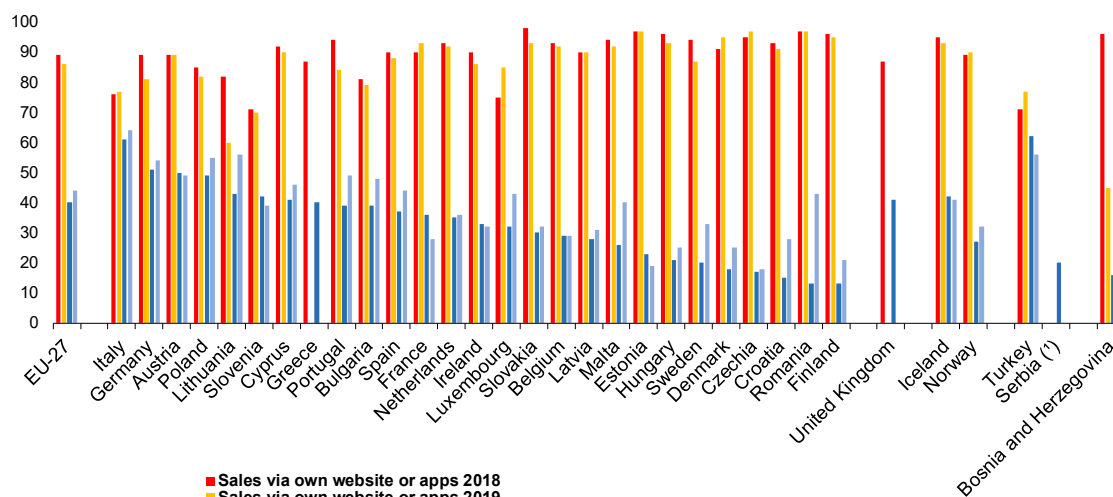
Enterprises receiving orders over computer networks
(Percentage of all enterprises with ten or more persons employed, by enterprise size, 2017)



Source: OECD Studies on SMEs and Entrepreneurship - The Digital Transformation of SMEs, OECD, 2021 [OECD (2019), Unpacking E-commerce: Business Models, Trends and Policies, OECD Publishing, Paris, <https://dx.doi.org/10.1787/23561431-en>, based on OECD (2020[54]), OECD ICT Access and Usage by Businesses Database, <http://oe.cd/bus>.]

From 2018 to 2019 we may verify a shift from enterprises with sales via own website or apps, to sales via an e-commerce marketplace. In Portugal, the percentage of enterprises with web sales via own website or apps reduced from 94% to 84% (EU27 average reduced from 89% to 86%) and the percentage of enterprises with web sales via an e-commerce marketplace grew from 39% to 49% (EU27 average increased from 40% to 44%).

Enterprises with web sales, by type of sales
(% of enterprises with web sales, 2018 and 2019)



(*) Sales via own website or apps: unreliable.

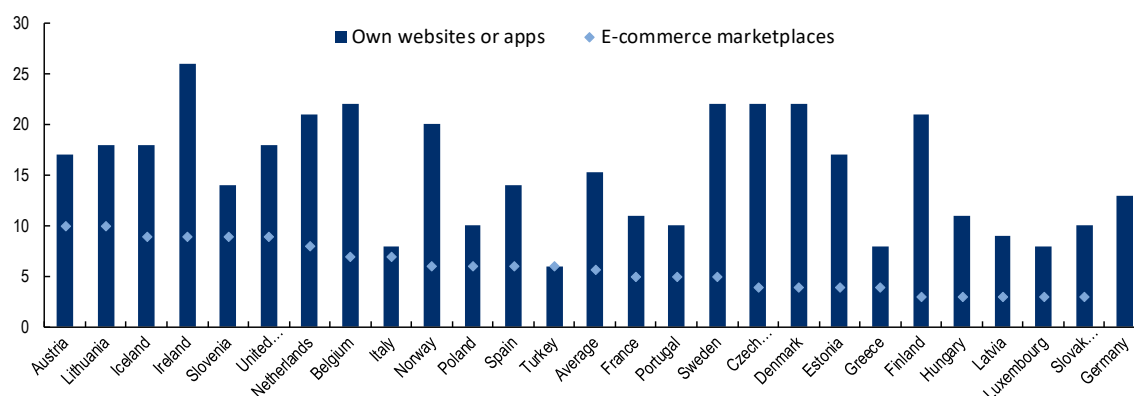
Notes: Data on e-commerce refer to the calendar year preceding the survey (2018 for the 2019 survey and 2019 for the 2020 survey).

Data for Montenegro: unreliable.

Source: Digital Economy and Society Statistics, Eurostat (online data code: isoc_ec_eseln2)

SMEs are more likely to sell online through their own websites or apps than through e-commerce marketplaces.

Percentage of small enterprises using e-commerce, by enterprise size (2019)

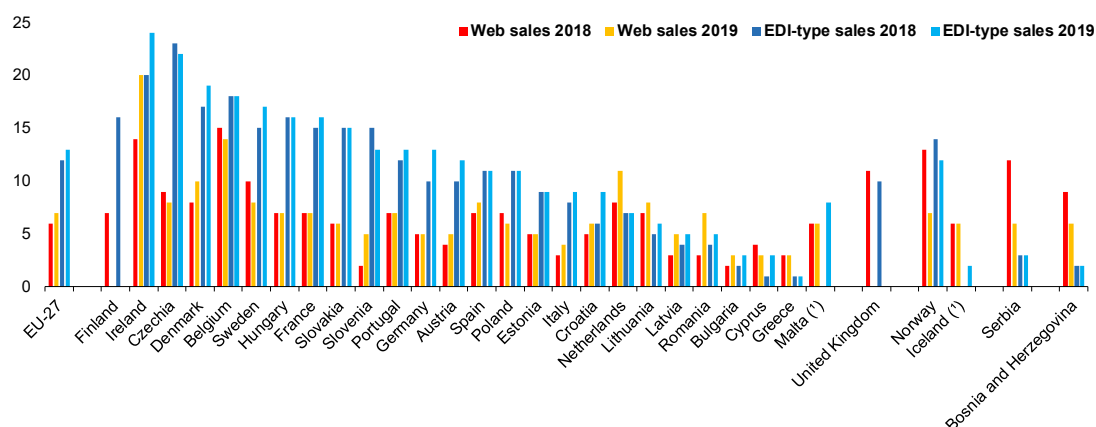


Note: Data only cover enterprises with ten or more persons employed. Small enterprises are defined as with between 10 and 49 employees.

Source: OECD Studies on SMEs and Entrepreneurship - The Digital Transformation of SMEs, OECD, 2021 [Eurostat (2020), Community survey on ICT usage and e-commerce in enterprises.]

E-sales can be carried out via web sales (through websites or apps) or in an automated way via electronic data interchange (EDI). In Portugal, in 2019, as in most of the EU27 countries, the turnover generated from the EDI-type sales (7%) was greater than the one generated from web sales (13%). Portugal is in line with the EU average regarding this indicator.

Turnover from e-sales, by type of order (Web sales and EDI-type sales)
(% of total turnover, 2018 and 2019)



(*) EDI-type sales not available for 2018

Notes: Data on e-commerce refer to the calendar year preceding the survey (2018 for the 2019 survey and 2019 for the 2020 survey).

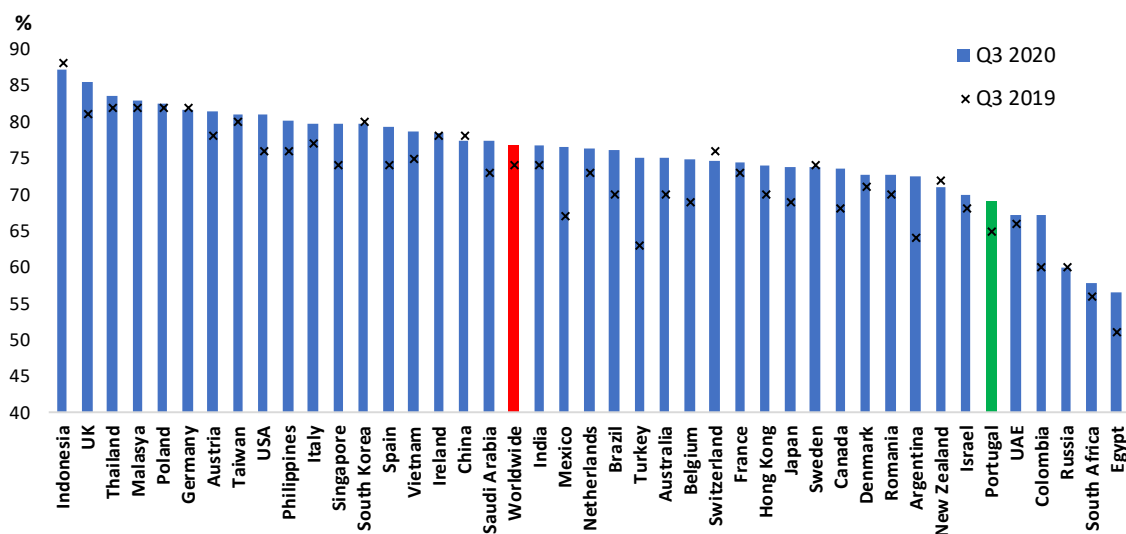
Data for Luxembourg: confidential

Source: Digital Economy and Society Statistics, Eurostat (online data code: isoc_ec_evaln2)

Because of the pandemic of Covid-19, 2020 represented a big leap for e-commerce. The pandemic strongly affected not only consumers but also retailers and logistics operators.

Despite improving in e-commerce adoption (considering internet users that bought online via any device in the previous month) since the previous edition of the Global Web Index, from 65% in the third quarter of 2019 to 69% in the third quarter of 2020, in a global trend, Portugal evolved more slowly than other countries.

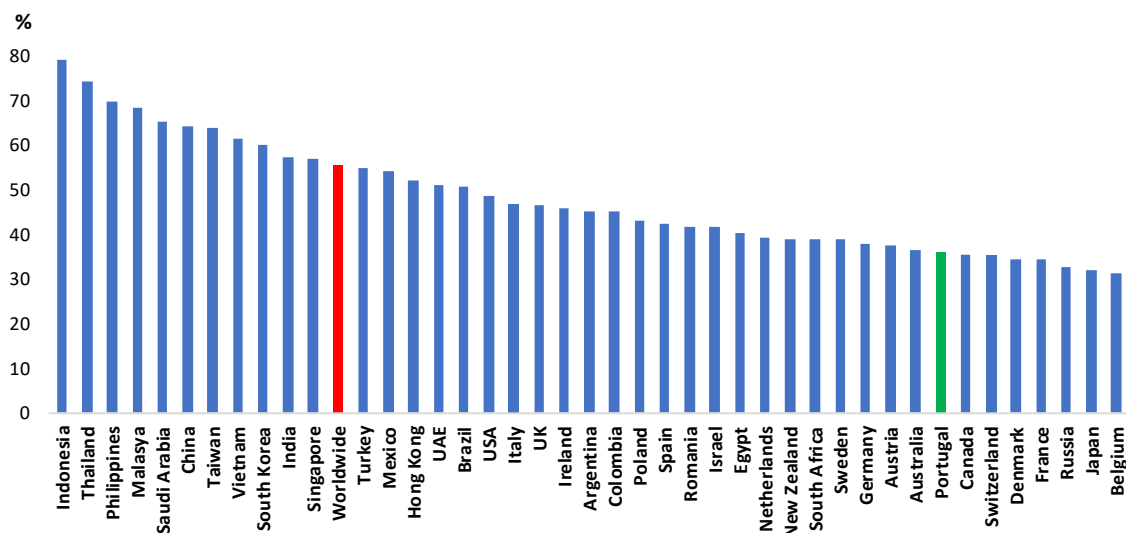
E-Commerce adoption (Percentage of internet users aged 16 to 64, Q3 2019/2020)



Source: Digital 2020 and 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2020 and 2021

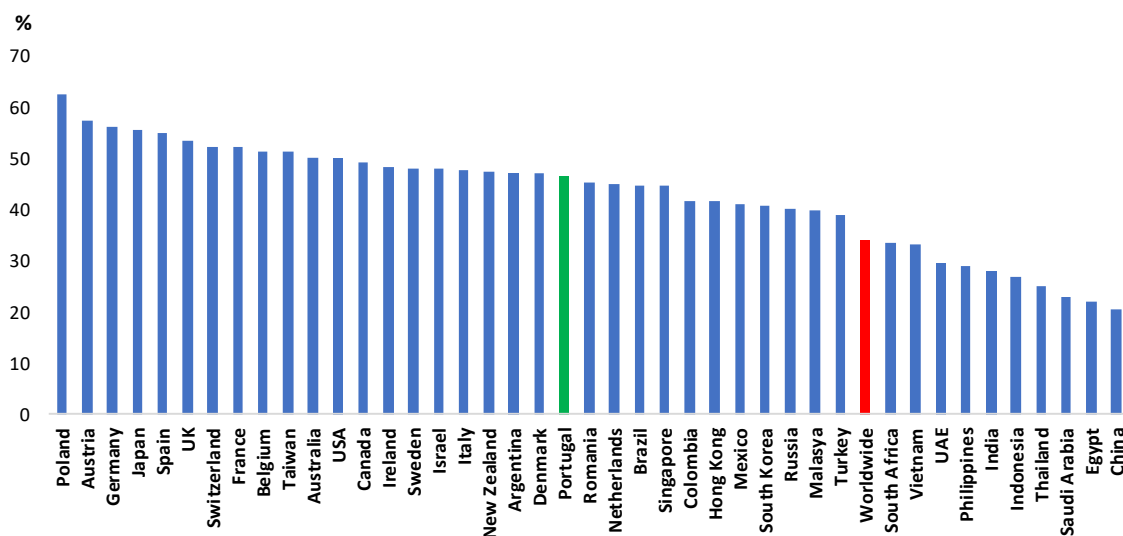
The mobile e-commerce adoption in Portugal is more significant among users that bought sometimes online via a laptop or desktop computer (46.6%), than among users that bought sometimes online via a mobile device (36.1%) in the previous month.

Mobile ecommerce adoption (Percentage of internet users aged 16 to 64, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

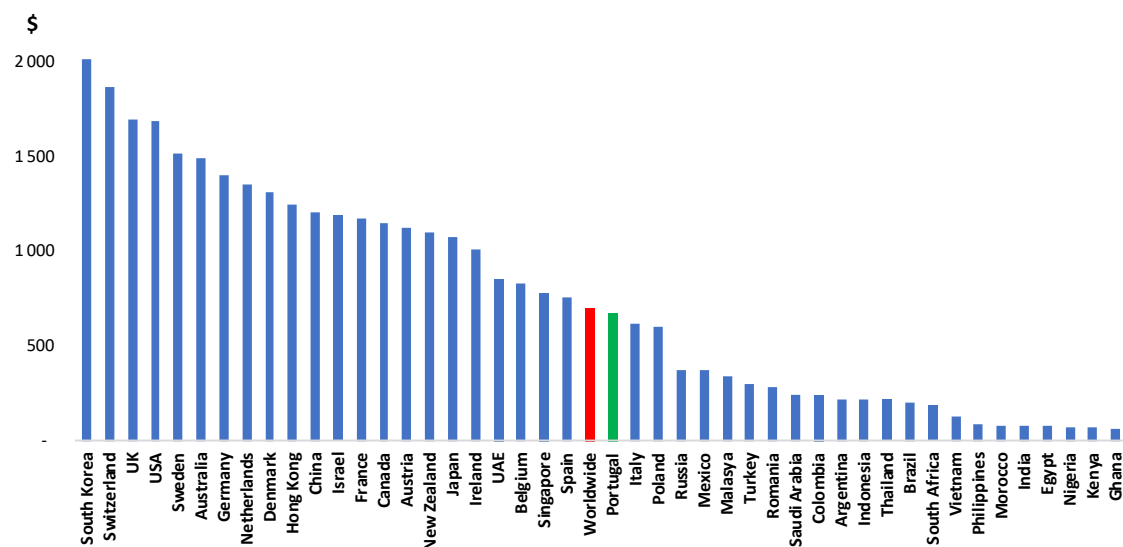
Making ecommerce purchases via a computer (Percentage of internet users aged 16 to 64, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

In Portugal, in 2020, the average amount spent on online purchases of consumer goods by each ecommerce user is in line with the average.

Ecommerce ARPU [Average Revenue Per Unit]: Consumer goods (Average amount per e-commerce user, in US Dollars, 2020)



Notes: Figures based on estimates of full-year consumer spend for 2020, excluding B2B spend. Consumer goods include fashion & beauty products, electronics & physical media, food & personal care products, furniture & appliances, and toys, hobby & diy [do-it-yourself] products.

Source: Digital 2021 – Statista Market Outlook for e-commerce, We Are Social/Hootsuite, 2021

In terms of the perception of e-commerce during the Covid-19 pandemics, respondents in Portugal reported a positive perception of e-commerce - both public and political perception. Some countries, as France, Belgium, Austria and Spain, reported a negative focus on large e-commerce players. Other countries, like Italy and Denmark, referred objections in defense of local enterprises.

Perception of e-commerce

Country	Perception of e-commerce
AT	PPU; PPO; NFL
BE	PPU; PPO; NFL
BG	PPU
CH	PPU; PPO
CZ	PPU
DE	NPO; NPU; PPU
DK	PPU; PPO; OT
ES	PPU; PPO; NFL
FI	PPU
FR	NPO; PPU; NFL
GR	NC
IE	PPU; PPO
IT	PPU; OT
NL	PPU; PPO
NO	PPU; PPO
PL	PPU; PPO
PT	PPU; PPO
RO	PPU; PPO
SE	PPU; PPO

Has the COVID-19 crisis in 2020 had an impact on the perception of e-commerce in your country? (multiple answers possible)

NC - No change

NPU - Negative public perception of e-commerce

NPO - Negative political perception of e-commerce

PPU - Positive public perception of e-commerce

PPO - Positive political perception of e-commerce

NFL - Mainly negative focus on large e-commerce players

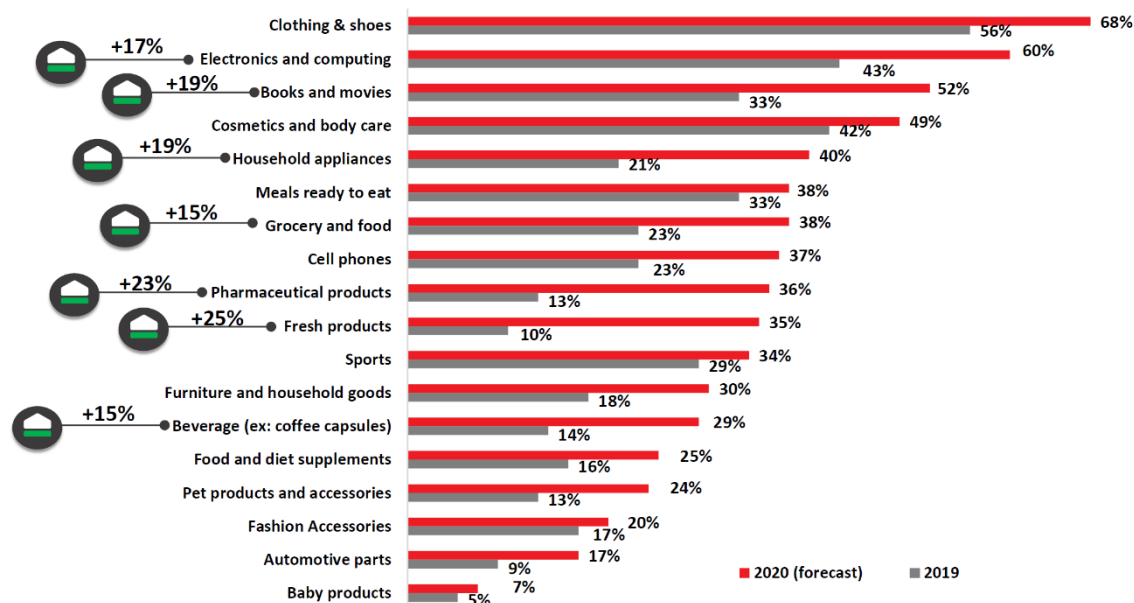
OT - Other

Source: Coronavirus on e-commerce - survey results report, Ecommerce Europe, January 2021

According to the E-commerce Report 2020 (CTT, 2020), with data regarding the third quarter of 2020, the e-commerce business-to-client in Portugal grew 20% in 2020 with a growing interest in online shopping, very much influenced by the limitations in mobility resulting from Covid-19 containment measures. The study also refers an increase in the importance of web sales via e-commerce marketplaces.

The main products that e-buyers referred to have bought in 2020 were clothing and shop (68%), electronics and computing (60%), books and movies (52%) and cosmetics and body care (49%). E-buyers bought more in all categories of products in 2020 than in 2019.

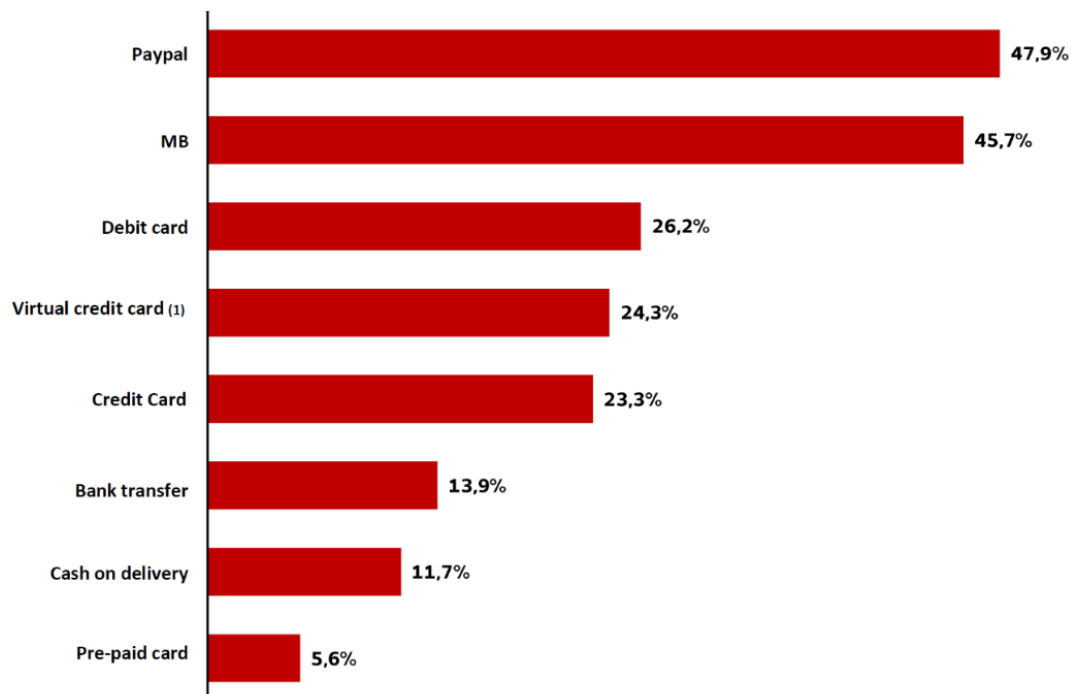
Products profile of the e-buyers



Source: E-commerce Report 2020 (data collected in Portugal between July and September 2020), CTT, 2020

Most of the Portuguese e-buyers referred having paid, when shopping online, with Paypal (47.9%) and MB - Multibanco (45.7%).

Main payment methods for online shopping

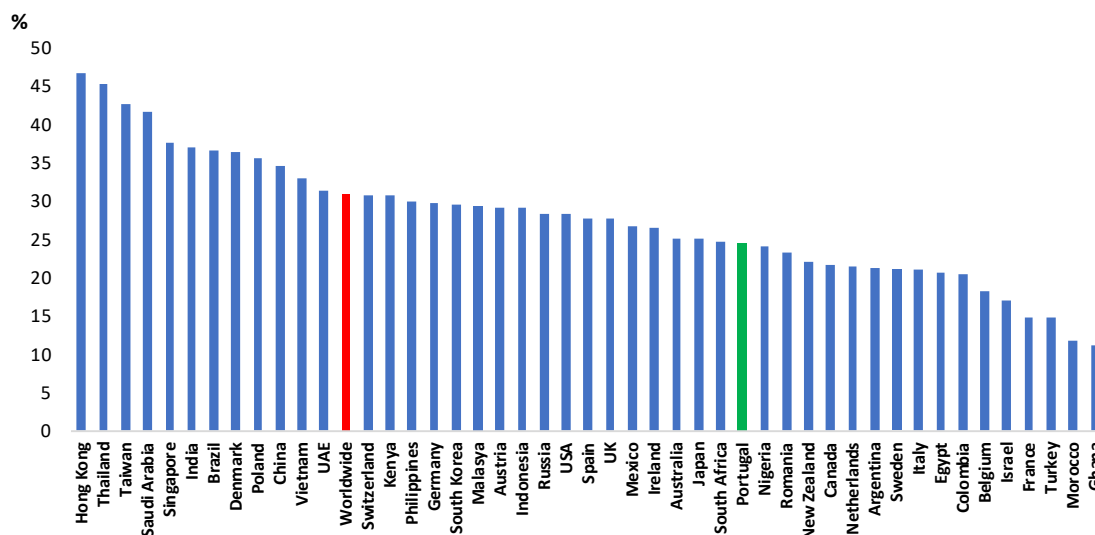


(1) –includes Mbnet, Mbwat, Revolut, etc.

Source: E-commerce Report 2020 (data collected in Portugal between July and September 2020), CTT, 2020

In the third quarter of 2020, only 24.4% of internet users aged between 16 and 64 years used a mobile payment service (e.g. Apple or Samsung Pay) in the previous month. The data is unclear but seems that the use of an app like MBWay might have been disconsidered.

Use of Mobile Payment Services
(Percentage of internet users aged 16 to 64 who have, Q3 2020)

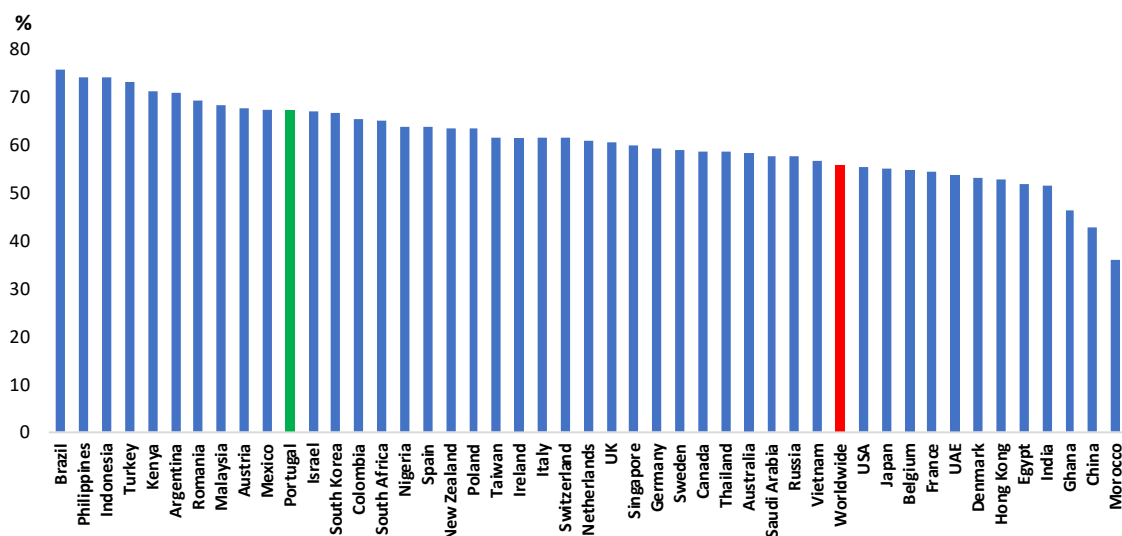


Source: Digital 2020 and 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2020 and 2021

Also according to the E-commerce Report 2020 (CTT, 2020), and as a consequence of the first wave of the pandemic, 45% of the e-sellers duplicated e-sells and 22.5% increased e-sells in 50%. 25% of the e-sellers estimated, for 2020, to more than double e-sells and 30% to increase e-sells in more than 50%. Moreover, 47.5% of the e-sellers expect an increase of more than 20% in the weight of the Portuguese domestic market.

During the third quarter of 2020, 67.2% of internet users aged between 16 and 64 years old reported having researched products online before making a purchase, much above the average.

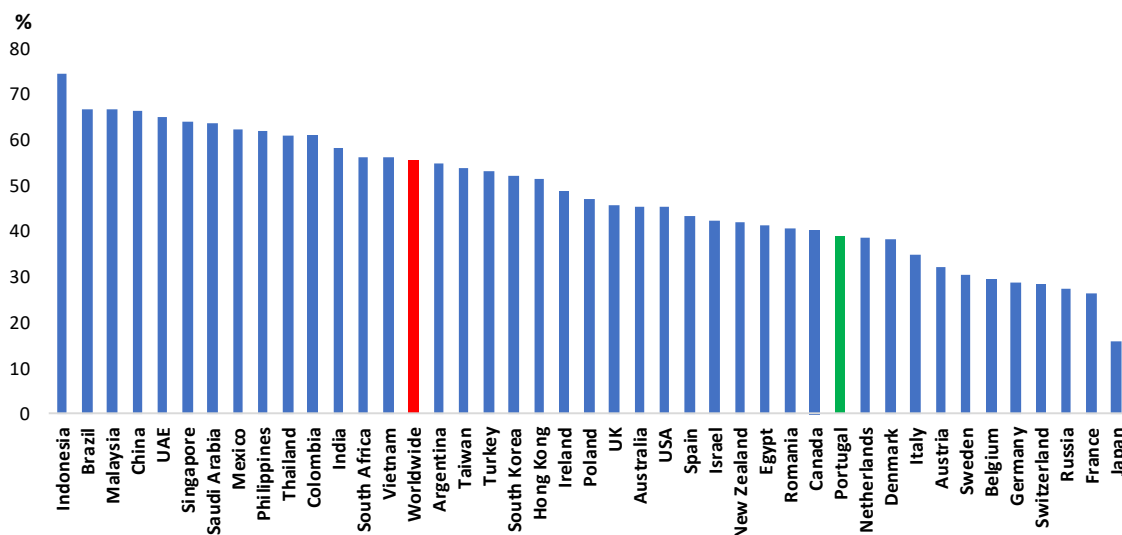
Online Product Research (Percentage of internet users aged 16 to 64, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

In the third quarter of 2020, 39.0% of internet users in Portugal, aged between 16 and 64 years reported using online services to order take-away food for delivery in the previous month, under the average value of 55.5%.

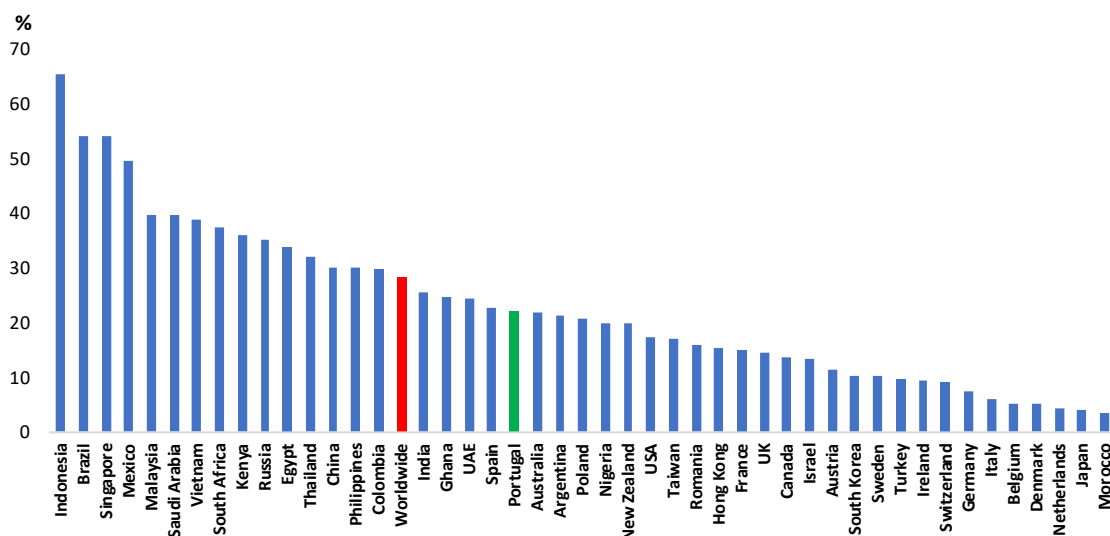
Ordering take-away food online for delivery (Percentage of internet users aged 16 to 64, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

In the same period, 22.2% of internet users in Portugal reported having used an online ride-hailing or taxi booking service in the previous month, under the average value of 28.3%.

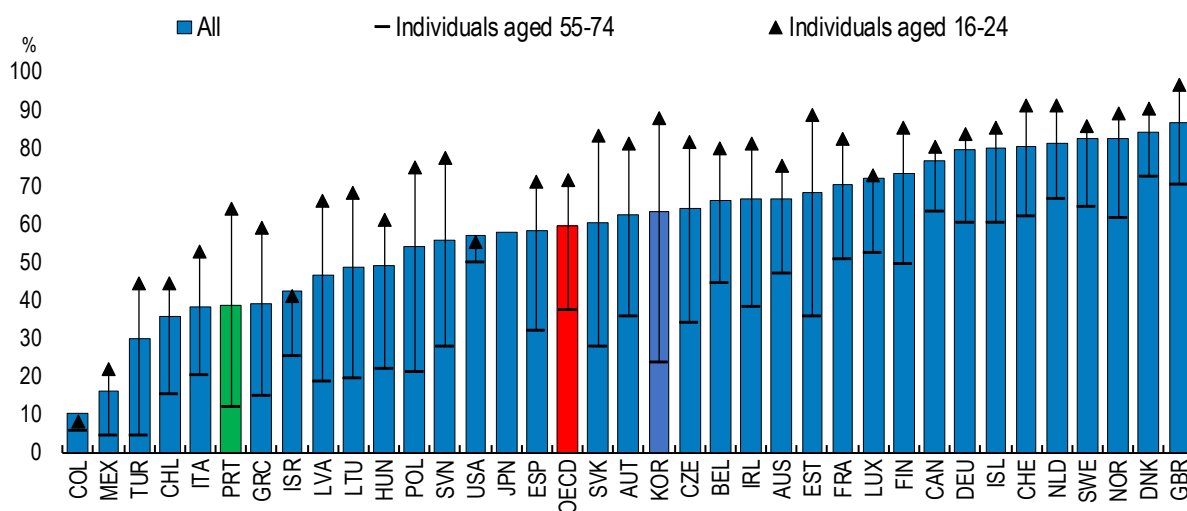
Use of ride-hailing apps (Percentage of internet users aged 16 to 64, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

The age gap in online purchasing in Portugal is one of the highest among OECD countries. The gap between the share of individuals participating in e-commerce aged 55-74 (11.9%) and aged 16-24 (63.9%) is the 5th highest gap among 36 OECD countries considered.

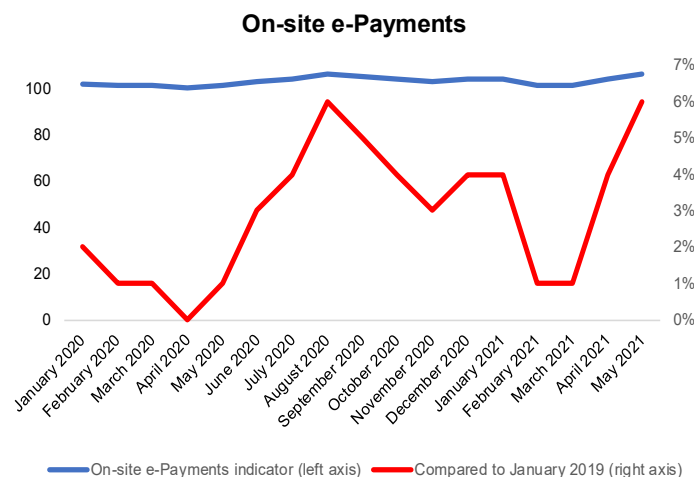
Age gap in online purchasing (Share of individuals participating in e-commerce, 2019 or latest available year)



Note: Data refer to 2018 for Canada, Columbia, Japan and Mexico, 2017 for Chile, Israel and United States, 2016 for Australia.

Source: OECD ICT Access and Usage by Individuals Database

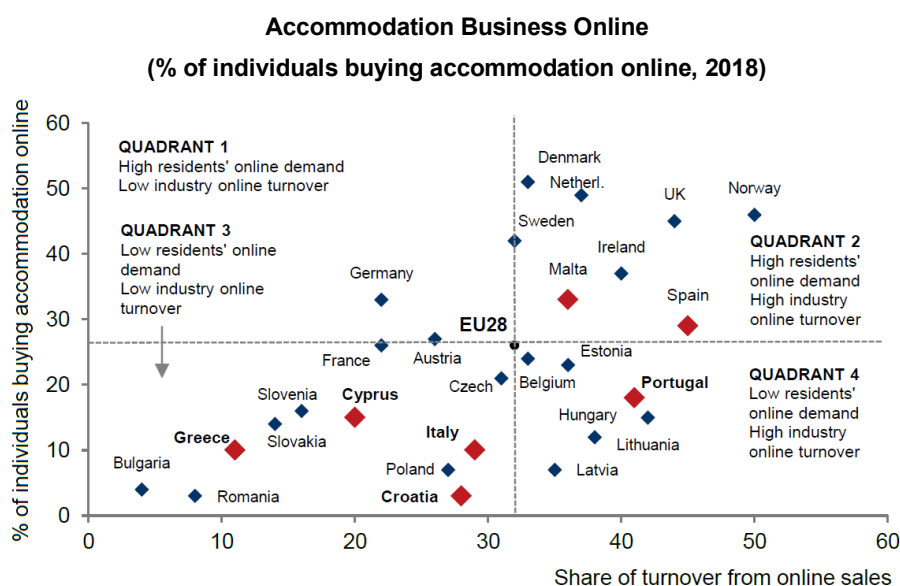
The evolution of on-site e-Payments in Portugal, measured by the weight of on-site purchases in the total of on-site purchases and cash withdrawals carried out in Multibanco Network is very much influenced by the periods of containment, influencing the increase in e-commerce.



Index = 100 for volumes of January 2019.

Source: SIBS Analytics, 2021 (<https://www.sibsanalytics.com/en/digital-economy/>)

Considering the accommodation business online, Portugal has a low level of resident's online purchases of accommodation but a high share of tourism revenue from online sales. Although this information is pre-Covid-19, which caused a strong reduction in tourist activity due to successive periods of confinement decreed by the governments of the several countries, this chart shows the importance of online sales for tourism's turnover in Portugal and the investment in the use of online sales channels to meet the demand of foreign customers.



Source: The impact of online content on Portuguese tourism, Tourism Economics (an Oxford Economics Company), 2019

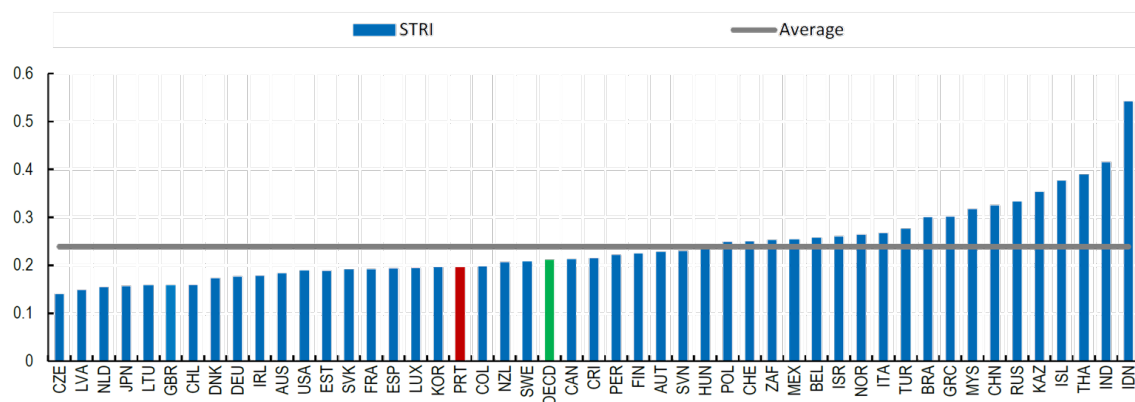
To assess barriers that affect services traded digitally, we consider the OECD Digital Services Trade Restrictiveness Index (Digital STRI).

The report concludes that restrictions on trade and investment in the services sector increased in 2020 around the world. Although the pandemic crisis may have acted as a catalyst for this evolution, many of the measures were already in place before the pandemic erupted. Sectors where restrictions on trade and investment have increased the most are computer, banking and broadcasting services. In contrast, most countries have very significantly reduced barriers to cross-border digital trade in response to the crisis.

The report highlights for Portugal that:

- The index is below the OECD average;
- The persistence of barriers to foreign direct investment in some sectors;
- The most liberalized sectors at national level are courier services, broadcasting, rail freight transport and logistic cargo-handling;
- The most restrictive sector are legal services, accounting services, architecture services and engineering services.

Average STRI across countries (2020)

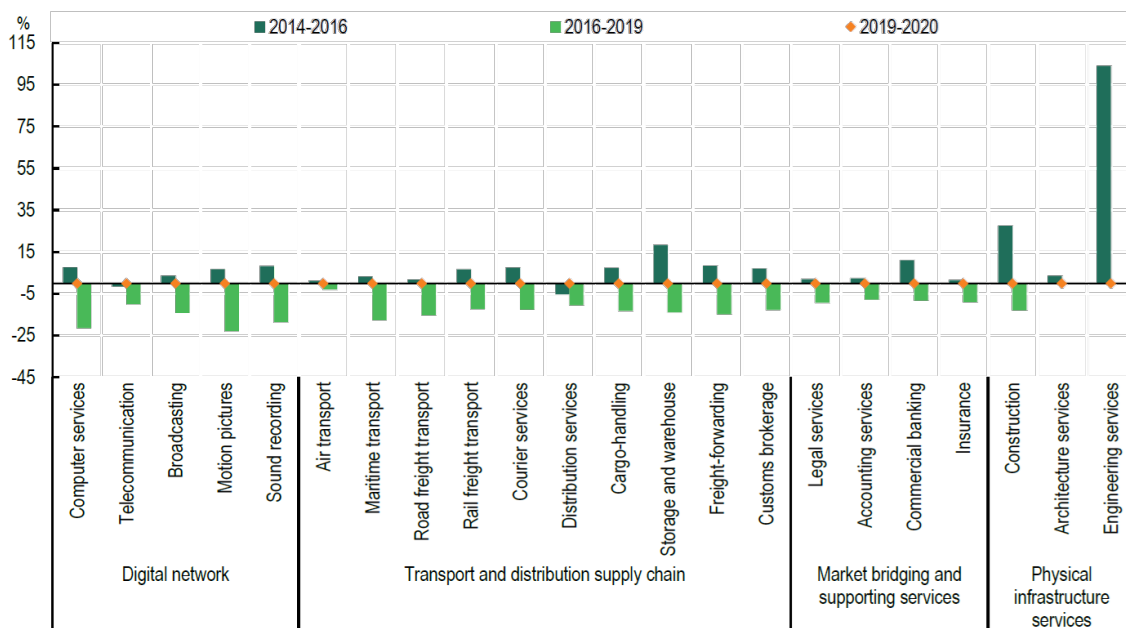


Note: The STRI indices take values between zero and one, one being the most restrictive. The STRI database records measures on a Most Favoured Nations basis. Air transport and road freight cover only commercial establishment (with accompanying movement of people). The indices are based on laws and regulations in force on 31 October 2020. The STRI regulatory database covers the 37 OECD Members, Brazil, China, Costa Rica, India, Indonesia, Kazakhstan, Malaysia, Peru, Russia, South Africa, and Thailand.

Source: OECD Services Trade Restrictiveness Index (STRI), OECD, 2020

From 2016 to 2019, measures were taken to increase openness to services trade and regulations became less rigorous in several sectors, in particular those on the Digital network. In 2020, the index is unchanged compared to 2019.

Evolution of STRI scores by sector in Portugal (Services Trade Restrictiveness Index, percentage change over the period 2014-2016, 2016-2019 and 2019-2020)



Source: OECD Services Trade Restrictiveness Index (STRI), OECD, 2020

As the innovation and adoption of technology relies on access to knowledge and to the networks, the report recommends that Portugal continues to promote the opening of trade in services in sectors where important barriers still exist to enhance the transfer of knowledge, innovation and new technologies.

7. Public Administration

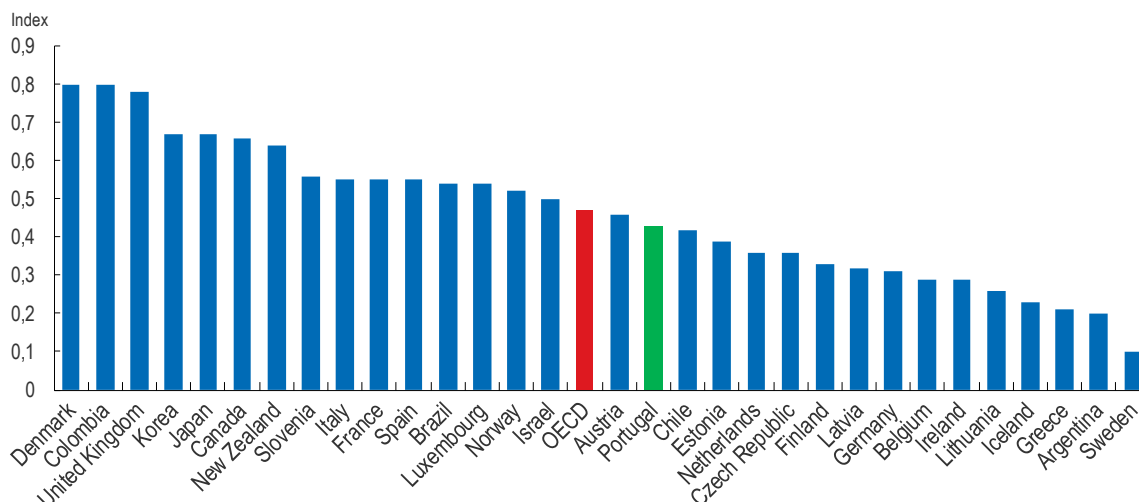
Accelerating the digital transformation of Public Administration, namely through the adoption of Artificial Intelligence tools, will play a fundamental role in the economy and in the society by improving the delivery of public services, making it easier and faster to use the services provided.

Public Administration is an essential element on the path to the digital transition. On the one hand, this digital transition will enable to better serve citizens and enterprises. On the other hand, the digital transition can boost the efficiency and transparency of Public Administration through the full use of digital technologies.

A Public Administration capable of placing itself at the service of citizens, enterprises and other institutions (e.g., academia) must use its full potential to help create investment opportunities by taking advantage of the potential of technologies.

The user-driven approach implies delivering policies and public services centred on the needs of citizens and enterprises. In 2019, Portugal ranked slightly under the OECD average in the user-driven index. But in recent years, namely due a greater focus on digital transition led by a specific governmental area, Portugal advanced in the user-driven approach.

Governments with a user-driven approach, 2019

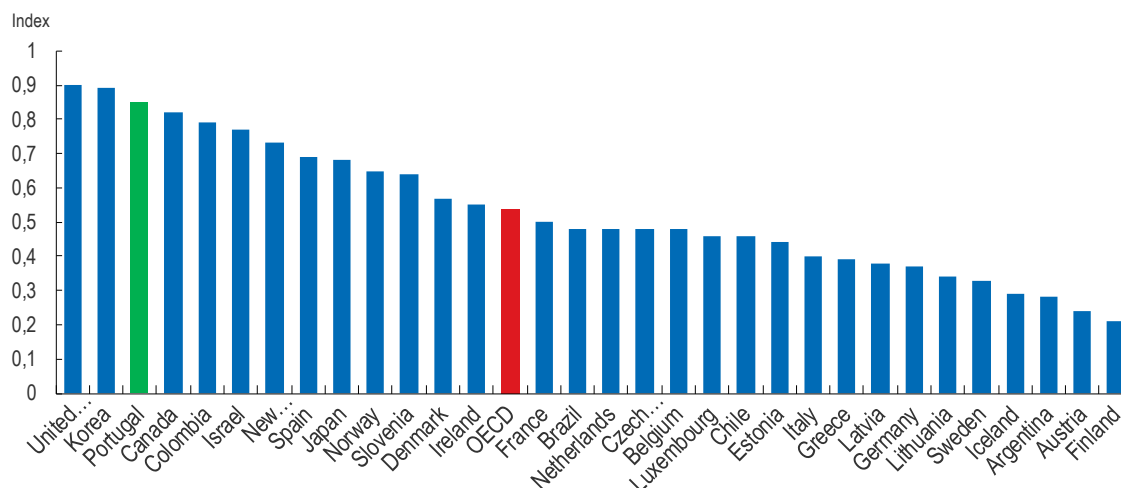


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on OECD Survey on Digital Government.]

In fact, since 2019 the body responsible for the digital government strategy is located at the Ministry of Economy and Digital Transition, with a state department (Secretary of State) for Digital Transition, leading the mission structure “Portugal Digital” responsible to implement the Action Plan for Digital Transition.

Portugal is one of the leading countries embracing the government as a platform approach, which is a holistic approach to obtain greater outcomes from the interaction between public sector and private sector (citizens and enterprises).

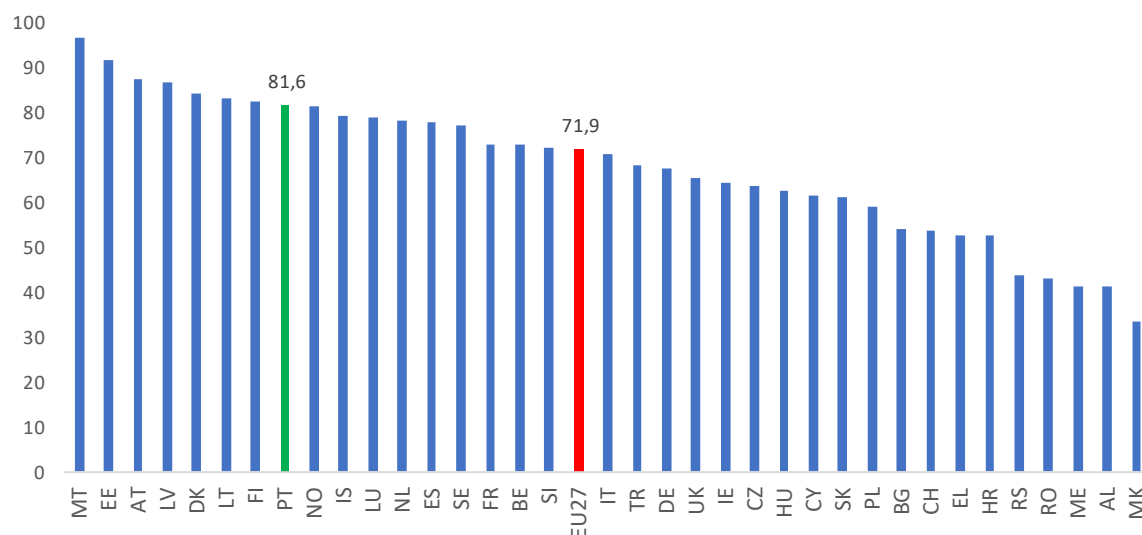
Countries with a government as a platform approach, 2019



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on OECD Survey on Digital Government.]

Regarding the overall country performance in the eGovernment Benchmark, ranks in the 8th position among 36 OECD countries and significantly above the EU27 average.

eGovernment Benchmark - Overall country performance (2019 biennial average)



Source: eGovernment Benchmark 2020, European Commission, October 2020 (<https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2020-egovernment-works-people>)

In 2019, besides the good overall country performance, Portugal presents a growth of seven percentage points compared to two years ago.

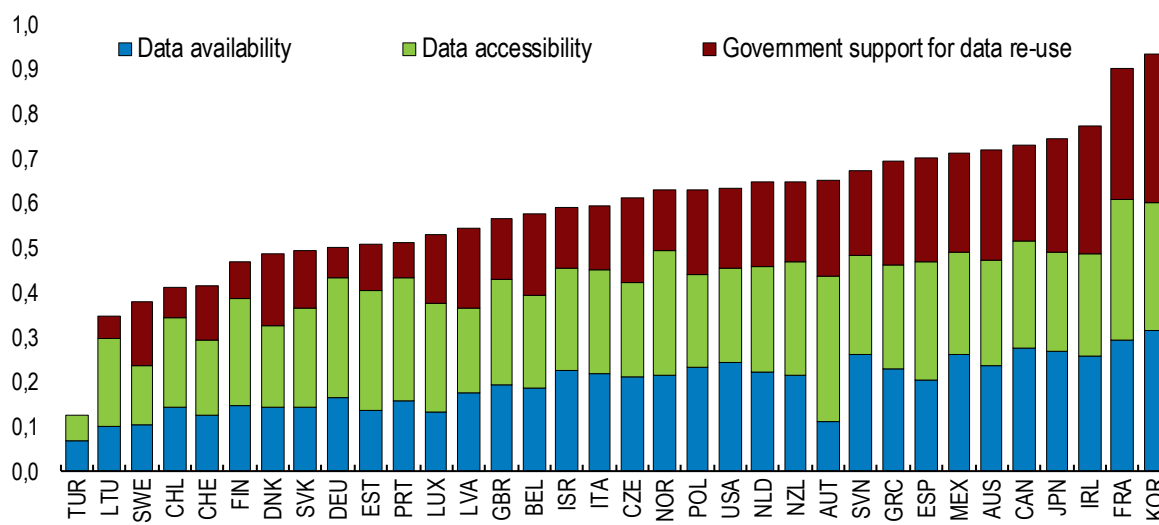
Overall country performance (2019 biennial average + growth compared to two years ago)



Source: eGovernment Benchmark 2020, European Commission, October 2020 (<https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2020-egovernment-works-people>)

Nonetheless, there is room for improvement, in particular regarding Government support for data re-use, as Portugal ranks in the 29th position among 34 OECD countries. In fact, it is a stylized fact that Public Administration has a large quantity of data that could be made available to researchers and enterprises, respecting confidentiality and privacy issues, in order to support public policies and to enable the identification of new business opportunities.

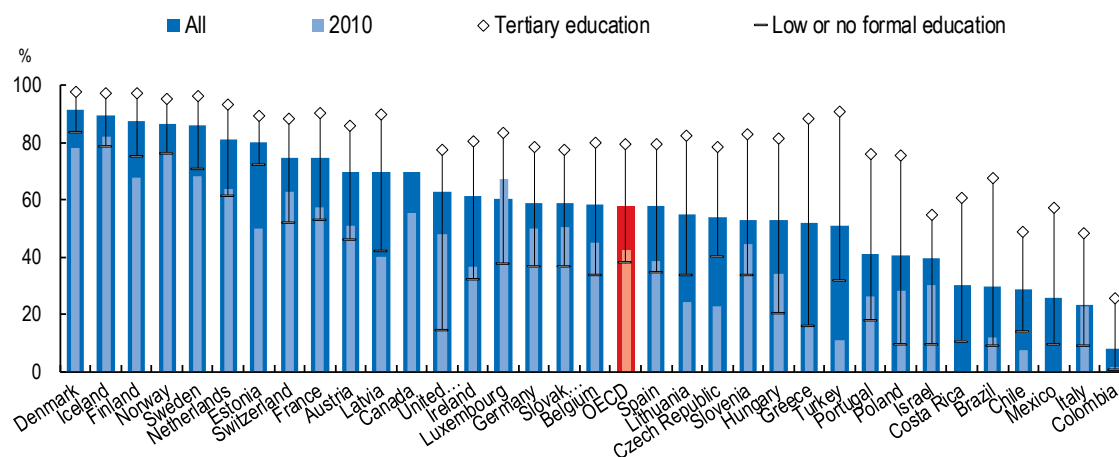
Score in open-useful-reusable government data
(OURdata Index scores in the dimensions of data availability, accessibility and reusability, 2019)



Source: OECD OURdata Index on Open Government Data

Portugal also needs to improve the access to public services, especially among individuals with lower educational attainment. In 2019, only 41.0% of individuals used internet to interact with public authorities, much below the OECD average (57.9%). This represents, nevertheless, an important overall progress since 2010 – more 14.9 percentual points.

Individuals who used the Internet to interact with public authorities, by educational attainment
(As a percentage of individuals in each group, 2019)

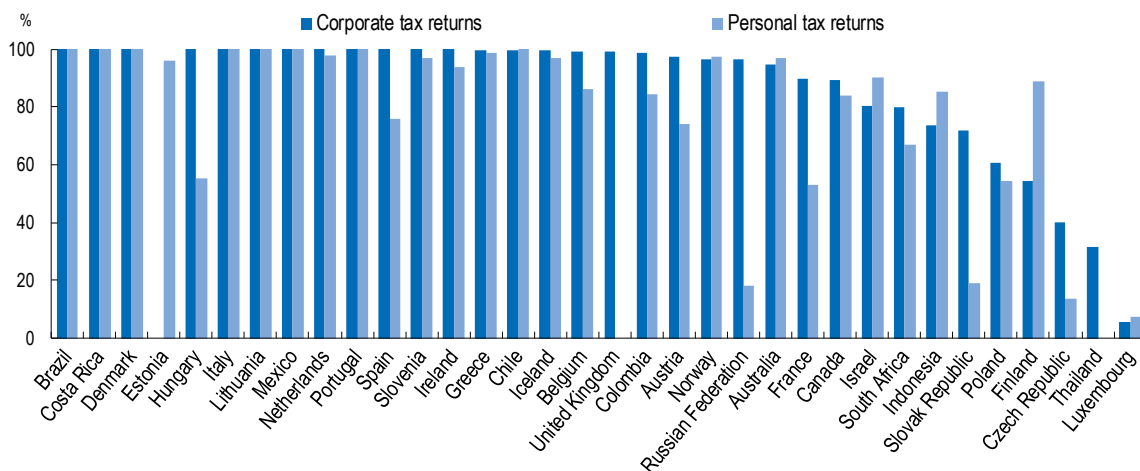


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>]

Considering both personal and corporate income tax return filed online, Portugal ranks very well in this indicator – in 2017, Portugal already ensured all these tax returns filled online and was one of the six OECD countries (among 34 considered) with 100% in both the indicators.

Personal and corporate income tax returns filed online

(As a percentage of all tax filings, 2017)

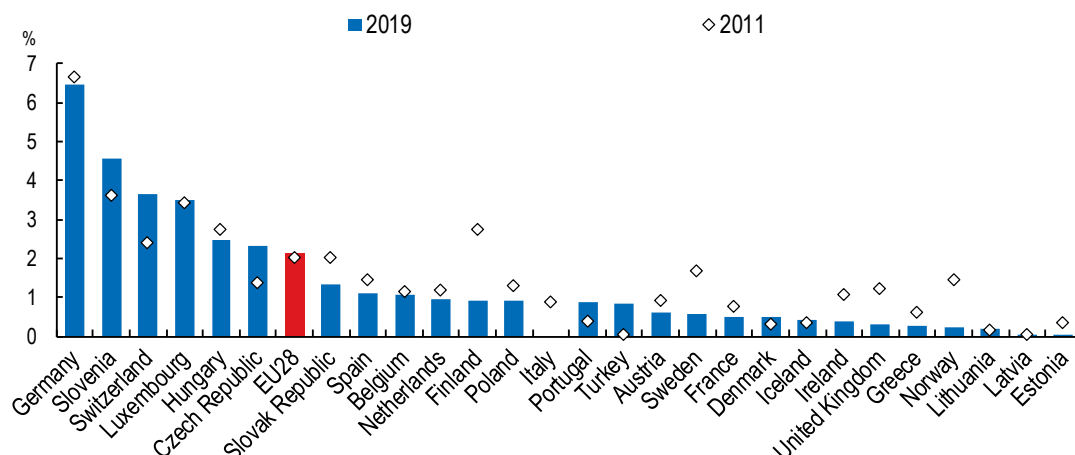


Note: Note: For Iceland, the corporate tax return data refer to 2014.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2019), Tax Administration 2019: Comparative Information on OECD and other Advanced and Emerging Economies, OECD Publishing, Paris, <https://doi.org/10.1787/74d162b6-en>.]

Notwithstanding, if we consider other types of forms, in 2019, in Portugal, 0.89% of individuals referred unavailability of online submission channels as a reason for not submitting online forms to public authorities. Although this is a low value, under the EU28 average (2.14%), it represents an increase regarding 2011 (0.42%). According to the OECD, “this may reflect greater awareness of survey respondents about unavailability (as a result of being more likely to seek how to submit forms online), rather than the closure of online submission channels” (Digital Economy Outlook 2020, OECD, 2020).

Individuals who did not submit forms to public authorities online due to service availability (As a percentage of all individuals, 2019)



Note: For Switzerland, data refer to 2014 and 2017. For Turkey, data refer to 2012 instead of 2011.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>.]

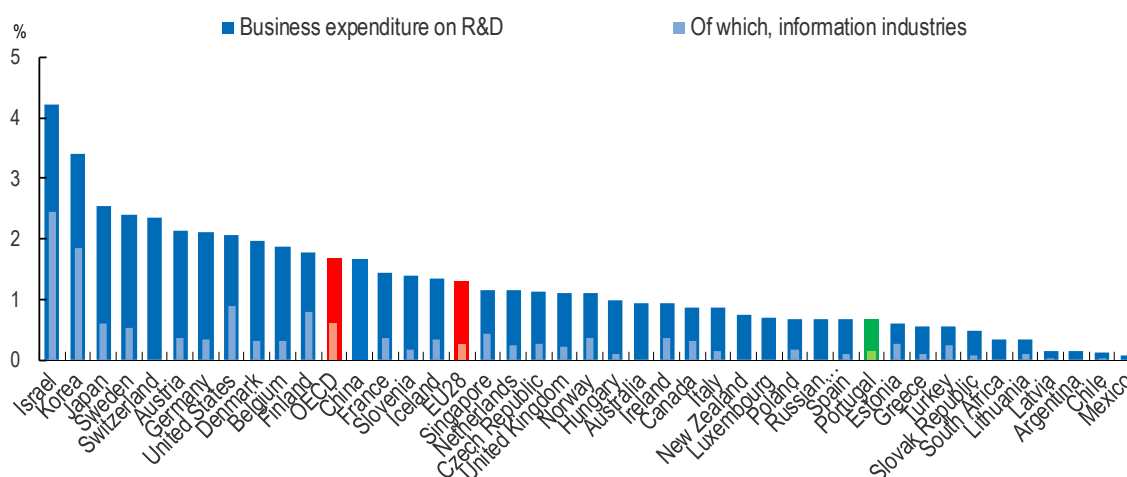
8. Digital Innovation

Innovation is an essential factor to ensure the necessary means for digital transformation so that enterprises in general, as well as start-ups and technology enterprises, have at their disposal the digital technologies that allow them to solve challenges in terms of performance, effectiveness and productivity. Using digital innovation is essential to develop, test and launch these solutions on the market and foster digital transition.

Digital transition also requires Research and Development (R&D) and enterprises are the main drivers. Portugal has low business R&D intensity, representing only 0.67% of Gross Domestic Product (GDP), below the OECD (1.67%) and EU28 (1.30%) averages.

In some countries, information industries (which includes producers of ICT and digital contents), which are knowledge-intensive, contribute significantly to the percentage of business R&D expenditure. For instance, in 2017, in Israel and Korea, information industries contribute with more than 50% of business R&D expenditure. In Portugal, the business R&D expenditure of information industries represents only 0.15% of Gross Domestic Product (GDP), about 22.7% of business R&D expenditure, below the average of OECD (0.60%) and EU28 (0.25%).

**Business R&D expenditure, total and information industries
(As a percentage of gross domestic product, 2017)**

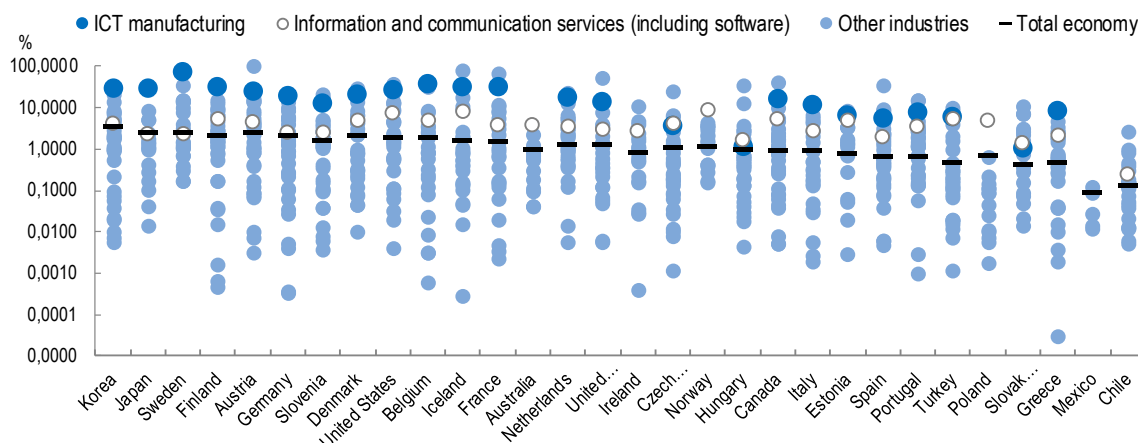


Notes: R&D = research and development. "Information industries" comprise ISIC Rev.4 divisions: "Computer, electronic and optical products" (26), "Publishing, audiovisual and broadcasting activities" (58 to 60), "Telecommunications" (61) and "IT and other information services" (62 to 63). Zone estimates (OECD and EU28) correspond to member countries' R&D intensity averages weighted by GDP in purchasing power parity. For information industries, they exclude countries where no data are available. Data on total business expenditure on R&D (BERD) refer to 2017 except for South Africa (2016). Information industries values relate to the same reference year where possible or are based on shares for the most recent available year.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on ANBERD (database), <http://oe.cd/anberd> and Main Science and Technology Indicators (database), <http://oe.cd/msti>]

Considering R&D intensity, in 2016, computer, electronic and optical products (7.42%) and information and communication services (3.44%) contributed significantly to this indicator. The most R&D-intensive enterprises are in the sector of pharmaceuticals, medicinal chemical and botanical products (14.76%) and scientific R&D (14.76%).

R&D intensity of ICT and other industries
(As a percentage of gross value added in each industry, log scale, 2016)

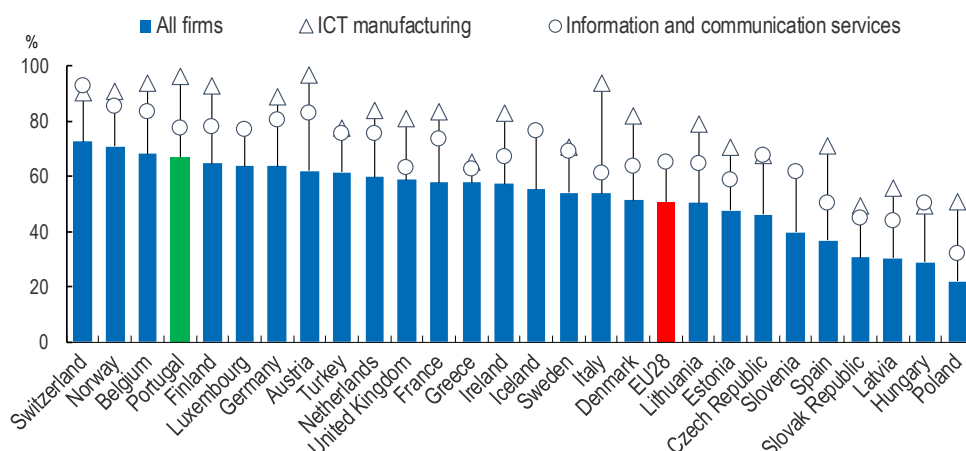


Notes: For Korea, Sweden, Germany, Denmark, Island, Spain, Portugal and Turkey, data refer to 2015. For Chile and Canada, data refer to 2014. For Poland and Norway, data refer to 2017. Figures are based on estimates of business R&D by industry reported on a main activity basis according to ISIC Rev.4. R&D intensity has been calculated for each industry, where both R&D and Value Added (VA) data were available. These ratios are sensitive to the statistical units used in both frameworks. A broader discussion is available in Galindo-Rueda and Verger (2016). In particular, national practices differ in respect to the treatment of large and complex multi-activity enterprises and those enterprises specialised in providing R&D services. StatLink contains more data.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on ANBERD (database), <http://oe.cd/anberd>, STAN (database), <http://oe.cd/stan>, National Accounts (database), and Research and Development Statistics (database), <http://oe.cd/rds>]

The incidence of innovation activities is higher in ICT manufacturing and information and communication services. Portugal, in 2016, ranked in the 4th position among 27 countries in the introduction of innovation (66.9% among all enterprises) – 2nd in ICT manufacturing (96.2%) and 7th in information and communication services (77.5%).

**Enterprises that have either introduced an innovation or have any kind of innovation activity
(As a percentage of all enterprises in the relevant sector, 2016)**



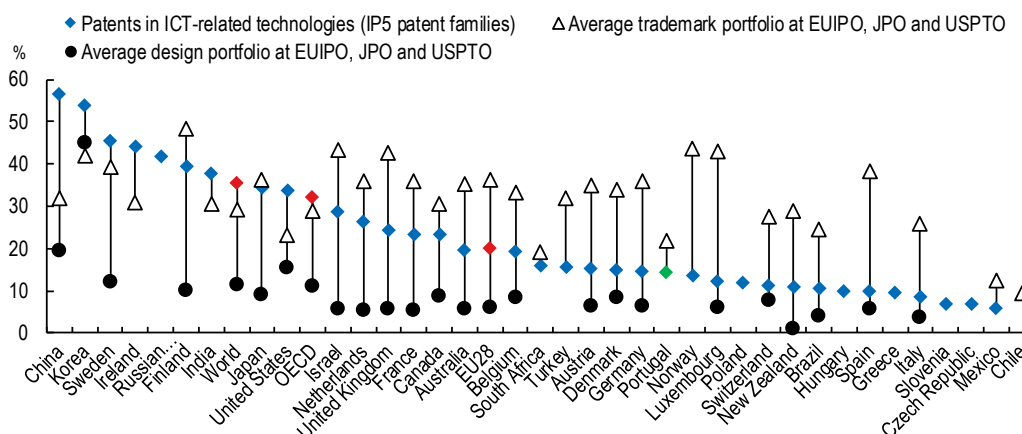
Notes: ICT = information and communication technology.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on Eurostat, Community Innovation Survey.]

Because patents are used to protect ICT-related technologies, such as high-speed communications, storage and computing, their volume may indicate the level of innovation in ICT-related technologies.

In Portugal, ICT-related patents, trademarks and designs, between 2014 and 2017, represented only 14.4% of total IP5 patent families (OECD – 31.9% | EU28 – 19.8%) and 22.0% of total trademarks at the EUIPO, JPO and USPTO (OECD – 28.9% | EU28 – 36.3%).

**ICT-related patents, trademarks and designs
(As a percentage of total IP5 patent families or total trademarks and total design patents at the EUIPO, JPO and USPTO, by country of ownership, 2014-17)**



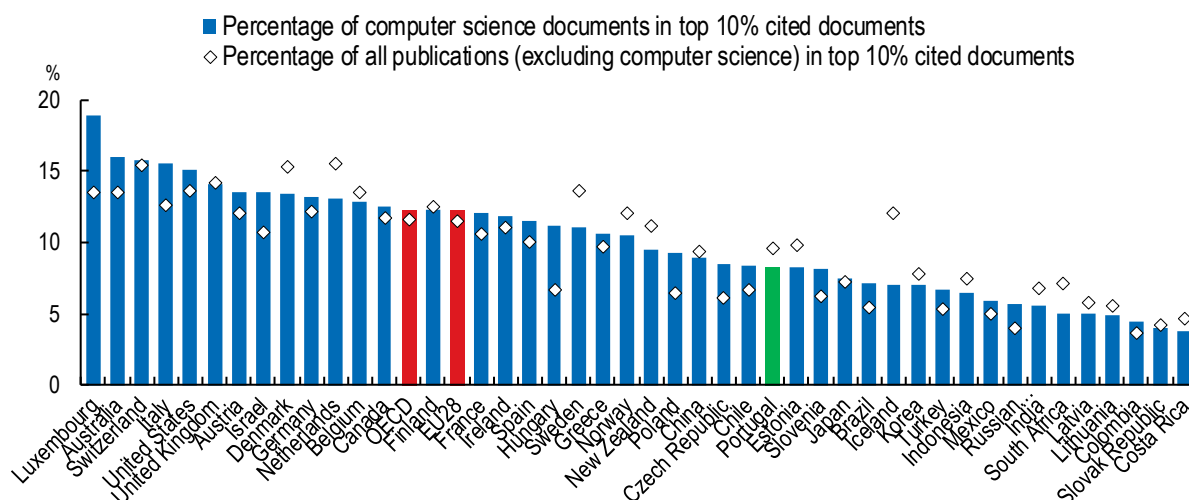
Notes: Patents protect technological inventions (i.e. products or processes providing new ways of doing something or new technological solutions to problems). IP5 patent families are patents filed in at least two offices worldwide, including one of the five largest IP offices..

Only economies with more than 250 patent families in the periods considered are included. Data for 2016 and 2017 are incomplete.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on OECD, STI Micro-data Lab: Intellectual Property Database, <http://oe.cd/ipstats>.]

Innovation in digital innovation and technologies benefit from studies on the scientific field of computer science. In Portugal, in 2018, only 8.3% of computer science documents were in the top 10% cited documents (OECD – 12.3% | EU28 – 12.2%), which is under the 9.6% registered by the other publications (excluding computer science) in top 10% cited documents.

Top 10% most-cited documents in computer science (Percentage of domestic documents (fractional counts) in the top 10% citation-ranked documents, 2018)

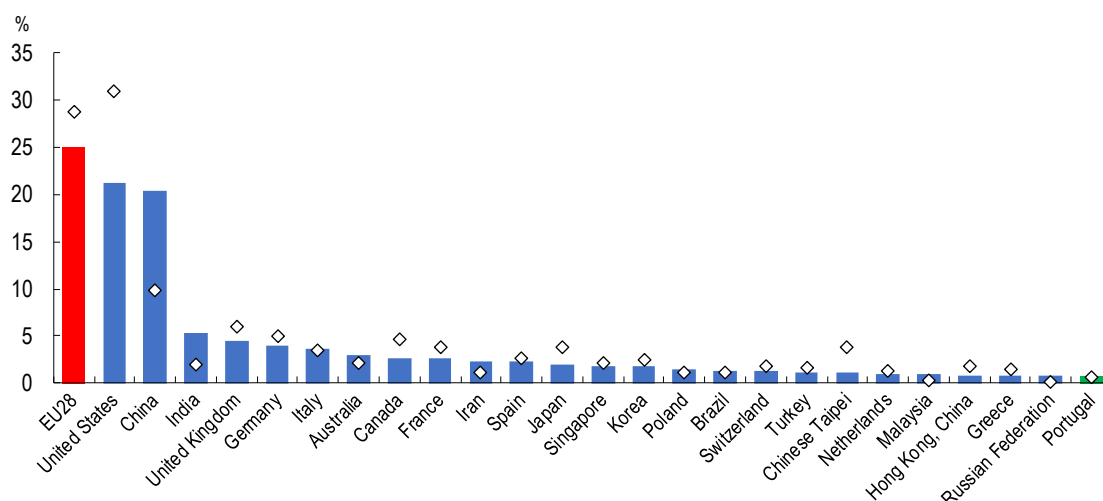


Notes: Computer science publications consist of citeable documents (articles, conference proceedings and reviews) featured in journals specializing in this field. "Top-cited publications" are the 10% most-cited papers normalised by scientific field and type of document. Instead of counting a publication repeatedly if two or more countries contribute to it, fractional counting distributes such publication across contributors so that all publications have the same equal weight.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based on Scopus Custom Data, Elsevier, Version 1.2018; and 2018 Scimago Journal Rank from the Scopus journal title list.]

In 2016, the EU28 and the United States were responsible for the largest shares of highly cited AI-related publications but both lost shares between 2006 and 2016. On the opposite, China almost doubled the share and occupied the 3rd position. From 2006 to 2016, Portugal's shares of AI-related publications featuring among the world's top 10% most cited publications grew slightly, from 0.6% to 0.7% but was extremely low.

Top-cited scientific publications related to AI (Economies with the largest number of AI-related documents among the 10% most cited publications, 2016 and 2006)

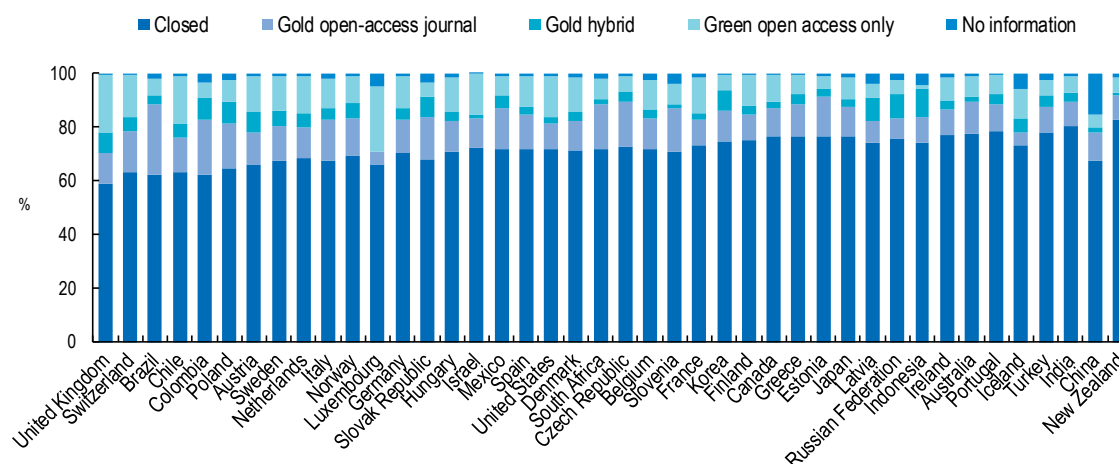


Note: AI = artificial intelligence. Economies' shares in global AI top-cited publications are based on fractional counts.

Source: The Digitalisation of Science, Technology and Innovation: Key Developments and Policies, OECD, 2020 [OECD Measuring the Digital Transformation: A Roadmap for the Future, OECD Publishing, Paris, <https://doi.org/10.1787/9789264311992-en> - OECD calculations based on Scopus Custom Data, Elsevier, Version 1.2018 and 2018 Scimago Journal Rank from the Scopus journal title list, January 2019.]

The dissemination of scientific knowledge through open access to scientific articles is important to promote the development of new R&D and Innovation. Although digital technology may facilitate the diffusion of large number of research documents, many are not available openly. Portugal is one of the countries with more closed (only available through payment or subscription) scientific documents (78.3%), ranking in the 37th position among 42 countries.

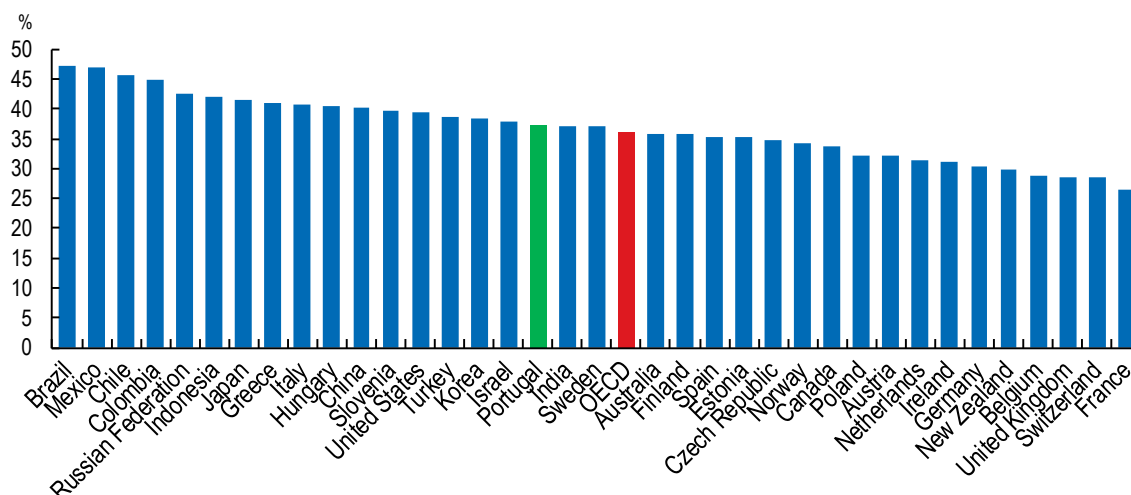
Open access of scientific documents (As a percentage of a random sample of 100 000 documents published in 2016, by country of affiliation)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2017), OECD Science, Technology and Industry Scoreboard 2017: The Digital Transformation, OECD publishing, Paris, <https://doi.org/10.1787/9789264268821-en>.]

In 2018, according to an experimental indicator, 37.3% of scientific authors in Portugal have a positive view on the digital transformation of scientific research, above OECD average (although disclaimers should be considered).

Scientific authors' views on the digitalisation of science, by country of residence
(Average sentiment towards a positive digitalisation scenario, as percentage deviation from the mid-range of possible responses, 2018)

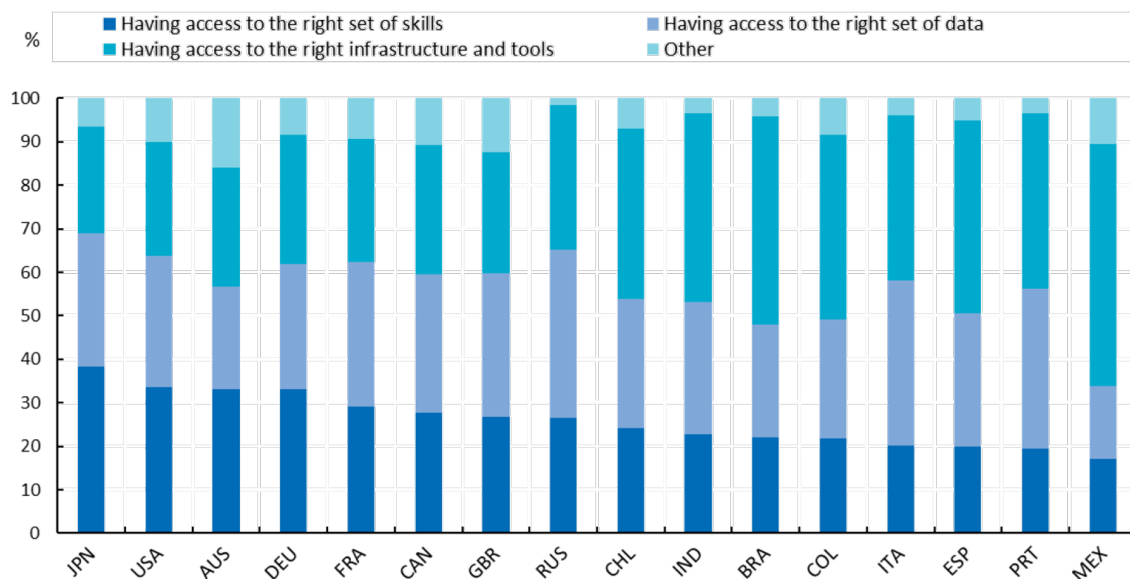


Notes: This is an experimental indicator. Cross-country comparisons should be interpreted with caution as the population of corresponding scientific authors is not uniformly representative of their scientific community. Economies with fewer than 75 survey responses not shown. Average scores are weighted and consider the sample design and non-response.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [Bello, M. and F. Galindo-Rueda (2020), Charting the digital transformation of science: findings from the 2018 OECD International Survey of Scientific Authors, OECD Publishing, Paris, <https://doi.org/10.1787/1b06c47c-en>.]

In Portugal, the most important challenges faced by scientific authors are the access to the right set of data and the access to the right infrastructure and tools. This is important to assess how national capacity is responding to the digitalisation of research.

Challenges for data-intensive research in different countries



Most important challenge faced by scientific authors, by country of residence. Percentage of authors within each field selecting the relevant option. Note: Weighted estimates based on sampling weights adjusted for nonresponse.

Source: Bello and Galindo-Rueda (2020), based on the OECD International Survey of Scientific Authors 2018. <http://oe.cd/issa>.

To measure Open Data maturity across Europe, the following indicators were considered, that provide different metrics for policies to promote, impacts expected, features of portals and quality of Open Data in each EU27 country.

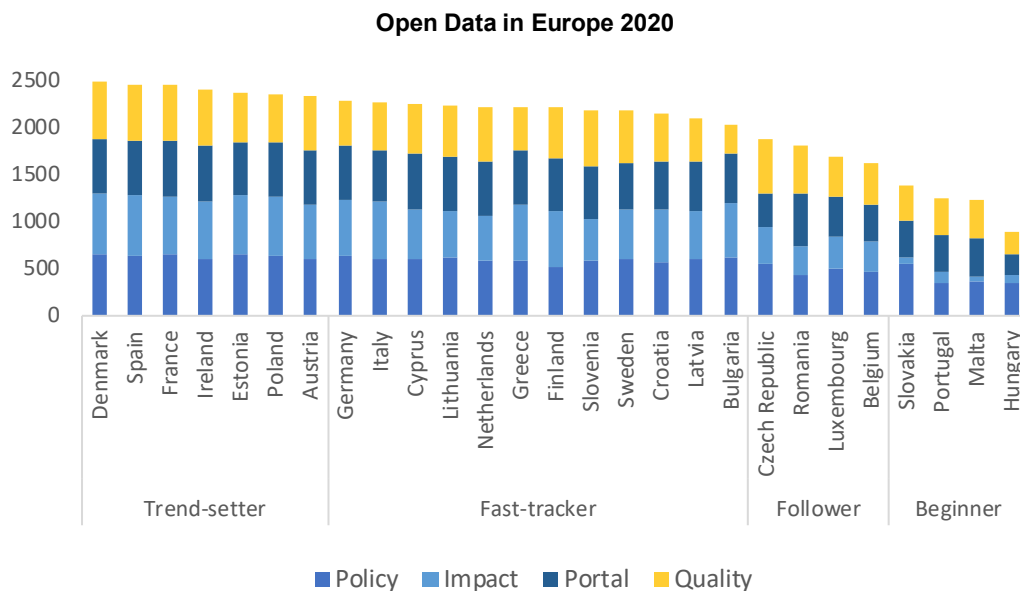
Open Data Maturity dimensions and dimension-specific metrics

Dimension	Metrics
Open Data Policy	Policy framework
	Governance of open data
	Open data implementation
Open Data Impact	Strategic awareness
	Political impact
	Social impact
	Environmental impact
	Economic impact
Open Data Portal	Portal features
	Portal usage
	Data provision
	Portal sustainability
Open Data Quality	Currency
	Monitoring and measures
	DCAT-AP compliance
	Deployment quality and linked data

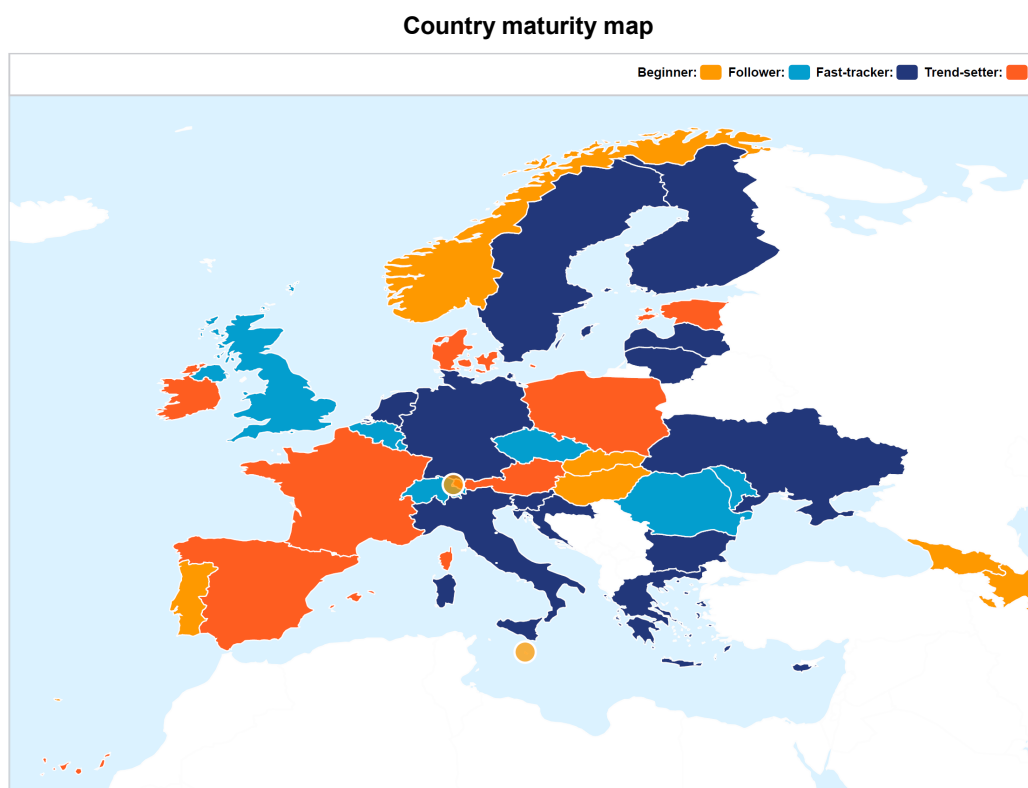
Source: Open Data Maturity Report 2020, European Data Portal, European Commission, 2020

(<https://www.europeandataportal.eu/en/dashboard/2020>)

Portugal ranks in the 25th position among EU countries and is considered a beginner as regards to Open Data maturity.



Source: Open Data Maturity Report 2020, European Data Portal, European Commission, 2020
<https://www.europeandataportal.eu/en/dashboard/2020>



Source: Open Data Maturity Report 2020, European Data Portal, European Commission, 2020
<https://www.europeandataportal.eu/en/dashboard/2020>

9. Artificial Intelligence and Blockchain

Artificial Intelligence (AI) is a fast-growing technology that enables public and private institutions (not necessarily technology enterprises) to use data-driven decision making and is gaining importance in many areas like industrial processes logistics, facility management, sales, digital marketing or human resources. The systems based in AI may be virtual and built upon software that mimics human behaviour by learning patterns (e.g., Chatbots and Machine Learning Software) or inserted in hardware devices (e.g., Robots and Autonomous Cars).

Blockchain has emerged as the main technology solution for the cryptocurrencies but has been adapted to enable new applications in areas such as Energy, Automotive, Healthcare or Financial Services. Blockchain, using decentralized information to make markets more democratic, may allow greater security and decentralization in the storage and transfer of information, seeking to ensure privacy, avoiding over-concentration of market power by shifting control of information from business to consumers.

AI and Blockchain may be important tools to increase productivity and build solutions in essential areas as healthcare or climate but they also carry risks, namely unethical and malicious use. Therefore, it is necessary to safeguard society from negative effects through the approval of national strategies.

The Artificial Intelligence is a priority for Member-States which have been developing and approving national strategies. Portugal is among the 20 countries of the EU27 that have already published an AI strategy (in June 2019), the “AI Portugal 2030” National Strategy (INCoDe.2030, 2019).

Overview of Member States' Artificial Intelligence strategies as of February 2020

Country	Status	Date	Country	Status	Date
 Austria	Final draft	June 2019	 Italy	Final draft	July 2019
 Belgium	In progress		 Latvia	Published	Feb. 2020
 Bulgaria	In progress		 Lithuania	Published	April 2019
 Croatia	Final draft	Nov. 2019	 Luxembourg	Published	May 2019
 Cyprus	Published	Jan. 2020	 Malta	Published	Oct. 2019
 Czech Republic	Published	May 2019	 Netherlands	Published	Oct. 2019
 Denmark	Published	March 2019	 Poland	Final draft	Aug. 2019
 Estonia	Published	July 2019	 Portugal	Published	June 2019
 Finland	Published	Oct. 2017	 Romania	In progress	
 France	Published	March 2018	 Slovakia	Published	Oct. 2019
 Germany	Published	Nov. 2018	 Slovenia	In progress	
 Greece	In progress		 Spain	Final draft	Nov. 2019
 Hungary	Action plan	Nov. 2019	 Sweden	Published	May 2019
 Ireland	In progress				

Source: Artificial intelligence, blockchain and the future of Europe: How disruptive technologies create opportunities for a green and digital economy, European Commission and European Investment Bank, 2021

Considering Blockchain, only five of the EU27 countries have published a national strategy. This reveals that Blockchain is at an initial phase, with 12 countries, including Portugal, with no strategy or initiatives to foster Blockchain technologies.

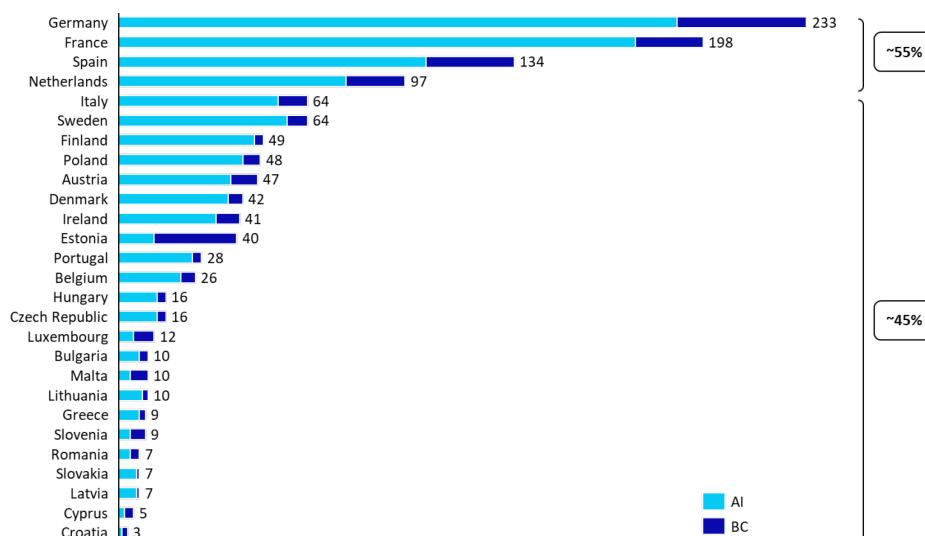
Overview of Member States' Blockchain strategies as of May 2020

Country	Status	Date	Country	Status	Date
Austria	None		Italy	In progress	Dec 2018
Belgium	None		Latvia	In progress	Feb 2019
Bulgaria	None		Lithuania	Other activities	Mar 2020
Croatia	None		Luxembourg	Other activities	Jun 2018
Cyprus	Published	Jun 2019	Malta	Published	May 2018
Czech Republic	Other activities	May 2019	Netherlands	Published	Jun 2018
Denmark	None		Poland	None	
Estonia	Other activities		Portugal	None	
Finland	Proposed	May 2019	Romania	None	
France	In progress	Apr 2019	Slovakia	Published	2019
Germany	Published	Sep 2019	Slovenia	Action planned	May 2018
Greece	None		Spain	None	
Hungary	None		Sweden	None	
Ireland	Other activities	May 2019			

Source: Artificial intelligence, blockchain and the future of Europe: How disruptive technologies create opportunities for a green and digital economy, European Commission and European Investment Bank, 2021

Portugal ranks in the 13th position among EU27 countries, with 28 AI and Blockchain SME (most of them AI SME).

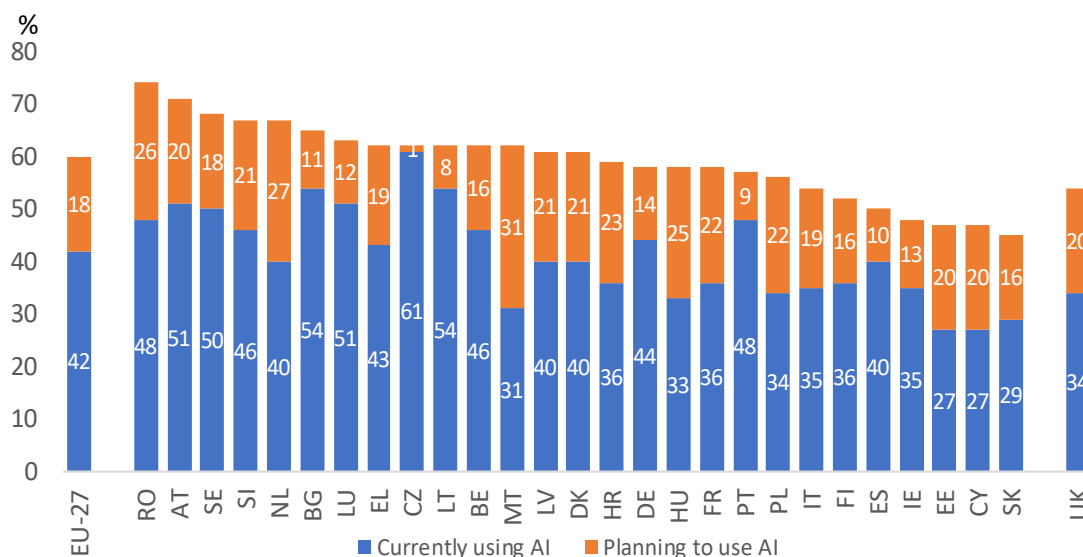
Total number of Artificial Intelligence and Blockchain SME per EU27 country, April 2020



Source: Artificial intelligence, blockchain and the future of Europe: How disruptive technologies create opportunities for a green and digital economy, European Commission and European Investment Bank, 2021

In Portugal, 48% of the enterprises refer using technologies that depend on AI, above EU-27 average (42%) and countries like Ireland (35%), Italy (35%), Finland (36%), France (36%), Spain (40%), Greece (43%) or Belgium (46%).

Enterprises using Artificial Intelligence (% , 2020)



Notes: The survey asked about the use or plans for use of ten different AI related technologies, such as speech recognition, visual diagnostics, fraud detection, analysis of emotions, forecasting based on machine learning and more. Includes the percentage of enterprises using at least one AI technologies. N = 9,640.

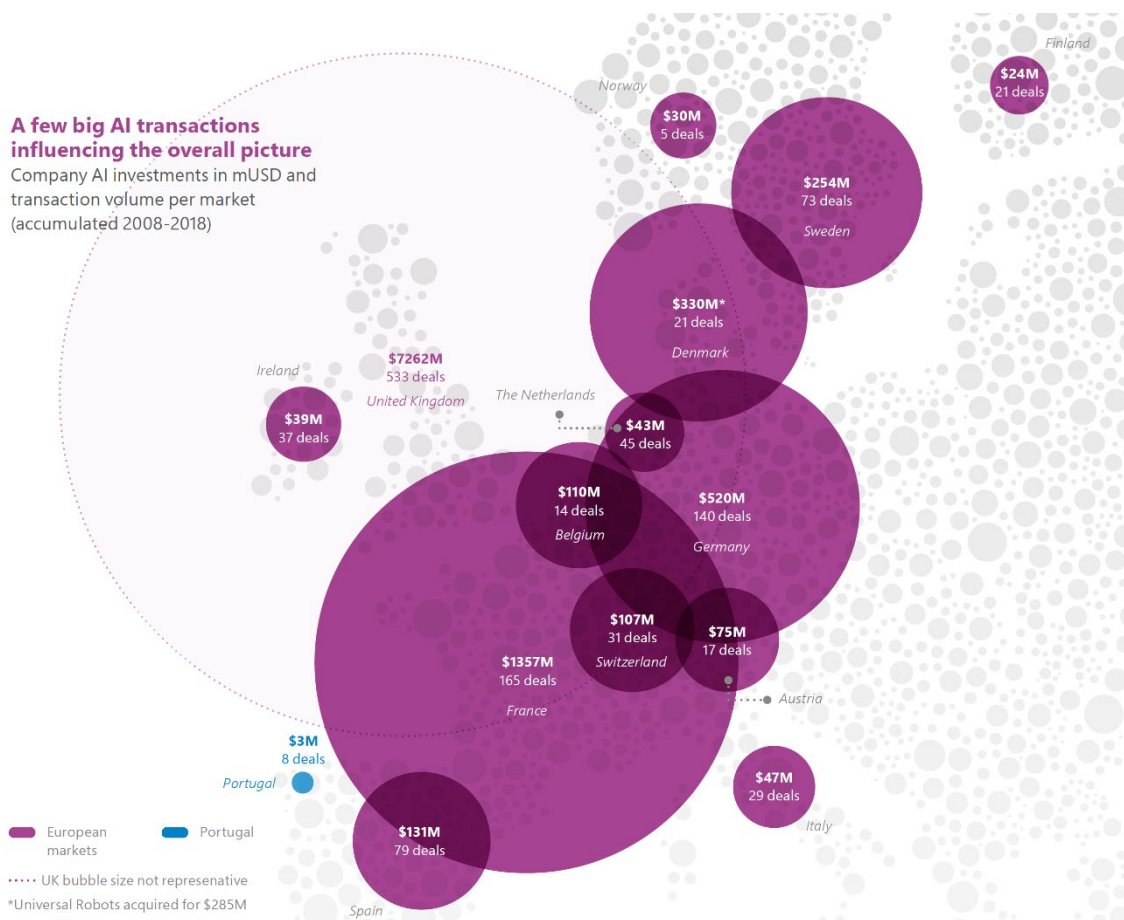
Source: Getting the Future Right - Artificial Intelligence and Fundamental Rights, European Union Agency for Fundamental Rights, 2020 [based on data extracted from European Commission, European enterprise survey on the use of technologies based on artificial intelligence, Luxembourg, July 2020]

According to the report “Artificial Intelligence in the Public Sector - How 213 Public Organizations Benefit from AI”, commissioned by Microsoft and conducted by EY (2020), machine learning (82%) and smart robotics (59%) are the AI underlying technologies most useful for Portuguese enterprises, well above the European aggregate, and 86% of Portuguese enterprises selected more than one type of AI technology. More than half of Portuguese respondents consider themselves to be more competent in Data Governance and IT Architecture than their European counterparts.

The report refers that Portuguese national AI approach aims to nurture economic growth by fostering AI innovation through the private sector and the academia to develop competencies and new solutions that may be useful for the public sector.

The report “Artificial Intelligence in Europe - How 277 Major Companies Benefit from AI”, commissioned by Microsoft and conducted by EY (2018), refers that over \$3.3 million were invested in AI start-ups in Portugal in the past decade.

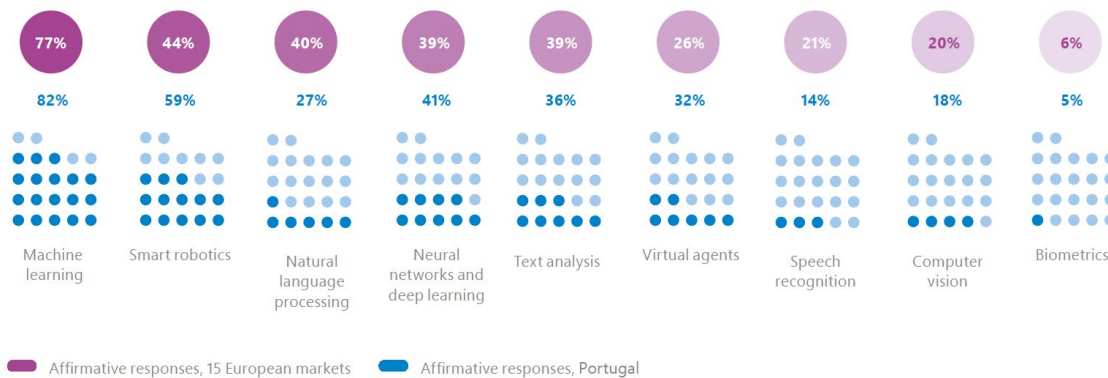
Investment in AI in Europe (mUSD, 2008-2018)



Source: Artificial Intelligence in Europe - How 277 Major Companies Benefit from AI, Outlook for 2019 and Beyond, Report Commissioned by Microsoft and conducted by EY, 2018

Most enterprises consider the Machine Learning (82%) and the Smart Robotics (59%) to be the most useful AI technologies.

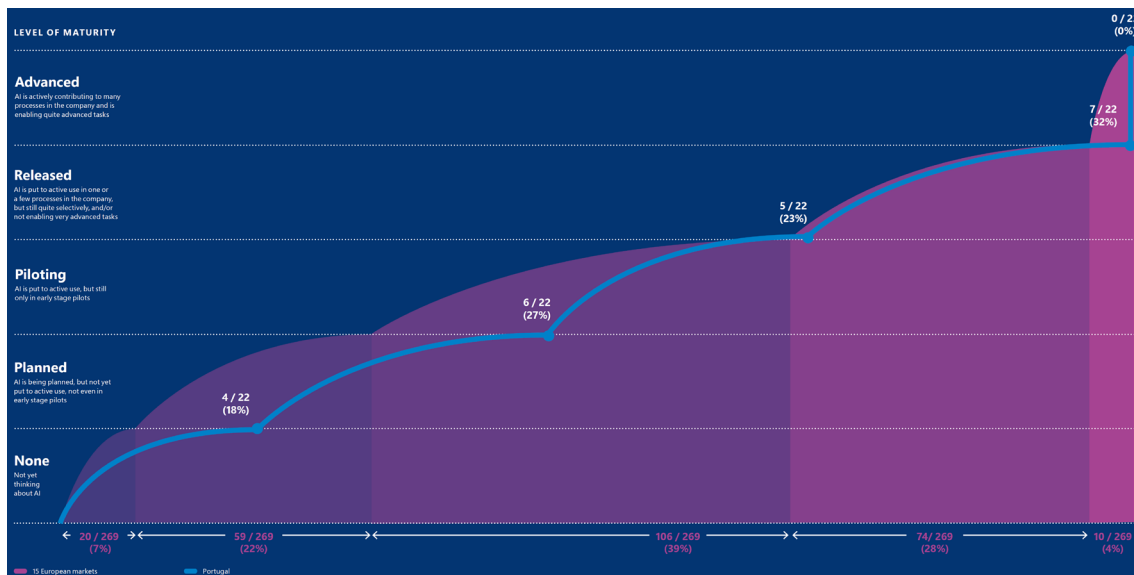
Most useful AI technologies



Source: Artificial Intelligence in Europe - How 277 Major Companies Benefit from AI, Outlook for 2019 and Beyond, Report Commissioned by Microsoft and conducted by EY, 2018

The enterprises that were surveyed consider that AI did not contribute significantly to processes in the organizations reflecting a low AI maturity. Although 82% of enterprises plan to implement AI initiatives in the future, 18% don't have that plan.

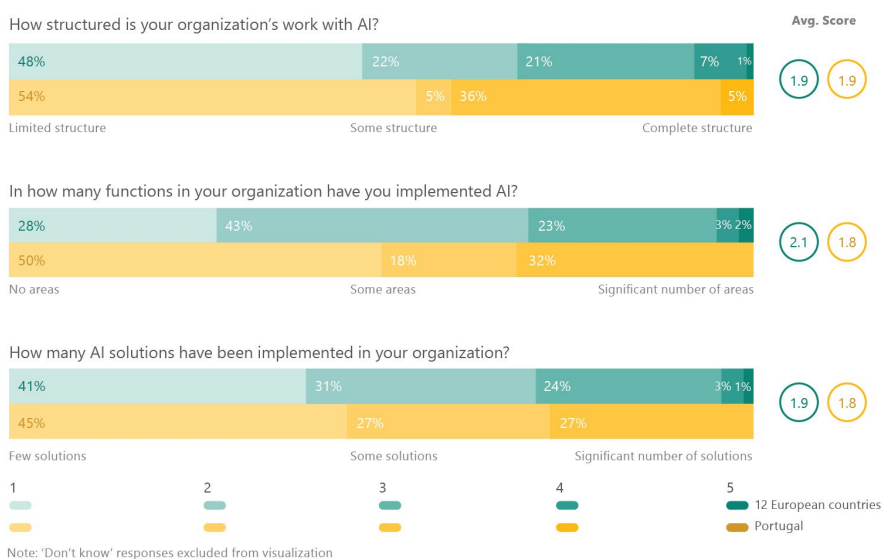
AI Maturity Curve Majority of enterprises are in the 'Piloting' or 'Released' stage



Source: Artificial Intelligence in Europe - How 277 Major Companies Benefit from AI, Outlook for 2019 and Beyond, Report Commissioned by Microsoft and conducted by EY, 2018

Public Sector organisations have adopted AI but many of them are only emergent and Portugal scores below the average for 12 European countries.

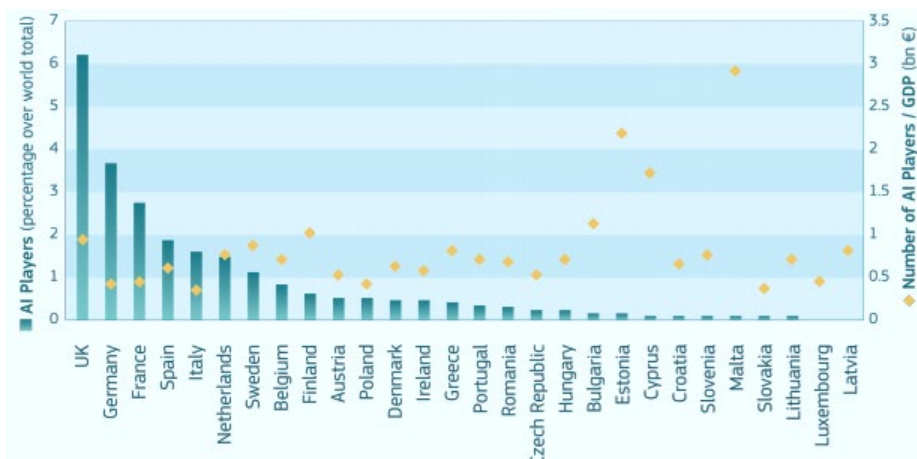
AI solution in the Public Sector



Source: Artificial Intelligence in the Public Sector - How 213 Public Organizations Benefit from AI, European Outlook for 2020 and Beyond, Report commissioned by Microsoft and conducted by EY, 2020

Considering EU28 countries, most of AI players as a percentage of world total are in the largest economies (especially UK, Germany and France) although smaller economies' AI industry seems promising when considering AI players weighted by the GDP. Portugal ranks in an intermediate position in both indicators.

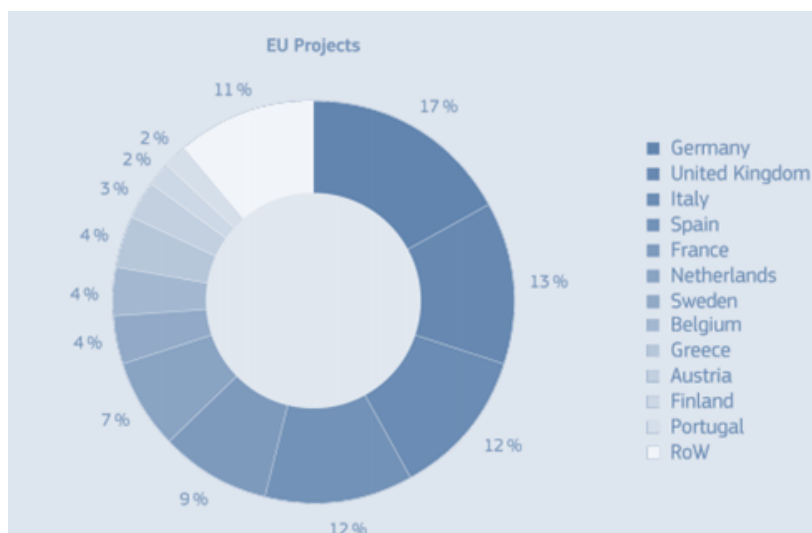
EU AI Players (2009 - 2018)



Source: Artificial Intelligence a Driver for Digital Transformation, Sousa, Osório de Barros and Tavares, 2021 [Artificial Intelligence - A European perspective, European Commission, 2018]

In the distribution of players by country which participated in AI-related research projects under de Seventh Framework Programme (FP7) and Horizon 2020 (H2020) European research programmes, between 2009 and 2018, Portugal occupies the 12th position among EU28 countries with only 2% of players with funded AI research projects.

Distribution of players (%) in EU funded AI research projects (2009-2018)



Source: Artificial Intelligence a Driver for Digital Transformation, Sousa, Osório de Barros and Tavares, 2021 [Artificial Intelligence A European perspective, European Commission, 2018]

The new technologies, in particular those based on AI, are changing the way we live and work. The Covid-19 pandemic boosted the adoption of AI but has also created new challenges in ensuring Cybersecurity and defending the Privacy of citizens and our fundamental values.

10. Cybersecurity and Privacy

Digital technology comes together with cyber risks that can jeopardise the benefits of digitalisation. The internet has changed the way we live and work, but the use of new technologies involves risks, as there are always those who prefer to live from crime – in the case of the digital world, cybercriminals or hackers.

Cybersecurity is a cross-cutting concern worldwide due to the increase in cyber-attacks and refers to the ability to protect networks and information systems from incidents that prevent or disrupt their operations or that, in any way, may compromise the data and information circulating in them.

Cybercrime usually covers a wide range of legal types of crime referred to in the Cybercrime Law, which include computer falsehood, computer damage, computer sabotage, illegitimate access, illegitimate interception and illegitimate reproduction of a protected program (Articles 3 to 8 of Law No. 109/2009, of 15 September). It also covers crimes provided for in the Penal Code, such as child pornography, intrusion by means of information technology and computer and communications fraud (Articles 176, 193 and 221 of Decree-Law No. 48/95, of 15 March), as well as crimes provided for in separate legislation (especially relating to data protection).

Among the various risks for those who use the internet, the following can be listed as examples:

- Data theft, for example through phishing (a way of obtaining the password), allows hackers to obtain information about people (for example through enterprises or other institutions such as states, which can also be victims of espionage attacks), and use it abusively to advertise and make sales;
- Attacks to enterprises and institutions can also aim at stealing valuable information about their processes, compromising their operation and blocking their systems, and afterwards asking for ransoms in exchange for returning the information (ransomware);
- Hackers often use viruses or malicious software (malware) to infect the computer systems of citizens, enterprises or institutions, using email, USB pens, allowing access to the computer system, making changes and even making it unusable;
- In identity theft, the hacker takes someone's identity to gain access to their personal data, email accounts, social networks and even bank accounts. In this situation, the attacker manages to impersonate someone else, sending information on his behalf, creating false accounts and using his personal information in different ways, namely, to perform online scams;
- Finally, cybercriminals often use fake emails (scam), posing as a credible entity, requesting information (for example, passwords and access codes for bank accounts) or arguing on the need to install an update.

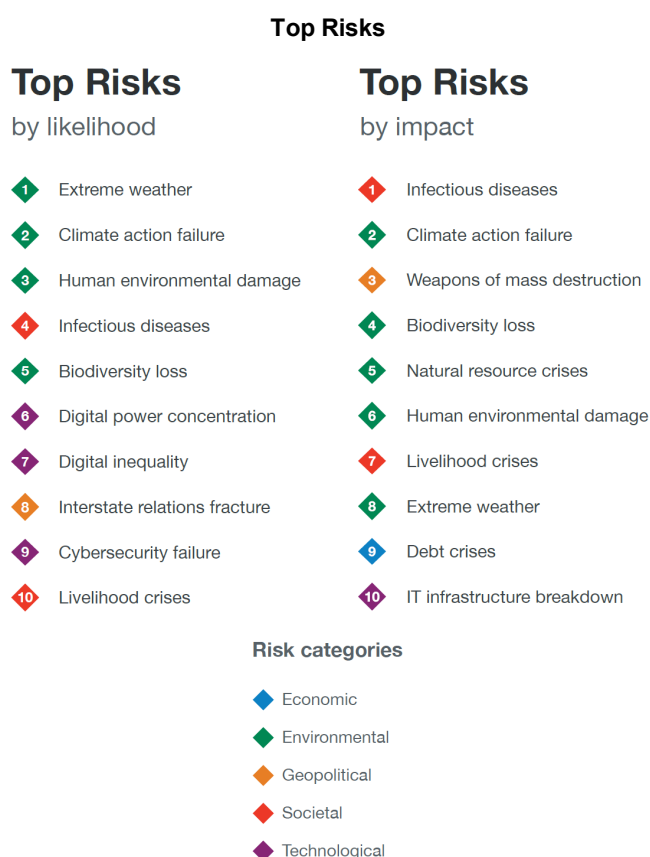
The most likely victims are the institutions that have the greatest number of records and, therefore, become more “appealing”. But individuals are also subject to attacks.

Cybersecurity also presupposes the protection of privacy while protecting personal data. Privacy, while technically not equated with that, is security from a data and metadata point of view. Hence, when we do large-scale metadata collection, we cannot say that we are just collecting information from one individual: we are collecting information about every individual and business in a nation.

In 2021, the main global threats identified by the World Economic Forum (The Global Risks Report 2021) by likelihood include three risks on the technological category: digital power concentration (6th position), digital inequality (7th position) and cybersecurity failure (9th position). Considering the impact, the list includes only one risk on the technological category: IT infrastructure breakdown (10th position).

This contrasts with the risks identified in 2020, when risks by likelihood included data fraud or theft (6th position) and cyberattacks (7th position), and risks by impact included information infrastructure breakdown (6th position) and cyberattacks (8th position).

Although Cybersecurity and related questions remains among the top risks, it is noticeable the shift to other concerns such as, by likelihood, infectious diseases, digital power concentration, digital inequality, interstate relations fracture or livelihood crises, and, by impact, infectious diseases, natural resource crises, livelihood crises and debt crises. Interestingly, most of the new risks identified may be related with Covid-19 pandemic.



Source: Global Risks Perception Survey 2020, The Global Risks Report 2021, World Economic Forum, 2021

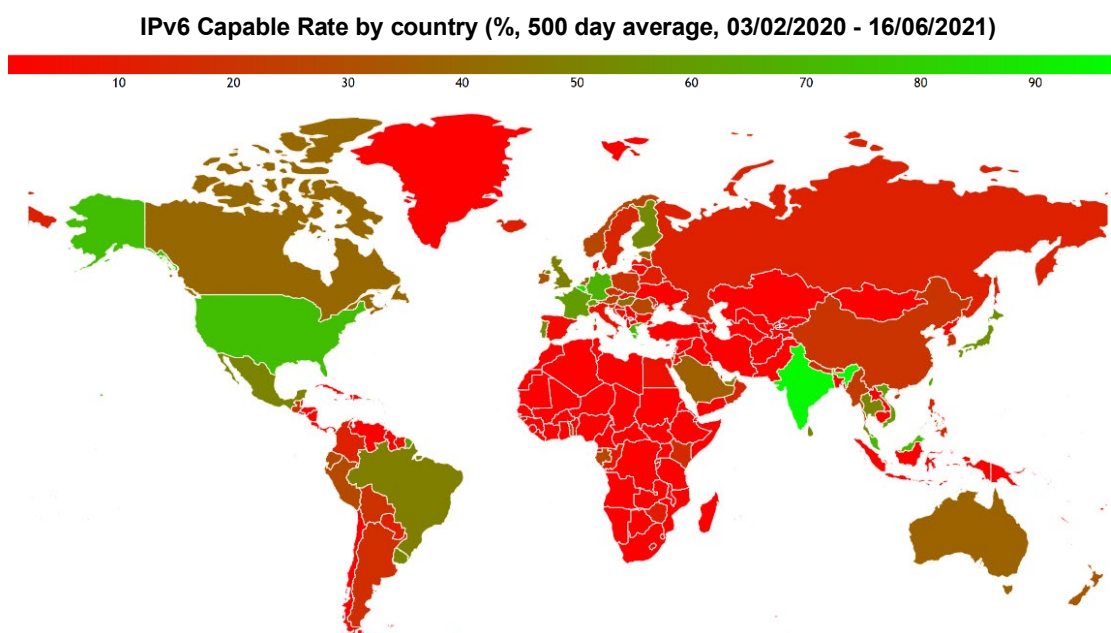
Regarding the forecast by respondents of when risks will become a critical threat to the world, cybersecurity failure (4th position) and digital inequality (5th position) are among the top 10 in a zero to two years period. In a longer period of three to five years, we find among the top 10 IT infrastructure breakdown (2nd position), cybersecurity failure (8th position) and tech governance failure (9th position). In a longer period of five to ten years, adverse tech advances (4th position) is the only global risk referred in the technological category.

The ecosystem called Internet of Things (IoT), with services and applications being driven by data collected from devices and complementing the physical world, has been growing in recent years and, with the pandemic of Covid-19, it became fundamental in everyday lives of people around the world. The internet is an essential infrastructure for individuals as institutions (private and public).

According to APNIC Labs, IPv6 Capable Rate by Country (where the system is capable of using IPv6) is being implemented slowly and disparities in IPv6 readiness between countries remains significant and may undermine the positive impacts of the internet on the economic and societal benefits.

The information published by APNIC Labs is just a part of the view on the IPv6 adoption but includes different data such as, the share of users accessing Google via IPv6 and the share of traffic transiting the Akamai CDN that uses IPv6, and the share of Internet addresses that are compliant with IPv6.

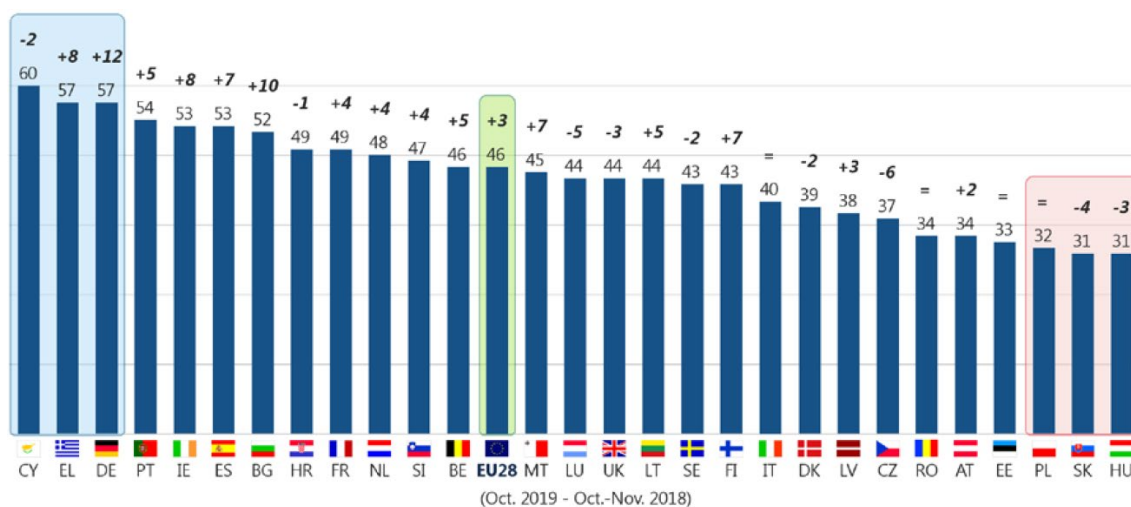
Portugal is in the 22nd position among the 248 countries considered regarding IPv6 capable (39,8% of the network supports IPv6 services, compared with a world average of 28,1%). Nevertheless, the goal must be to accelerate the uptake of key internet security standards, namely fostering programs to adjust/upgrade internet services and multistakeholder collaboration to promote IPv6.



Source: APNIC Labs, 2021 (<https://stats.labs.apnic.net/cgi-bin/worldmapv6?s=IPv6+Preferred&d=Auto&w=500&t=100> | <https://labs.apnic.net/?p=655> | <http://stats.labs.apnic.net/ipv6>)

In 2019, Portugal was among the seven countries where more than 50% of internet users say they are concerned about using the internet for activities such as online banking or buying goods and services online fearing misuse of their personal data – 54% of Portuguese respondents refer being concerned about this, above the EU28 average (46%) and 5 p.p. above the 2018 result. These concerns have grown in most of EU28 countries from 2018 to 2019.

Concerns about using the internet for activities such as online banking or buying goods and services online (% concerned about someone misusing personal data)



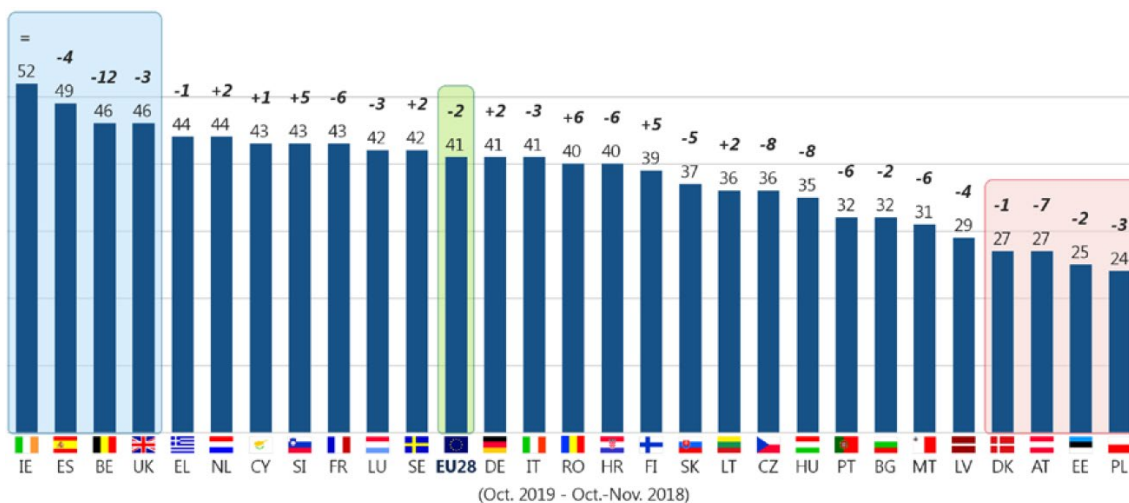
Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In contrast, in 2019, only 32% of Portuguese users of internet were concerned about the security of online payments, less 6 percentage points that in 2018 and below the EU28 average (41%). In most of the EU28 counties, internet users seem to be less concerns about online payments than in 2018.

In Portugal, this might be, in some way, connected with the quality of digital services offered such as MBway.

Concerns about using the internet for activities such as online banking or buying goods and services online (% concerned about security of online payments)

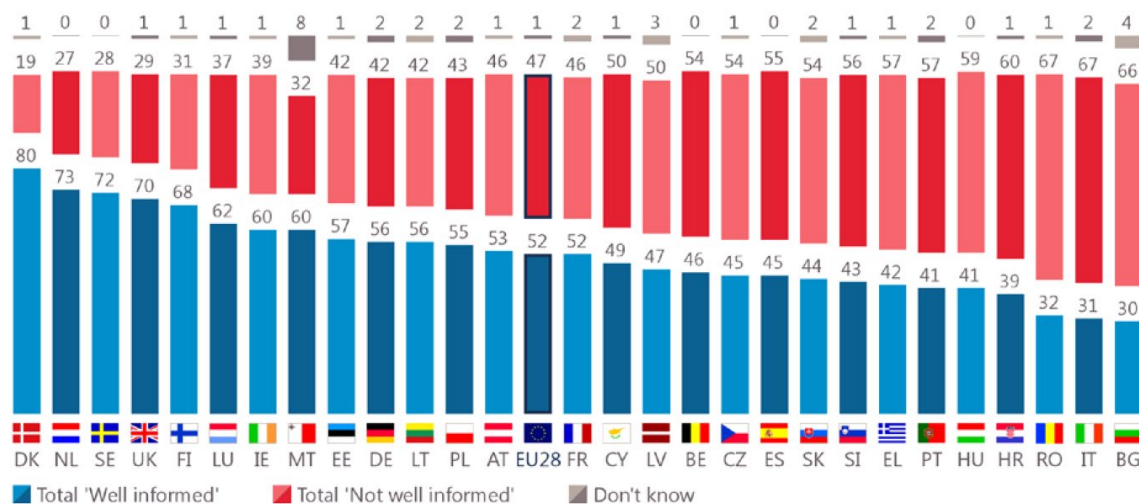


Base: respondents who use the Internet (N=23,420)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Regarding cybercrime, Portugal is the 6th among EU28 countries where more respondents feel not well informed about the risks of cybercrime (57%, above the EU28 average of 47%). Overall, there are 14 countries where at least half of all respondents say they feel well informed.

People that feel well informed about the risks of cybercrime (%)

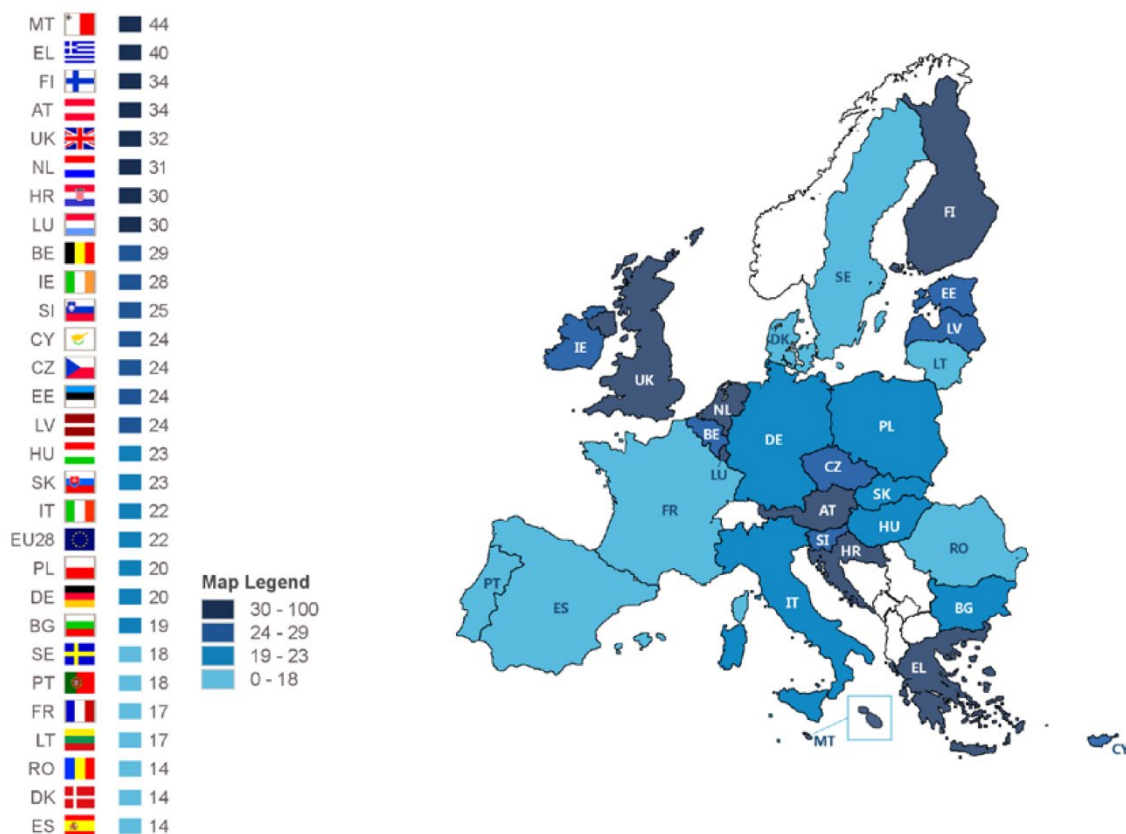


Base: all respondents (N=27,609)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Only 18% of respondents in Portugal are aware of the existence of official websites, email addresses, online forms or contact numbers to report a cybercrime or any other illegal online behaviour (e.g., cyberattack, online harassment or bullying), under the EU average of 22% and much below countries like Malta (44%) or Greece (40%).

People aware of the existence of a website, email address, online form or contact number to report a cybercrime or any other illegal online behaviour (%)

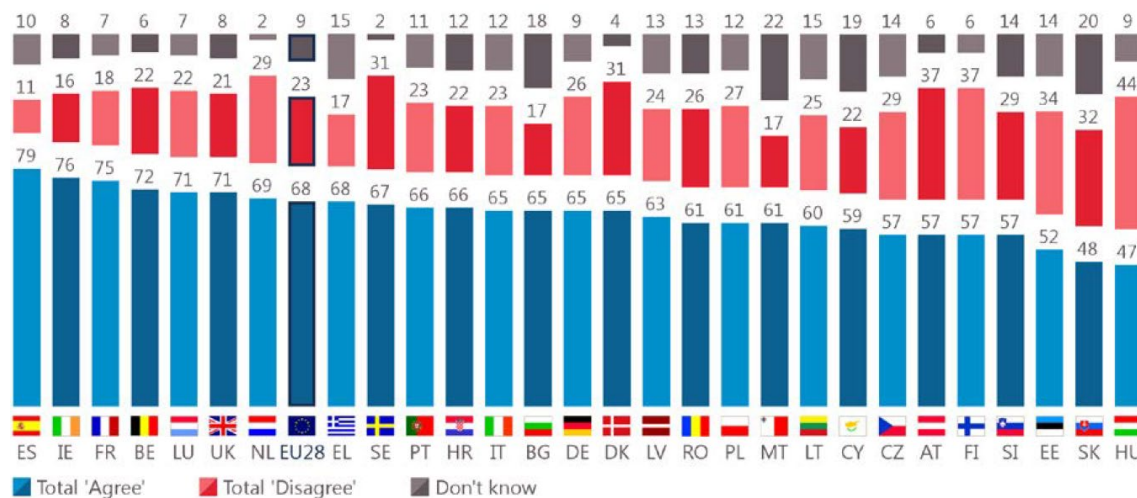


Base: all respondents (N=27,607)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

In Portugal, 66% of respondents are concerned that their online personal information is not kept secure by websites, slightly under the EU28 average (68%).

People concerned that their personal information is not kept secure by websites (%)

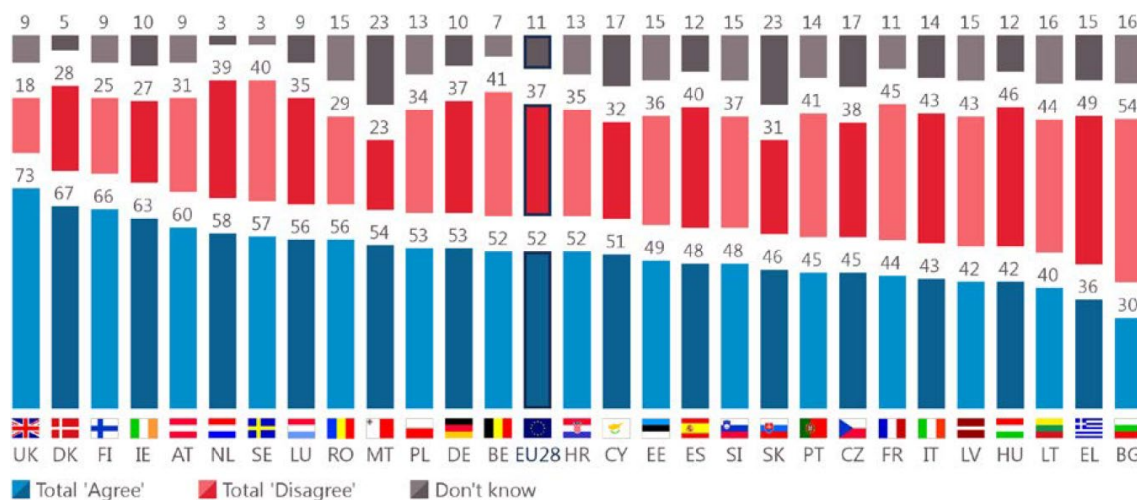


Base: all respondents (N=27,609)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Only 45% of Portuguese respondents consider to be able to protect themselves sufficiently against cybercrime, under the EU28 average (52%).

People that consider to be able to protect themselves sufficiently against cybercrime (%)

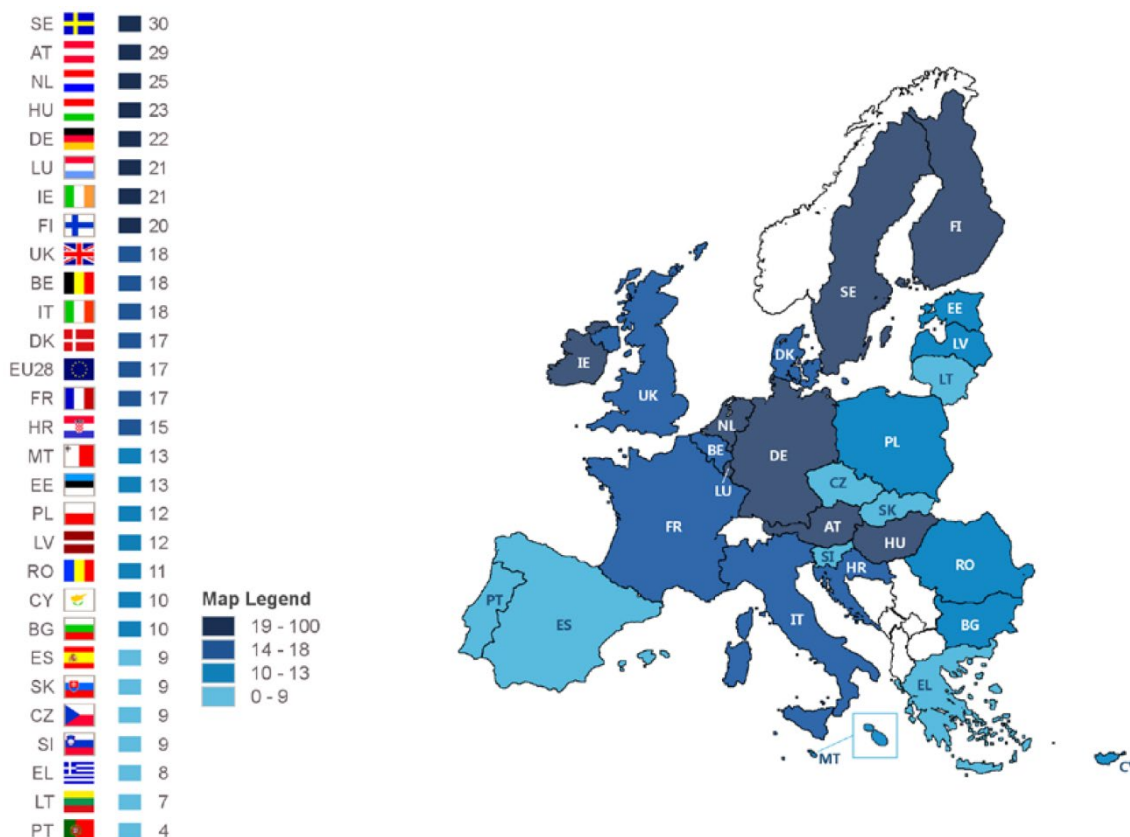


Base: all respondents (N=27,609)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

Only 17% of respondents in the EU28 reported a cybercrime or any other illegal online behaviour (e.g. cyberattack, online harassment or bullying) and, also according to Special Eurobarometer 499, are more likely to report it to the police or authorities, to a website, or to a service provider. Portugal is the country where less people reported a cybercrime or any other illegal online behaviour (4%).

People that reported a cybercrime or any other illegal online behaviour (%)



Base: all respondents (N=27,607)

Source: Europeans' attitudes towards cyber security, Special Eurobarometer 499, European Commission, January 2020

The sophistication and diversification of criminality leads public and private entities to operate under the permanent threat of incidents that could compromise the business strategy and/or the confidentiality of citizens' data.

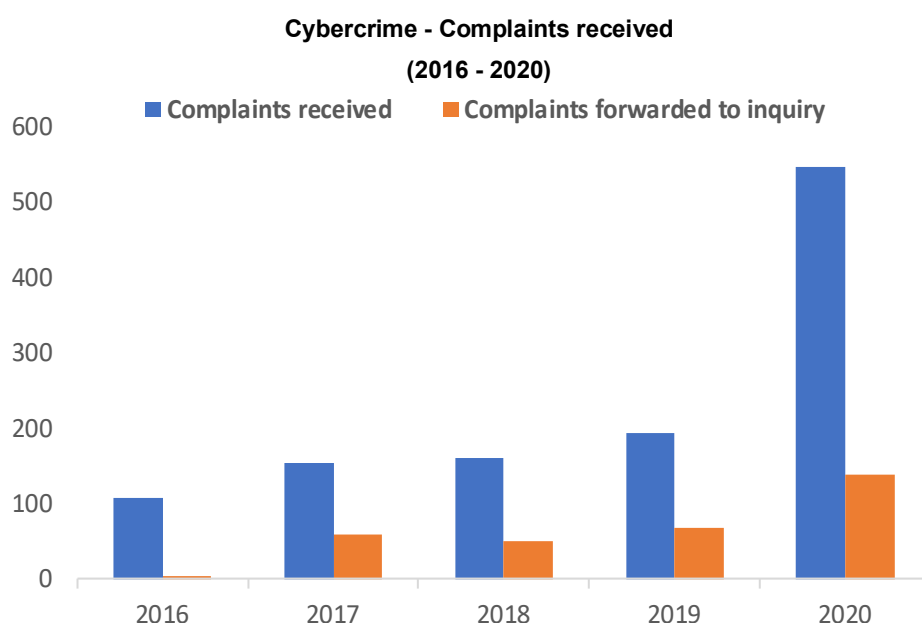
With the Covid-19 pandemic, cybersecurity registered a significant increase in incidents. This has been a concern for the national authorities that have required permanent monitoring, evaluation and analysis, in particular the National Cybersecurity Center and its CERT.PT.

According to the Internal Security System 2020 Annual Report:

- The CERT.PT of the National Cybersecurity Center received, throughout 2020, 6,525 notifications, of which 1,418 (about 22%) resulted in the opening of incidents, most of which due to fraud (649 incidents), malicious code (291 incidents), intrusion (180 incidents) and information security (76 incidents);
- In the year 2020 as a whole, the number of incidents increased by around 88% compared to 2019;
- Phishing, smishing and spear phishing attacks are dominant, with 613 incidents recorded in 2020, representing an increase of 160% compared to 2019, a number that was strongly influenced by the beginning of the pandemic;

- Another class with a high number of incidents is malicious code (includes infected systems) and malware distribution, registering 4,175,517 incidents;
- Among the 61,045,497 incidents registered by CERT.PT, around 91% refer to vulnerable services;
- In 2020, CERT.PT started 3,142 cases for crimes in the EUROPOL area of competence, among which cybercrimes stand out in second place, representing 20% of these cases.

The number of complaints received and forwarded to inquiry also rose significantly in 2020, mainly after the beginning of the Covid-19 pandemic. According to the Cybercrime Office of the Public Prosecutor's Office analysed the number of cybercrime complaints sent by email to this Office and verified a significant increase between 2019 and 2020, from 193 to 546 complaints.



Source: Cybercrime - denúncias recebidas 2020, Gabinete de Cybercrime da Procuradoria-Geral da República, 2021
(<https://cibercrime.ministeriopublico.pt/pagina/cibercrime-em-2020-denuncias-recebidas>)

Similarly, APAV (Portuguese Association for Victim Support) also reported an increase in the number of cases registered by its helpline (*Linha Internet Segura*), from 102 in 2019 to 587 in 2020 (https://www.apav.pt/intranet16/images/EstatisticasAPAV_Linha_Internet_Segura_2020.pdf)

It is important that those responsible for governments and organizations (private and public entities) are increasingly aware of the risks inherent to cybersecurity and the importance of data protection, and know how to mitigate them, ensuring respect and security for the fundamental right of each person to the privacy of their data.

The Global Cybersecurity Index maps 82 questions on Member State cybersecurity commitments across five pillars of measures: legal, technical, organizational, capacity development and cooperation measures.

Global commitments of specific indicators per pillar

	Legal	
	Measuring the laws and regulations on cyber-crime and cybersecurity	167 Countries with some form of cybersecurity legislation 133 Data Protection Regulations 97 Critical Infrastructure regulations
	Technical	
	Measuring the implementation of technical capabilities through national and sector-specific agencies	131 Active CIRTs 104 Engaged in a regional CIRT 101 Child Online Protection Reporting mechanisms
	Organizational	
	Measuring the national strategies and organizations implementing cybersecurity	127 National Cybersecurity Strategies 136 Cybersecurity Agencies 86 Child Online Protection strategies and initiatives reported
	Capacity development	
	Measuring awareness campaigns, training, education, and incentives for cybersecurity capacity development	142 Countries conduct cyber-awareness initiatives 94 Countries with cybersecurity R&D programs 98 Countries reported having national cybersecurity industries
	Cooperation	
	Measuring partnerships between agencies, firms, and countries	166 Countries engaged in cybersecurity Public-Private Partnerships 90 Countries with cybersecurity bilateral agreements 112 Countries with cybersecurity multilateral agreements

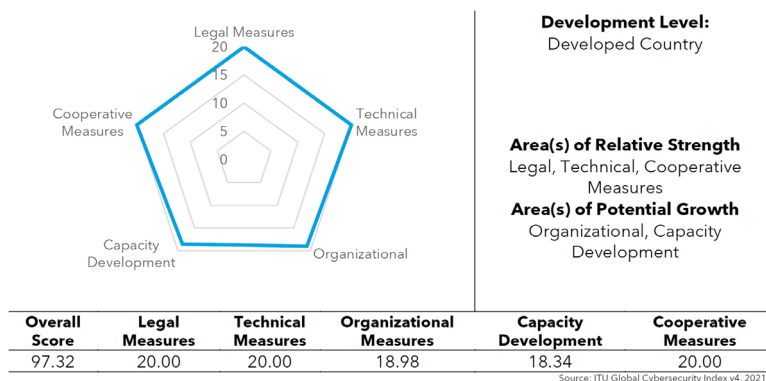
Source: Global Cybersecurity Index 2020, International Telecommunication Union, 2021

Among 194 countries, in the 2020 edition (fourth edition), Portugal ranks in the 14th position, an important improvement from the 42nd position occupied in the 2018 edition (third edition).

The Global Cybersecurity Index 2020 considers Portugal a developed country regarding cybersecurity and, notwithstanding this performance, it points two areas for potential growth: organizational and capacity development:

- The organizational measures are important to contribute to “clear responsibilities and accountability in the national cybersecurity governance” and to guarantee “effective intra-government and inter-sector coordination”;
- The cybersecurity capacity development measures are “necessary to reinforce processes, skills, resources and research and developments aimed at strengthening national capabilities”, reinforce “developing collective capabilities”, facilitate “international cooperation and partnerships to respond effectively to cyber-related challenges of the digital security” and to “contribute to managing cyber-related risks, protecting citizens, infrastructure, enterprises, and build stronger cyber communities”.

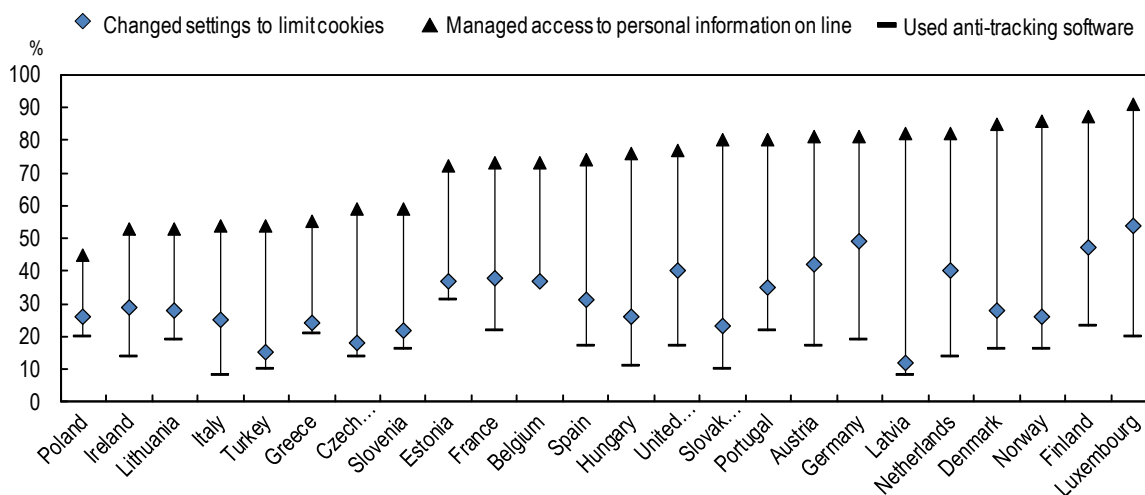
Global Cybersecurity Index 2020 – Portugal (Country profile)



Source: Global Cybersecurity Index 2020, International Telecommunication Union, 2021

Considering citizens' actions to protect their safety online, in 24 countries among EU28 countries, Portugal is 3rd regarding individuals who used anti-tracking software (22%), 9th regarding individuals who managed access to personal information online (80%) and 10th regarding individuals who changed settings to limit cookies (35%). Nonetheless, many users do not know the threats they face while surfing the internet, are not conscious of these threats or take no actions to protect themselves.

Online security and privacy activities (Share of individuals who performed a given activity among those who used Internet within the last year)

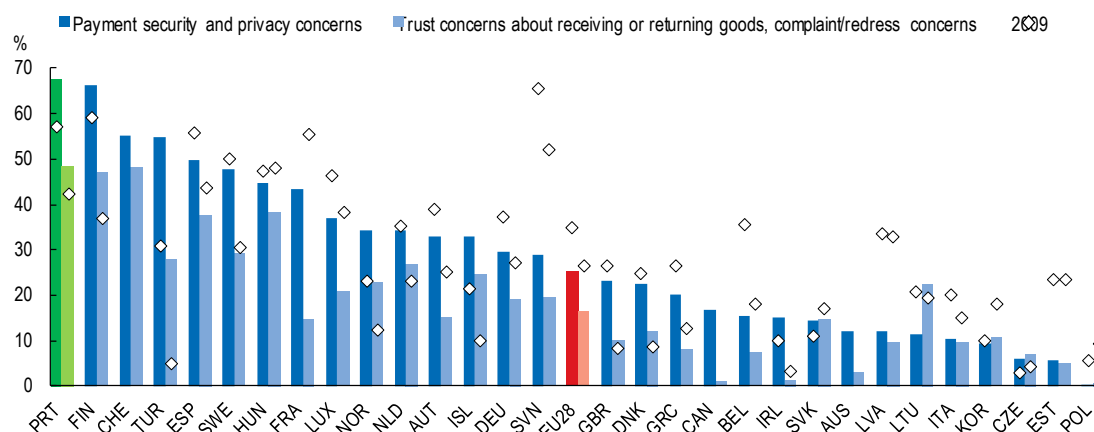


Note: Individuals who changed settings to limit cookies are individuals who declared changing the settings in their Internet browser to prevent or limit the number of cookies put on their computer. Individuals who managed access to personal information on line are individuals who declared performing any of the following activities: read privacy policy statements before providing personal information, restricted access to their geographical location, limited access to their profile or content on social networking sites, refused to allow the use of personal information for advertising purposes, checked that the website where they needed to provide personal information was secure (e.g. https sites, safety logo or certificate), asked websites or search engines to access the information they hold about them to update or delete it.

Source: OECD Skills Outlook 2019, OECD, 2019 [OECD calculations based on Eurostat (2016), European Community Survey on ICT Usage in Households and by Individuals.]

Many internet users have been avoiding online purchases. In 2017, the main reason indicated is the concern with payment security and privacy, but trust concerns are also important to justify that reluctance. Portugal ranks in the first position in both categories (67.6% and 48.3%, respectively) and is one of the few countries in which both concerns increased since 2009 (57.0% and 42.2, respectively).

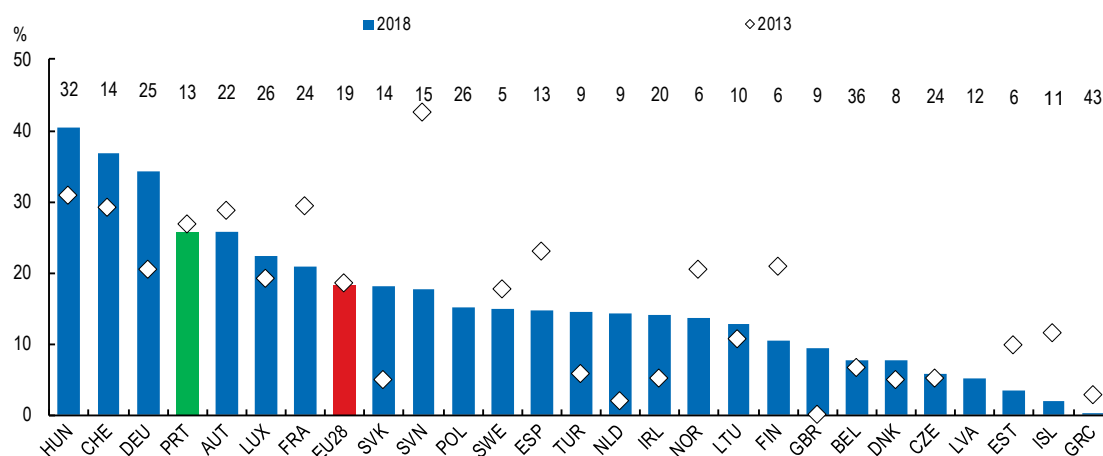
Reluctance to buy online due to payment security, privacy and consumer redress concerns (As a percentage of Internet users who did not buy online in the last 12 months, 2017)



Source: Measuring the Digital Transformation - A Roadmap for the Future, OECD, 2019 [OECD, based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database and national sources, December 2018.]

An often-referred reason for not submitting official forms online is the concern about privacy and security of personal data. In 2018, Portugal was the 4th EU28 country with more individual alleging this reason (25.9%), although a slight decrease from 2013 (26.9%).

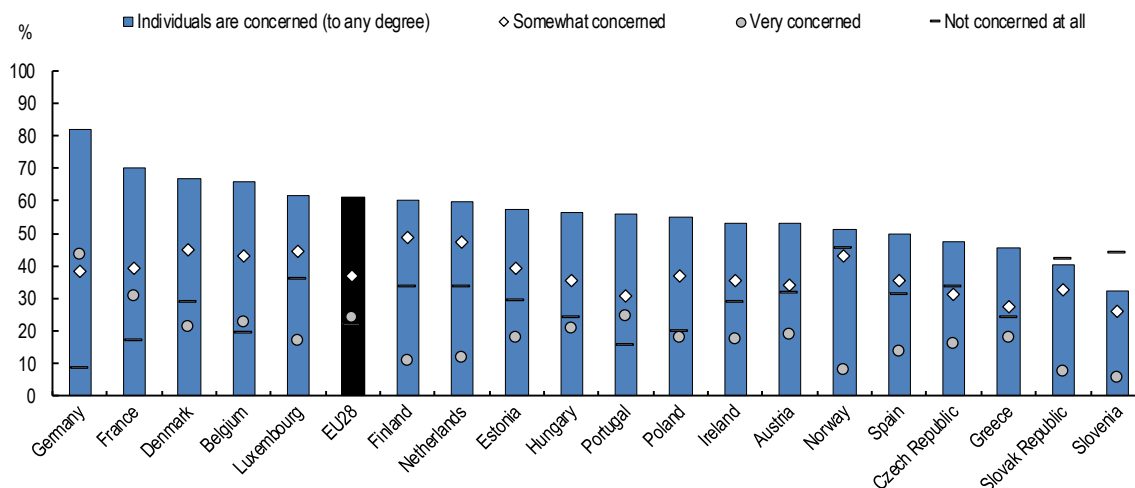
Individuals who did not submit official forms online due to privacy and security concerns (As a percentage of individuals having chosen not to submit official forms online, 2018)



Source: Measuring the Digital Transformation - A Roadmap for the Future, OECD, 2019 [OECD, based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database, December 2018.]

In Portugal, in 2016, 55.7% of people were concerned about registering their online activities being recorded to provide tailored advertising (EU28 countries average of 61.1%).

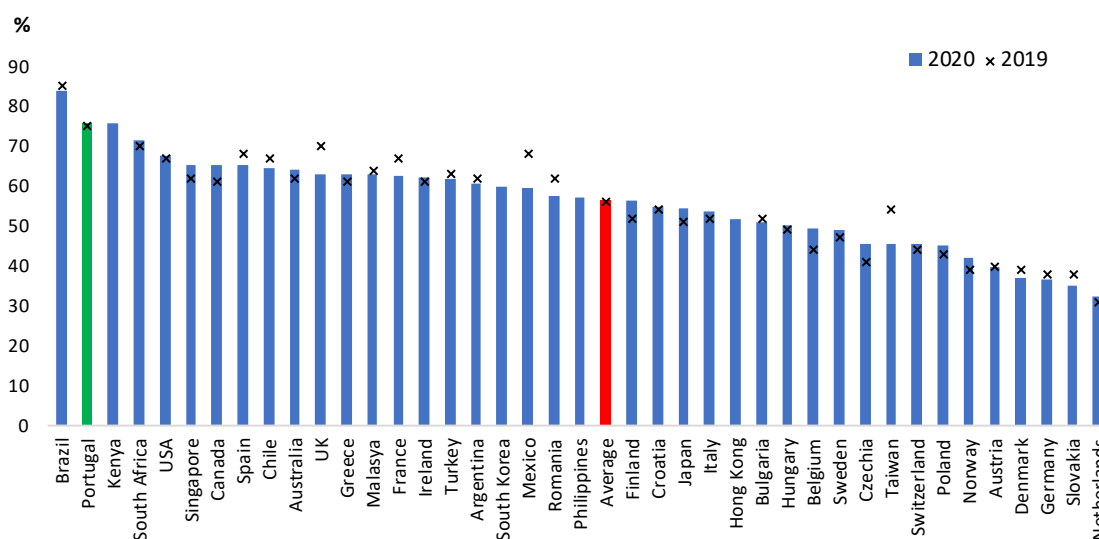
Concerns about online activities being recorded to provide tailored advertising (As a percentage of individuals, 2016)



Source: OECD Digital Economy Outlook, OECD, 2017 [Eurostat, Digital Economy and Society (database), <http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/comprehensive-database>.]

In 2020, similarly to 2019, Portugal was the 2nd country among 40 countries with a higher percentage of individuals concerned about misinformation and fake news on the internet (75.7%), above the average (56.4%).

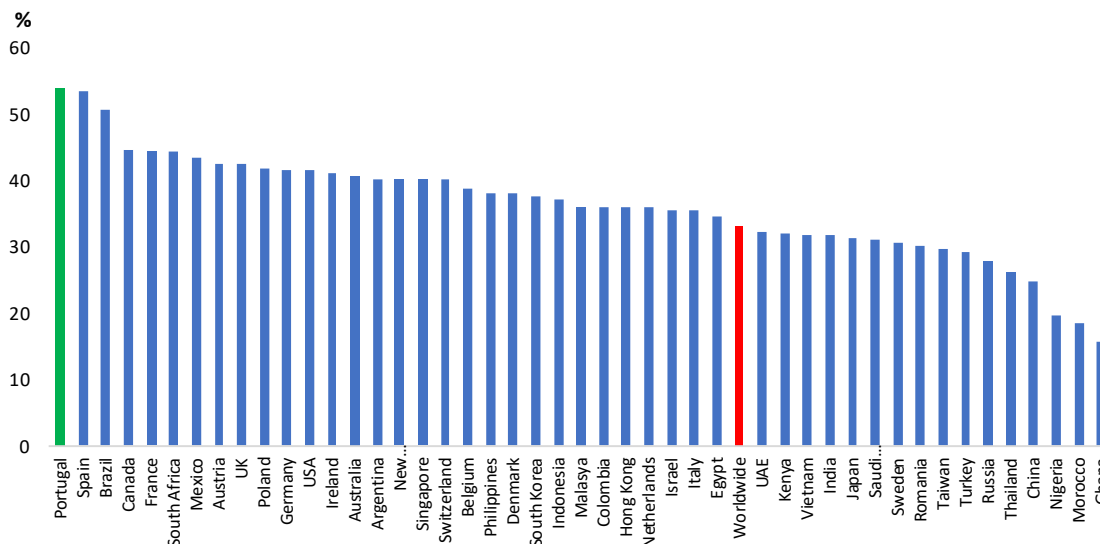
Concerns about misinformation and fake news (Percentage of adults aged 18+ who say they're concerned about what is real and fake on the internet, 2019 and 2020 editions)



Source: Digital 2020 and 2021 – Reuters Institute Digital News Report 2019 and 2020 (surveys), We Are Social/Hootsuite, 2020 and 2021

In the third quarter of 2020, Portugal was the 1st country among 46 countries worldwide in which internet users aged 16 to 64 years refer being worried about how enterprises use their personal data online (53.9%), above the average (33.1%).

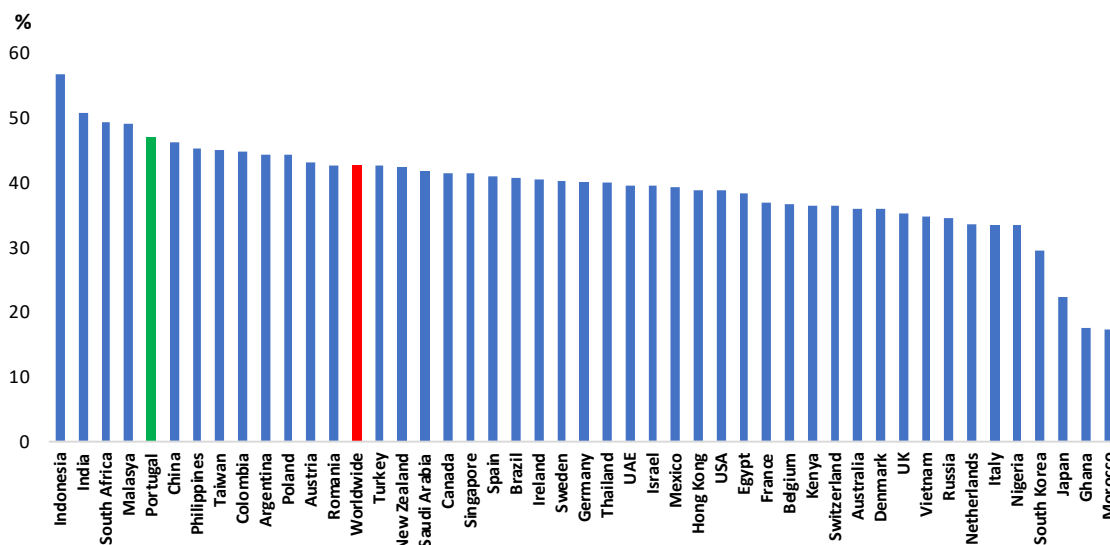
Concerns about misuse of personal data (Percentage of internet users aged 16 to 64 who say they are worried about how enterprises use their personal data online, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

Regarding the use of ad blockers in the third quarter of 2020, 47% of internet users aged 16 to 64 years in Portugal refer using tools to block online advertising, the 5th among 46 countries and above the average (42.7%)

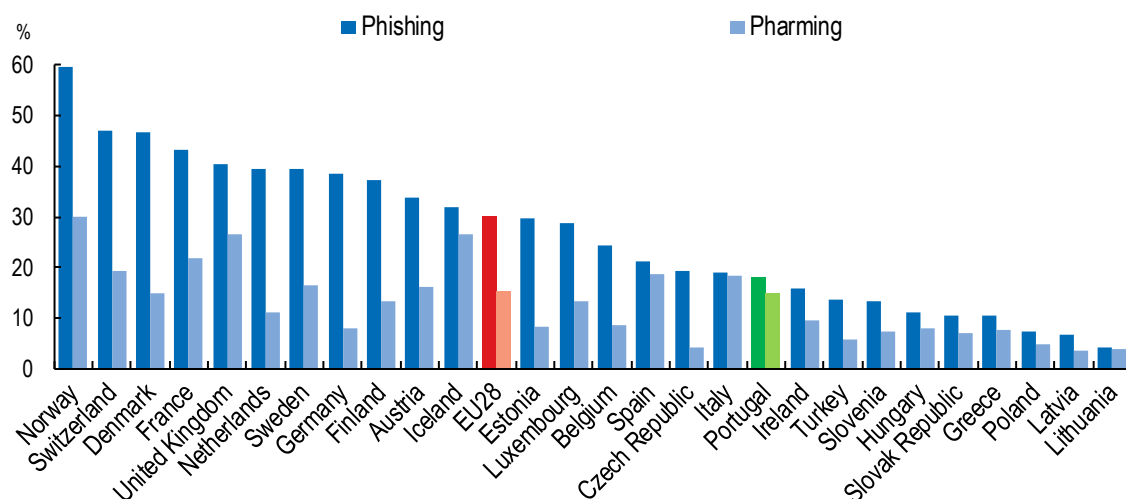
Use of Ad Blockers (Percentage of the internet users aged 16 to 64 who use tools to block online advertising each month, Q3 2020)



Source: Digital 2021 - Global Web Index (survey), We Are Social/Hootsuite, 2021

In Portugal, in 2019, of all internet users, 18.2% experienced phishing attacks and 14.9% experienced pharming attacks, being redirected to websites that ask for personal information, below the EU28 average (29.9% and 15.2%, respectively).

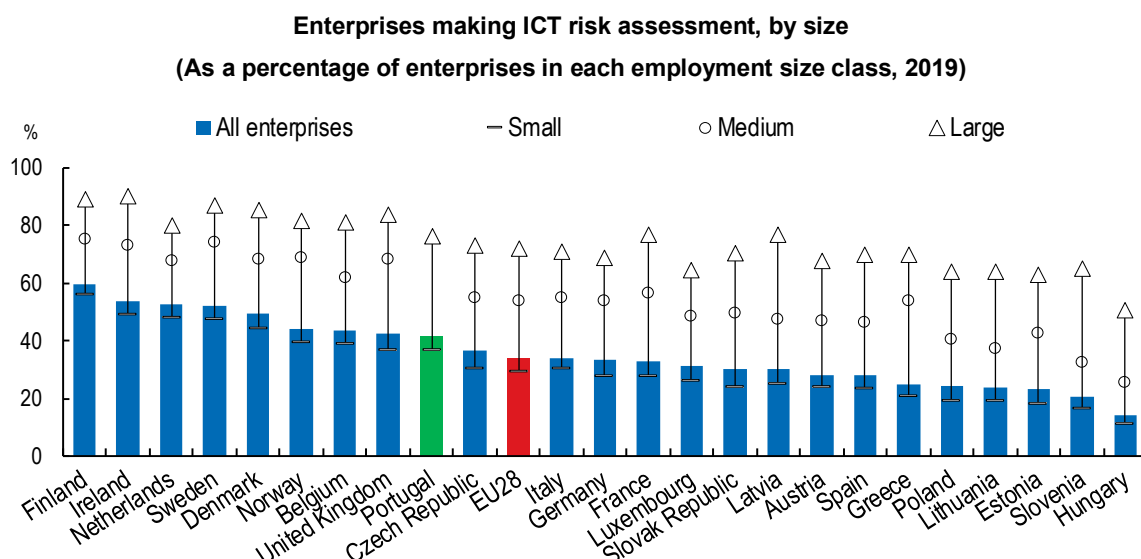
Individuals who experienced phishing and pharming attacks (As a percentage of all Internet users, 2019)



Notes: Phishing relates to receiving fraudulent messages. Pharming relates to being redirected to fake websites asking for personal information.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

Considering enterprises, in Portugal, in 2019, 41.3% makes digital security risk assessment, assessing periodically the probability and consequences of digital security incidents, above the EU28 average (34.1%). This share is higher on average for large enterprises (76.4%) than for smaller enterprises (37.2%) – more than double.

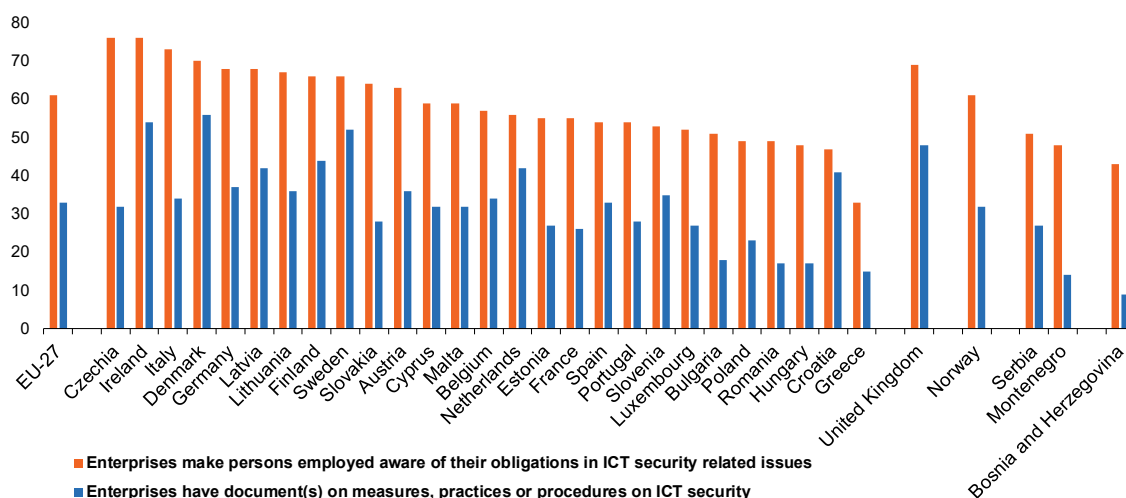


Note: Risk assessment: periodical assessment of probability and consequences of ICT security incidents.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

The rank is less positive in ICT security in enterprises in Portugal when we consider that only 54% of enterprises make persons employed aware of their obligations in ICT security related issues (below the EU27 average of 61%) and that only 28% of enterprises have document(s) on measures, practices or procedures on ICT security (below the EU27 average of 33%) – in both cases in the 19th position among EU27 countries.

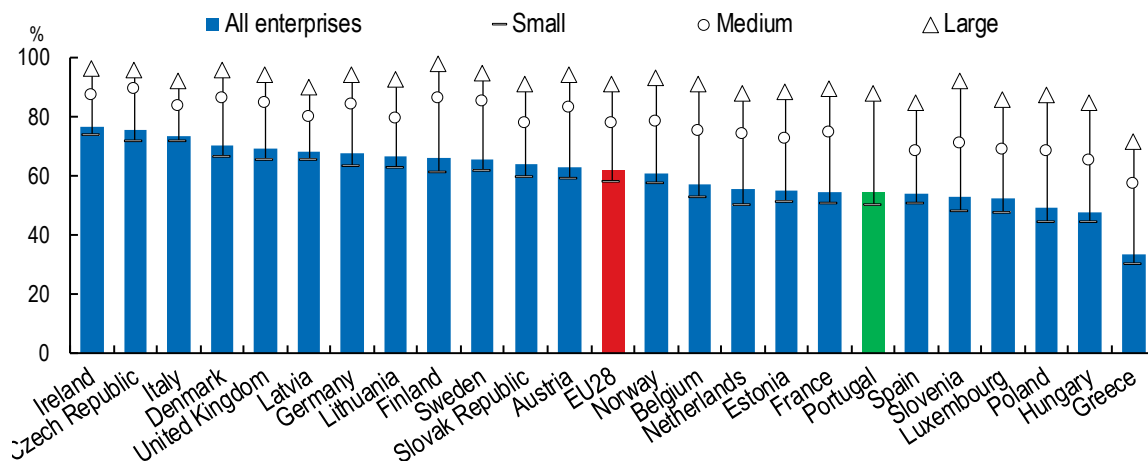
ICT security in enterprises, by country (% of enterprises, 2019)



Source: Digital Economy and Society Statistics, Eurostat (online data code: isoc_cisce_ra)

Still considering the enterprises that ensure persons employed aware of their obligations in ICT security related issues, as observed in other ICT security indicator, large enterprises undertake those activities on average much more frequently than small enterprises (88.1% vs. 50.1%), as in the EU28 average (80.8% vs. 58.2%).

Enterprises making persons employed aware of their obligations in issues related to ICT security, by size (As a percentage of enterprises in each employment size class, 2019)

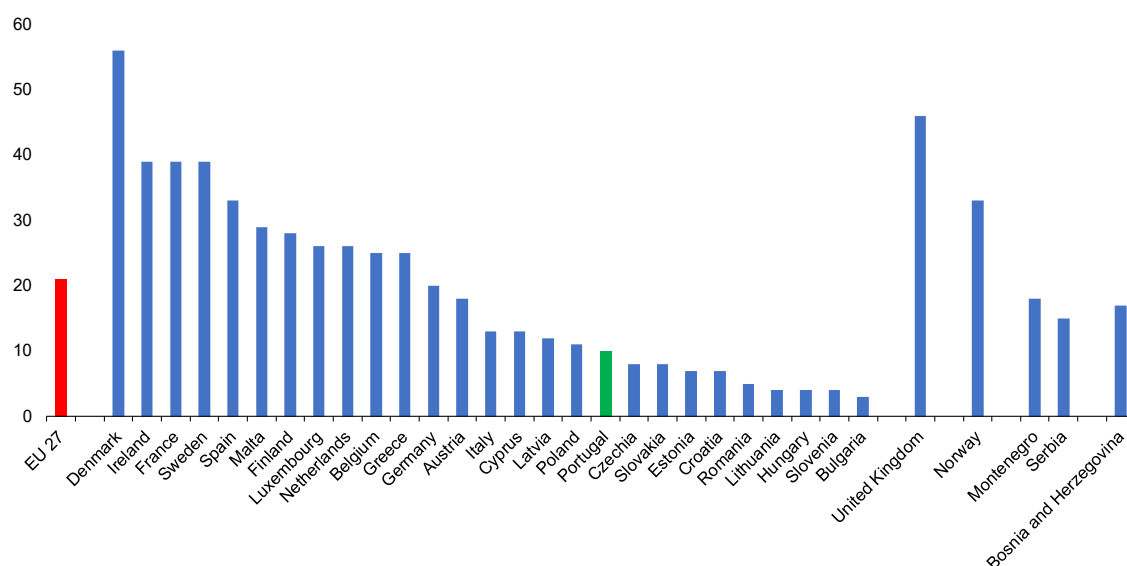


Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

Over the years there has been an increase in the uptake by enterprises of insurances that allow them to deal with situations of fraud. The cyber-insurance market is developing (see cyber-risk survey conducted by Marsh and Microsoft in Nordea, 2018) but only 10% of Portuguese enterprises, in 2019, reported having this type of insurance, below the EU27 average (21%).

Considering cyber-insurance enterprises, it is important to consider the entry of technological giants in the insurance sector. According to the World Insurance Report 2018 (Capgemini and Efma, 2018), around 30% of customers are willing to buy insurance from technology giants like Amazon or Google. As a threat to traditional insurance enterprises, the report suggests that they should adapt to new technologies so that they can compete with the BigTechs, without neglecting, of course, the necessary risk assessment.

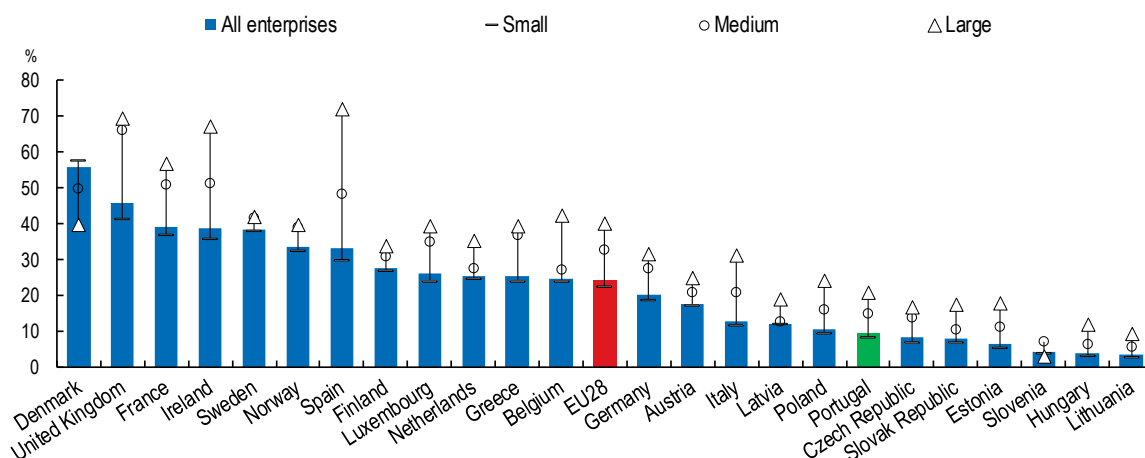
**Enterprises having insurance against ICT security incidents
(% of enterprises, 2019)**



Source: Digital Economy and Society Statistics, Eurostat (online data code: isoc_cisce_ic)

Again, we verify that the size of enterprises clearly influences this subscription to cyber-insurance and that the largest enterprises are the ones that, on average, mostly use this type of insurance (20.8%), clearly above the medium (15.1%) and small (8.4%) enterprises.

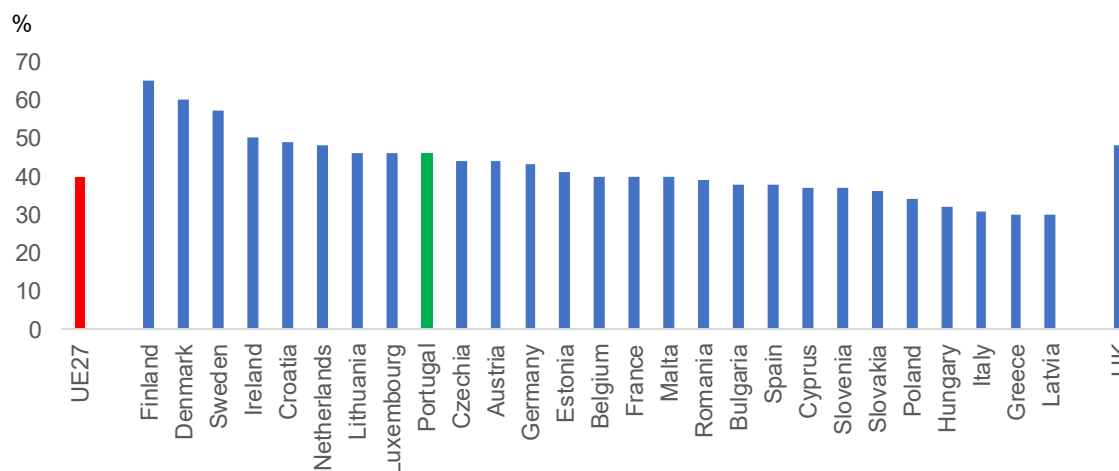
Enterprises with insurance against ICT security incidents, by size (As a percentage of enterprises in each employment size class, 2019)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD based on Eurostat, Digital Economy and Society Statistics, Comprehensive Database.]

In 2019, 46% of Portuguese enterprises internalized ICT security related activities, meaning that those activities are carried out by own employees, a figure above the EU27 average (40%).

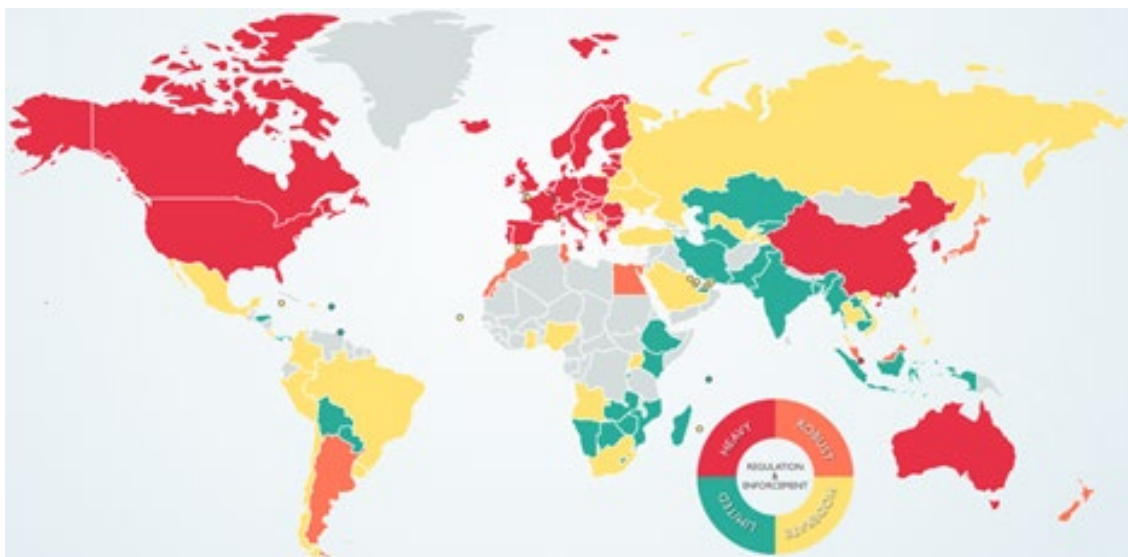
ICT security related activities carried out by own employees (% , 2019)



Source: Security policy: measures, risks and staff awareness, Eurostat (online data code: isoc_cisce_ra)

Data protection is important to guarantee privacy of citizens, and countries have been putting in place data protection frameworks, policies and legislation for privacy and personal data protection. Data protection and information privacy are matters that in recent years have gained greater visibility with the entry into force of important European legislation. This legislation makes the EU Member-States to be the countries in the world with a heavier legislation in terms of data protection.

Data protection laws around the world



Source: DLA Piper Data Protection Laws of the World (information accessed June 26, 2021), 2021
(<https://www.dlapiperdataprotection.com/>)

The General Data Protection Regulation (GDPR) promoted a change in the data protection landscape in the EU, aiming to respond to the challenges posed by risks associated with the mass circulation of information and the transition to an increasingly digital world:

- Establishes principles for the protection and processing of personal data;
- Establishes security measures – technical and organizational;
- Introduces new obligations for data controllers and subcontractors – greater accountability and protection of personal data;
- Creates an obligation to notify personal data breaches to the supervisory authority and, when necessary, to the data owner;
- Imposes heavy fines for non-compliance with its provisions.

Driven by the breadth, frequency and impact of security incidents, which pose a growing threat and are increasing, the EU also introduced the Directive concerning measures for a high common level of security of network and information systems across the Union, which establishes:

- Security measures – technical and organizational – for networks and information systems that include the data stored therein;
- Security incident notification rules – in close cooperation with data protection authorities when incidents concern personal data;
- A regime of constant cooperation with data protection authorities when incidents concern personal data.

In December 2020, the EU launched a new Cyber Security Strategy for the Digital Decade aimed at increasing resilience, technological sovereignty and leadership, strengthening operational capacity to prevent, deter and react, and promote cooperation in cyberspace on a global scale (<https://digital-strategy.ec.europa.eu/en/library/eus-cybersecurity-strategy-digital-decade>). This new Strategy results in the revision of the Network and Information Systems Security Directive, with the aim of expanding the sectors of activity and types of organizations covered, promoting risk management in the supply chain and strengthening supervisory and authority actions.

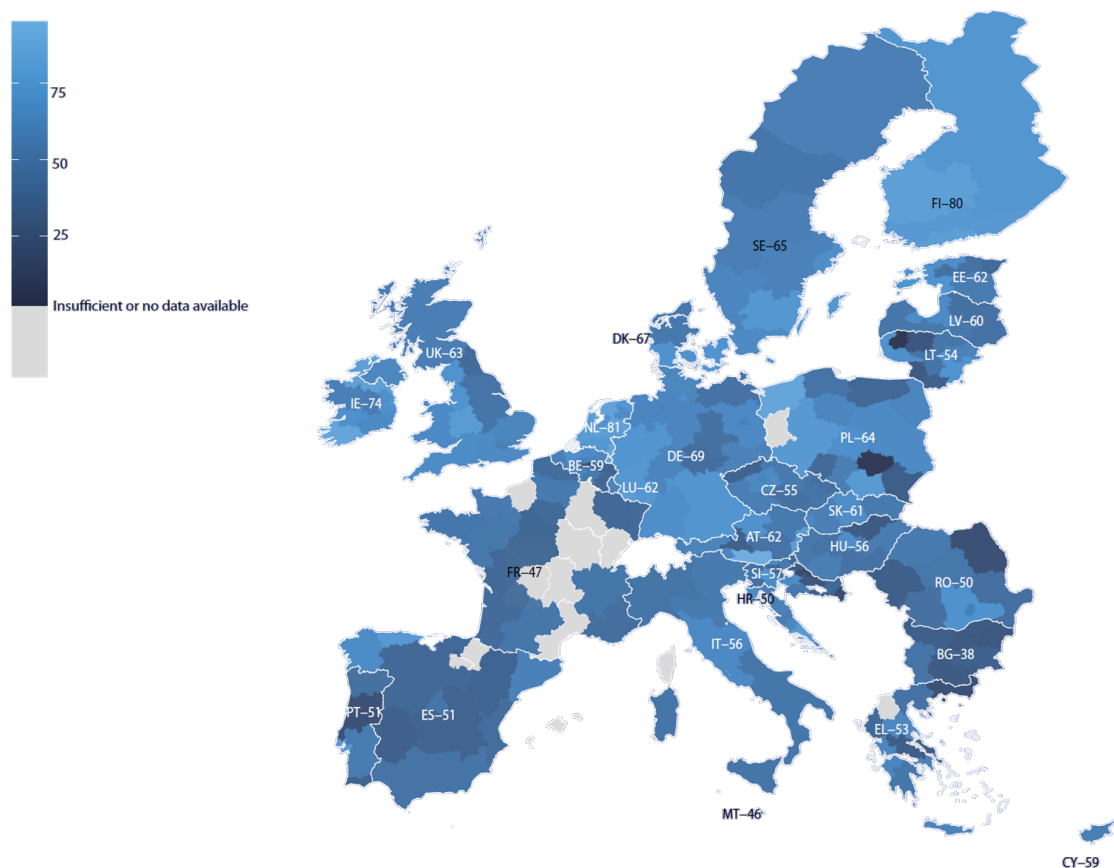
Portugal has in place legislation for privacy and personal data protection - Law No. 58/2019, 8 August, ensures the protection of individuals in the processing of their personal data and the free circulation of such data, while Law No. 59/2019, 8 August, approves the rules on the processing of personal data for prevention purposes, detection, investigation or prosecution of criminal offenses or enforcement of criminal sanctions. This legislation is based mostly on EU's General Data Protection Regulation (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679>) and Directive concerning measures for a high common level of security of network and information systems across the Union (<https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:32016L1148>) but also on OECD's Privacy Guidelines.

Notwithstanding the importance of this legislation to provide greater cybersecurity and data privacy, the existence of legislation must be accompanied by a great acknowledgement of the rights by the citizens.

In 2019, only 51% of people in Portugal were aware of their right to opt out from direct marketing, below the EU average (59%) and the United Kingdom (63%). In a world with increasing and more efficient direct marketing, this emphasizes the importance of providing training to people so they acknowledge their rights.

The Eurobarometer 92.3 (2019) also refers great differences between regions and points out regions with lower awareness of rights with higher shares of people at risk of poverty.

**Awareness of GDPR right to opt out from direct marketing,
in the EU and United Kingdom, by country and region (%)**



Note: Map does not show non-EU countries other than the UK. Light shading = more aware of right.

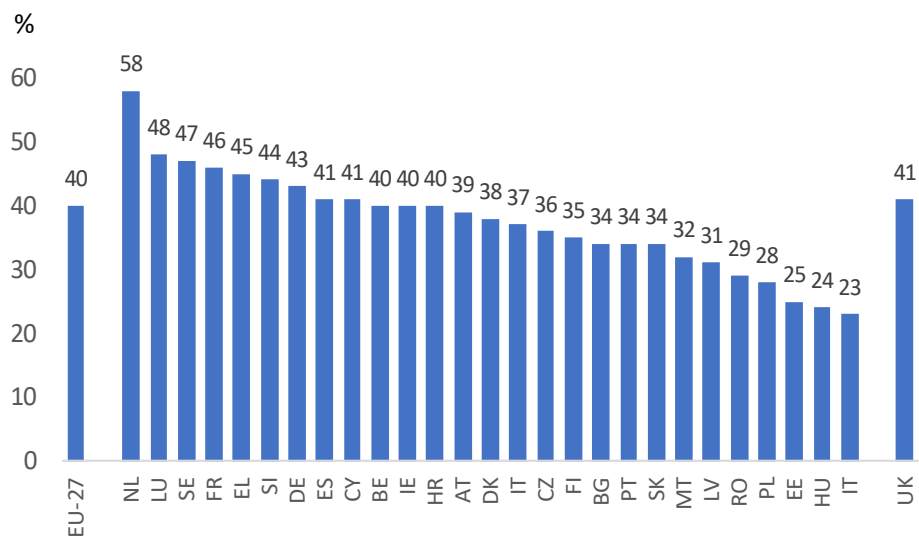
Dark shading = less aware of right. Results for regions within countries represented by light grey spaces were excluded because there were fewer than 20 respondents, meaning the numbers of observations were too low for reliable results. N = 26,503. Question: "The General Data Protection Regulation (GDPR) guarantees a number of rights. Have you heard of each of the following rights? [...] 18.2 The right to object to receiving direct marketing."

Date of Collection: 14.11.2019 - 13.12.2019

Source: European Union Agency for Fundamental Rights, 2020 [Calculations and presentation based on European Commission (2019), Eurobarometer, 91.2]

Also according to the Eurobarometer 92.3 (2019), only 34% of Portuguese respondents revealed being concerned that using AI might lead to discrimination in terms of age, gender, race or nationality, below the EU27 average (40%) and the United Kingdom (41%).

Awareness about the risks of discrimination when using AI, by country (%)



Notes: Includes people who indicated that they are concerned that AI could lead to discrimination among three possible issues, or all of the three issues.

Date of Collection: 14.11.2019 - 13.12.2019

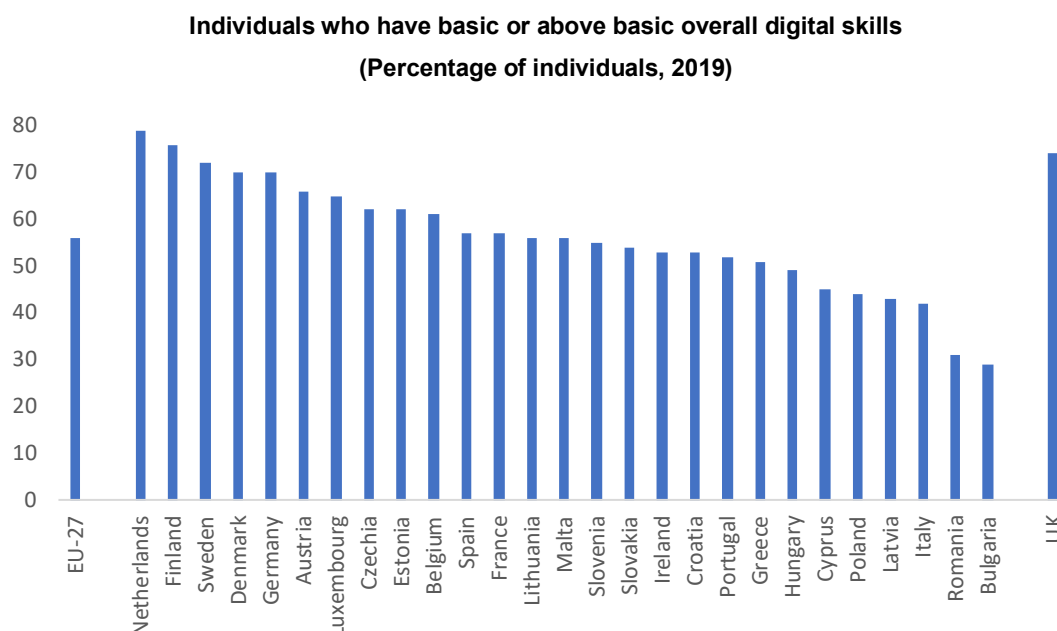
Source: European Union Agency for Fundamental Rights calculations based on European Commission (2019), Eurobarometer, 92.3

11. Skills

Although Portugal improved skills in recent years, the country still lacks qualified population when comparing with the European average and early school is an area to improve despite the positive evolution in recent years (Ferreira and Barros, 2021).

In 2019, the percentage of individuals with basic or above basic overall digital skills in Portugal was 52%, under the EU27 average (56%), and Portugal ranked in the 19th position.

Hence, it is important to address the low level of skills, including digital skills, especially among older adult population. For this purpose, adult learning system is essential to provide people with relevant and necessary skills along their working careers.

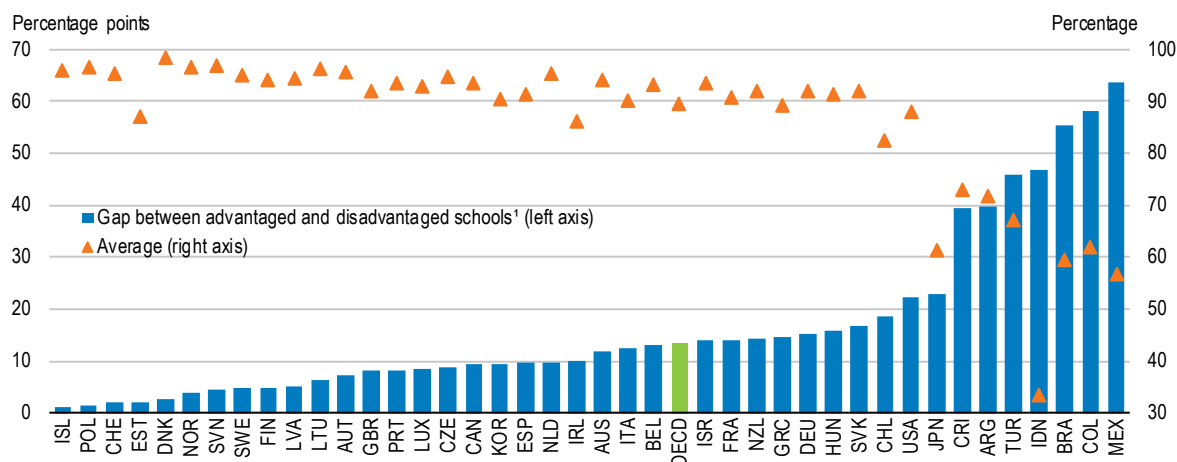


Source: Individuals' level of digital skills, Eurostat (online data code: isoc_sk_dskl_i)

The Covid-19 pandemic brought about a sudden change in the way of learning and made clear that many teachers and students did not have the necessary conditions for online education. This situation made visible the disparities in digital access and demanded greater autonomy of students in learning.

Although the gap on access to digital learning between advantaged and disadvantaged schools in Portugal is below the OECD average, there is a clear the need to invest in infrastructure development for online education and to increase the capacity of teachers and students to use these new channels.

Access to digital learning (Percentage of students that have access to a computer they can use for schoolwork, 2018)



Note: A socio-economically disadvantaged (advantaged) school is a school whose socio-economic profile (i.e. the average socio-economic status of the students in the school) is in the bottom (top) quarter of the PISA index of economic, social and cultural status amongst all schools in the relevant country.

Source: OECD, Going for Growth 2021: Shaping A Vibrant Recovery (PISA Database)

A dashboard with Priorities for Adult Learning made available by OECD (with the support of JP Morgan Chase & Co.) compares the future-readiness of countries' adult learning systems and concludes in the perspective of Portugal that:

- It is urgent to update the adult learning system;
- Enterprises and people are very much engaged in learning;
- Adult learning opportunities should be more flexible and provide readily guidance;
- Adult learning is very much aligned with labour market needs and has a highly perceived impact;
- The financing of adult learning system has weak arrangements.

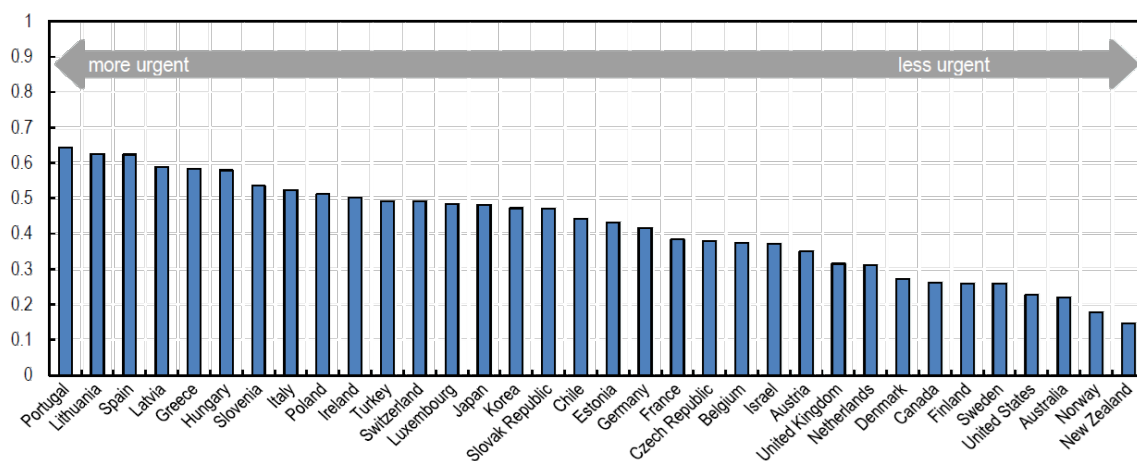
Dashboard on priorities for adult learning



Source: OECD, with the support of JP Morgan Chase & Co. (<https://www.oecd.org/els/emp/skills-and-work/adult-learning/dashboard.htm>)

It is important to highlight the urgency of getting the Portuguese adult learning systems ready for the future, as the highest urgency can be observed in Portugal.

Results of the Urgency dimension – Urgency index (0-1)

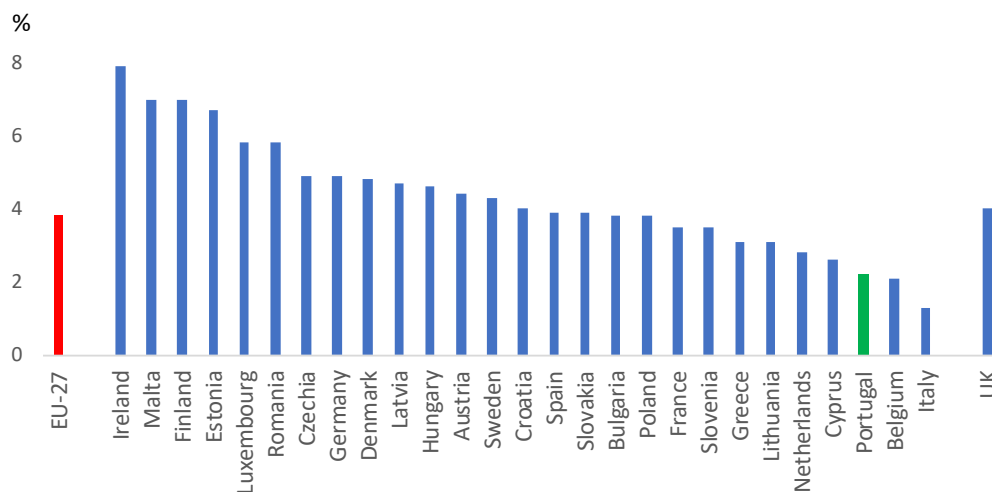


Note: The index ranges between 0 (least urgent) and 1 (most urgent). Switzerland was excluded due to missing data.

Source: OECD Future-Ready Adult Learning Systems, OECD, 2019

In Portugal, in 2018, the percentage of graduates with tertiary education in the field of ICT was of 2.2%, below the EU27 average (3.8%) and placing Portugal in the 25th position.

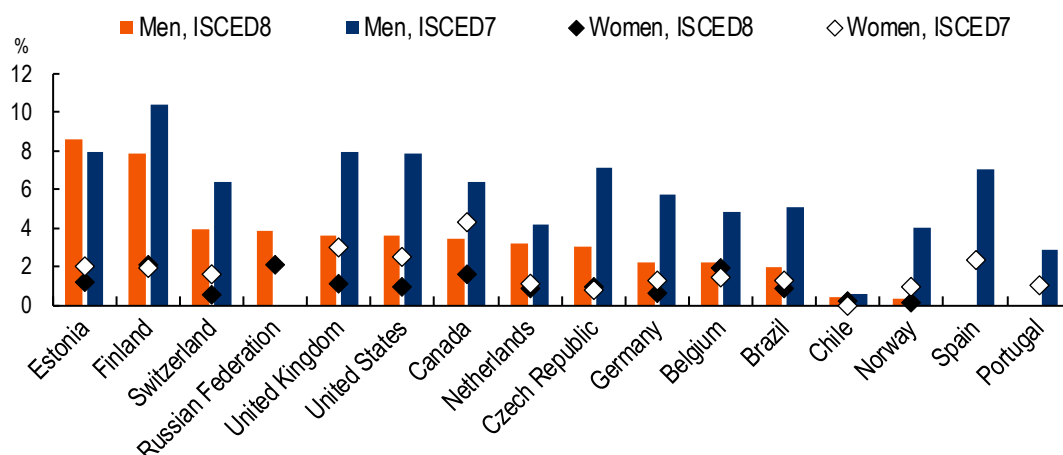
Tertiary education (levels 5-8) in the field of Information and Communication Technologies (Percentage of graduates, 2018)



Source: Eurostat (online data code: educ_uoe_grad03)

ICT advanced degrees are important to provide capacity for advanced research. ICT masters in Portugal account for only 2.86% of master graduates and the share of ICT masters is much higher among men than among women.

**Individuals holding master's (ISCED7) and doctorate (ISCED8) level degrees in ICT
(As a percentage of graduates in all fields, by sex and attainment level, 2016)**

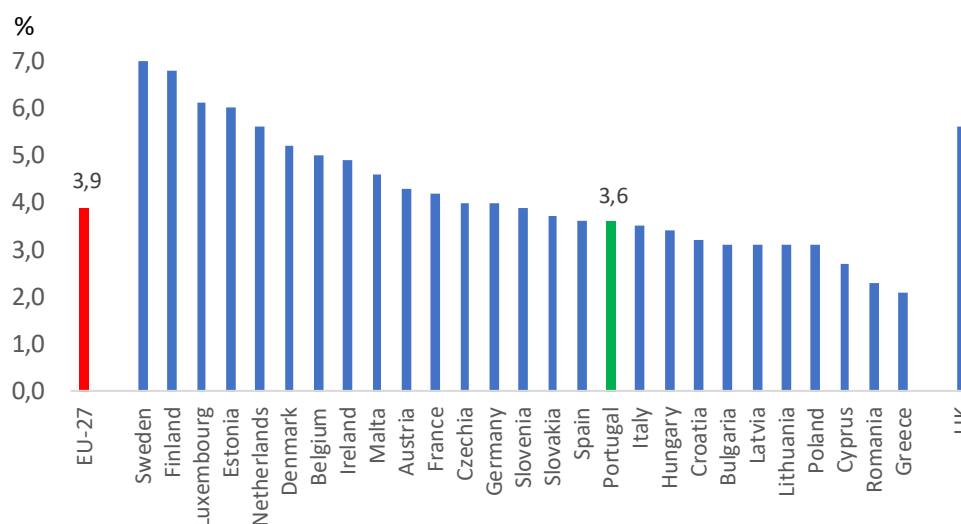


Note: ICT = information and communication technology.

Source: The Digitalisation of Science, Technology and Innovation: Key Developments and Policies, OECD, 2020 [OECD calculations based on OECD data collection on Careers of Doctorate Holders 2017 (database), <http://oe.cd/cdh>.]

Regarding employed ICT specialists, in Portugal, in 2019, represents 3.6% of the total employment, under the EU27 average (3.9%), placing Portugal 17th position.

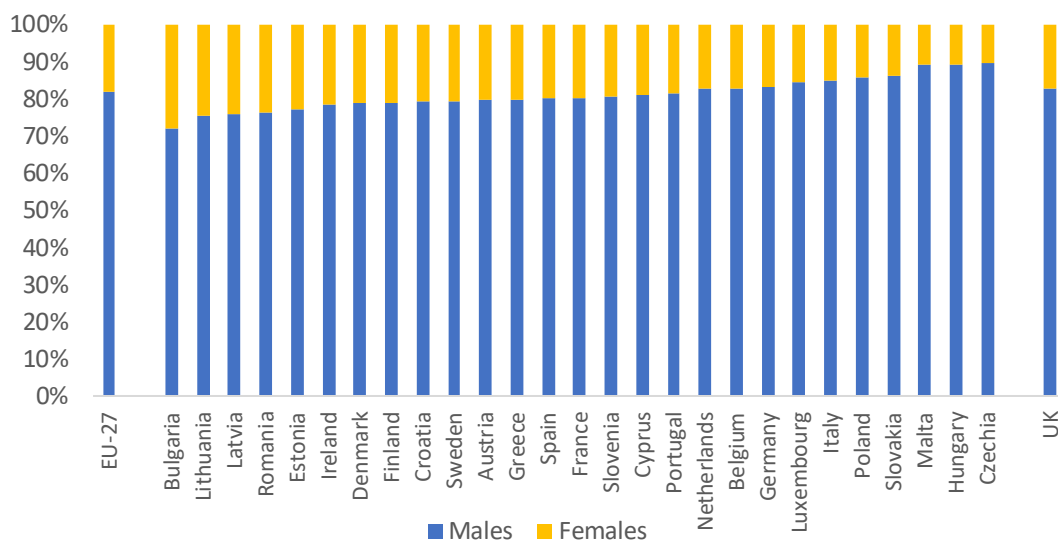
**Employed ICT specialists
(Percentage of total employment, 2019)**



Source: Eurostat (online data code: isoc_sks_itspt)

A feature, not specific of Portugal but which is deserving attention from public policies, is the percentage of female ICT specialists. In fact, with 18.3% of female ICT specialists, Portugal is the 11th country of the EU27 with a lower participation of woman in this area.

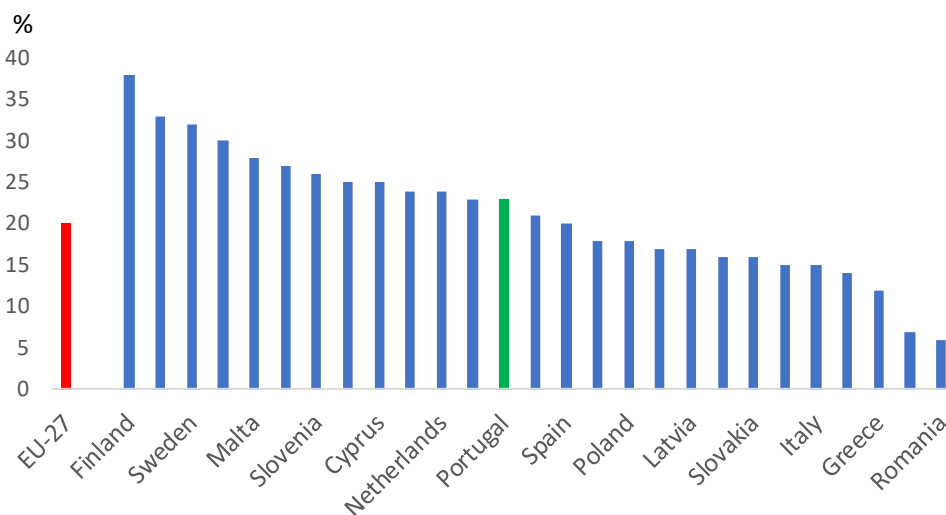
Employed ICT specialists by sex (Percentage, 2019)



Source: Eurostat (online data code: isoc_sks_ittps)

Considering ICT skills, In Portugal, in 2020, 23% of enterprises provided training to develop/upgrade ICT skills of their personnel, above de EU27 average (20%) and placing Portugal in the 12th position.

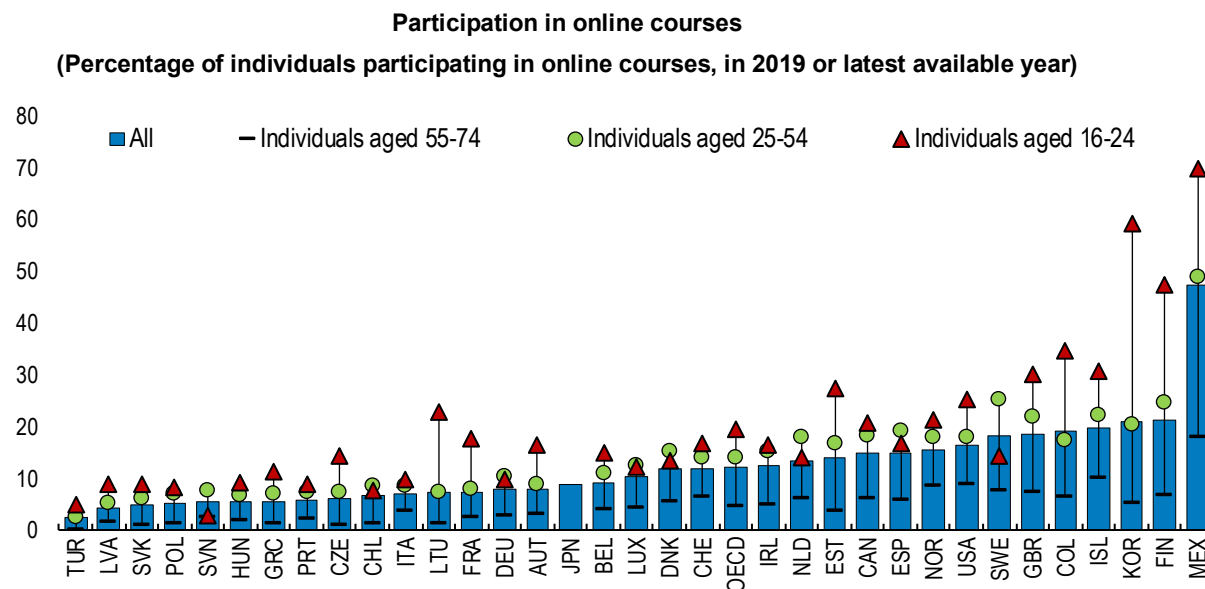
Enterprises that provided training to develop/upgrade ICT skills of their personnel (Percentage of enterprises, 2020)



Source: Eurostat (online data code: isoc_ske_ittn2)

Training is essential for individuals to foster their digital skills needs and the growing use of digital technologies provide alternative channels for training. In Portugal, according to 2019 data, only 5.8% individuals participated in online courses, below the OECD average (12.1%). This value is particularly low for older adults (55-74 years) with only 2.1% of participation in online courses. Although Massive Open

Online Courses (MOOCs) are popular among younger people nowadays, Portugal ranks below the OECD average in all age groups.

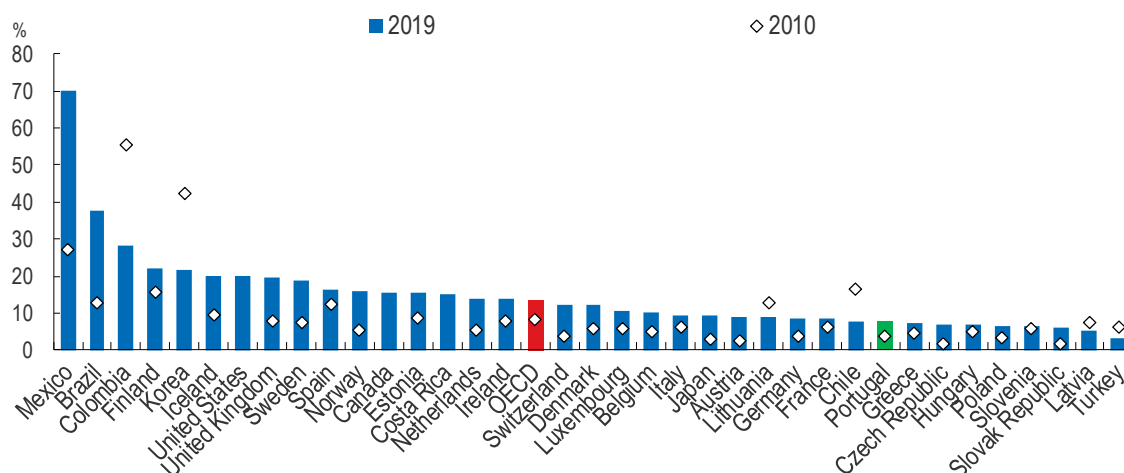


Note: Data refer to 2018 for Canada, Columbia, Japan and Mexico, 2017 for United States.

Source: OECD ICT Access and Usage by Individuals Database

Considering this indicator as a percentage of individuals who used the internet in the last three months, only 7.7% attended an online course but it is important to refer that this value almost doubled between 2010 and 2019.

Individuals who attended an online course
(As a percentage of individuals who used the Internet in the last three months, 2010 and 2019)

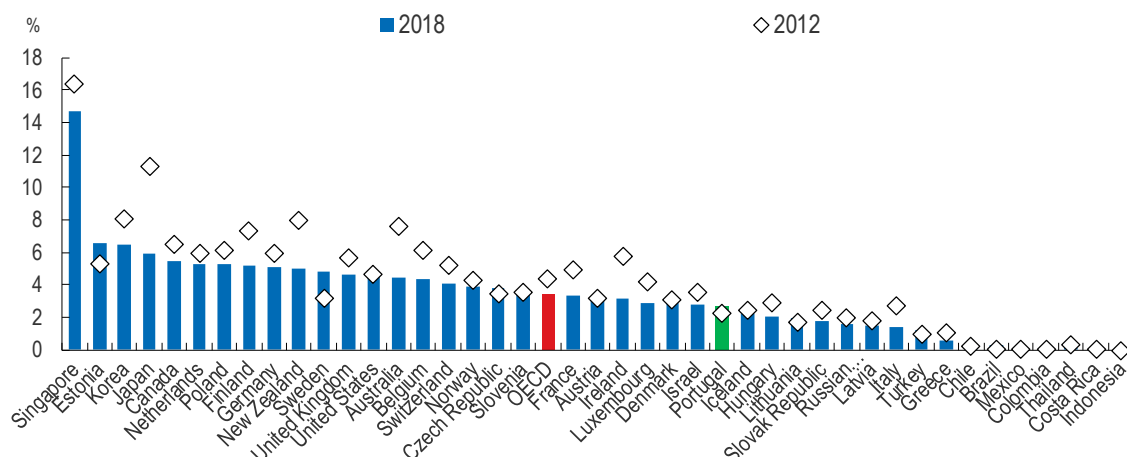


Notes: Data refer to 2017 for Chile and the United States, and to 2018 for Brazil, Canada, Colombia, Costa Rica, Japan and Mexico. For Chile, Colombia, Japan and Korea, the recall period is 12 months and data are as a percentage of individuals who used the Internet in the last 12 months. For Mexico, data refer to the category "To support education and learning". For Costa Rica and Japan, data refer to individuals aged 18-74 instead of 16-74. OECD data are based on a simple average of the available OECD countries.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2020), ICT Access and Usage by Households and Individuals Database, <http://oe.cd/hhind>.]

Another important area is the top performers in science, mathematics and reading, as they are essential to foster digital transformation in a knowledge-based global economy. Despite still having a small share of top performers in science, mathematics and reading (27%), and being under the OECD average (3.4%), Portugal is one of the few countries that improved in this indicator from 2012 to 2018.

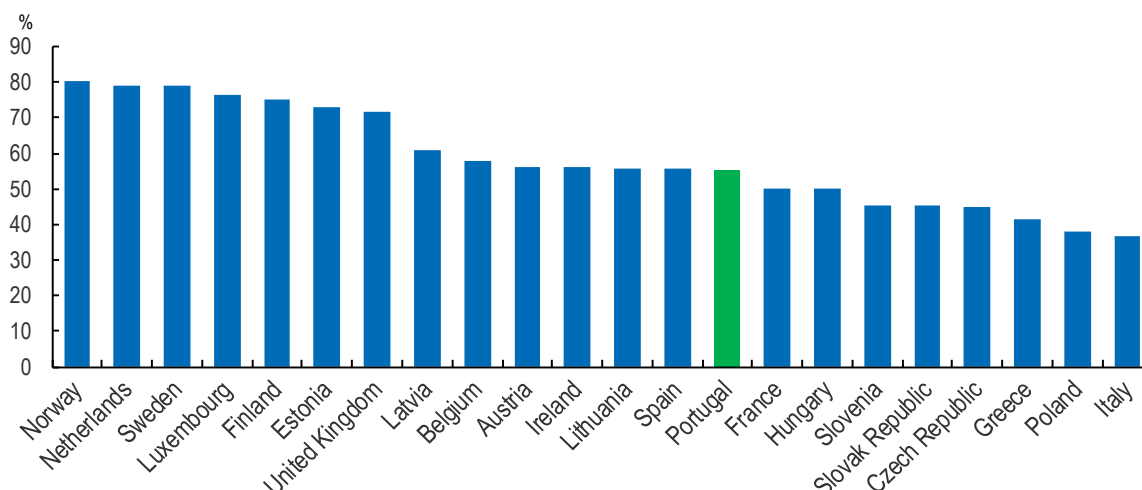
Top performers in science, mathematics and reading
(As a percentage of 15 year-old students, 2012 and 2018)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD calculations based Programme for International Student Assessment (PISA) (database), www.oecd.org/pisa/data.]

In 2016, more than 55% of individuals made diversified and complex use of the internet but Portugal ranked 14th among a list of 22 OECD countries.

Individuals with diversified and complex use of the Internet
(As a percentage of all individuals, 2016)

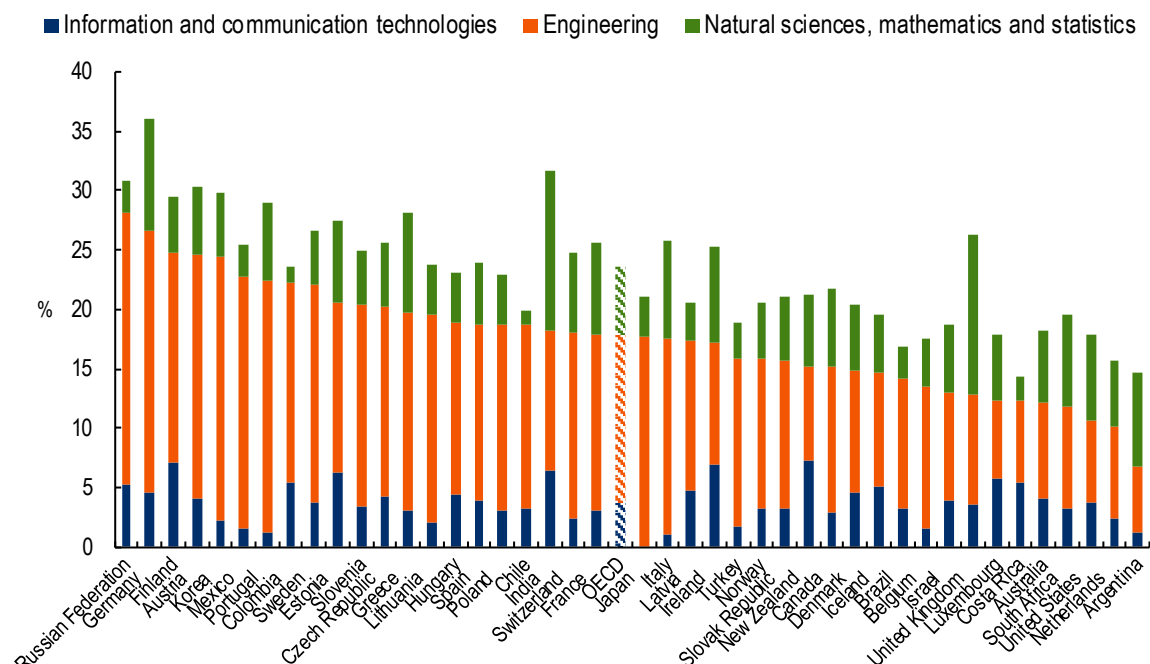


Notes: The European Community Survey on ICT Usage in Households and by Individuals provides information on what actions individuals perform online grouped into 11 major activities: communication, social networks, access to information, entertainment, creativity, learning, e-health, e-banking, e-finance, e-government and e-commerce. The identification of individuals with diversified and complex use of Internet is based on a clustering algorithm (k-means) that groups individuals according to the similarity of their online activities. Individuals with diversified and complex use are individuals who perform, on average, the largest number (more than 8 out of the 11 types of major online activities) and variety of activities. They are also those who perform the bigger share of activities linked to e-finance, learning and creativity – activities performed by the smallest range of individuals which can also be considered more complex activities. The clustering algorithm is run on the entire sample of OECD countries with available data in the European Community Survey on ICT Usage in Households and by Individuals (2016).

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2019), OECD Skills Outlook 2019: Thriving in a Digital World, OECD Publishing, Paris, <https://dx.doi.org/10.1787/df80bc12-en>.]

Considering tertiary graduates in natural sciences, engineering and ICT fields, in 2016, as a percentage of all tertiary graduates, Portugal (29%) ranks in the 7th position among 43 countries and above OECD average (24%), with a particularly good result regarding engineering (21% against OECD average of 14%).

**Tertiary graduates in natural sciences, engineering and ICT fields
(As a percentage of all tertiary graduates, 2016)**



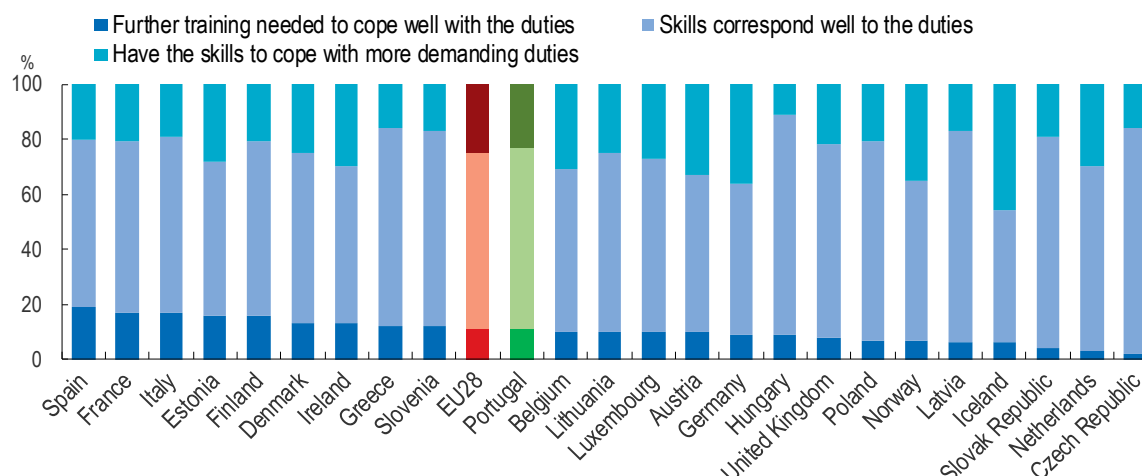
Notes: ICT = information and communication technology. Data on ICT graduates for Japan are included in other fields. The Netherlands excludes doctoral graduates. Data for China not included because of reporting differences. Natural sciences and engineering account for about 25% of higher education institution graduates (60% for new doctorates).

Source: The Digitalisation of Science, Technology and Innovation: Key Developments and Policies, OECD, 2020

Regarding digital skills at work, Portugal is much in line with the EU28 average, with 66% of the individuals who use computers or computerised equipment at work with skills corresponding well to the duties. It is also noticeable that 23% of those individuals have skills to cope with more demanding duties, indicating a mismatch between their skills and those required by their occupation.

Digital skills (mis)match at work

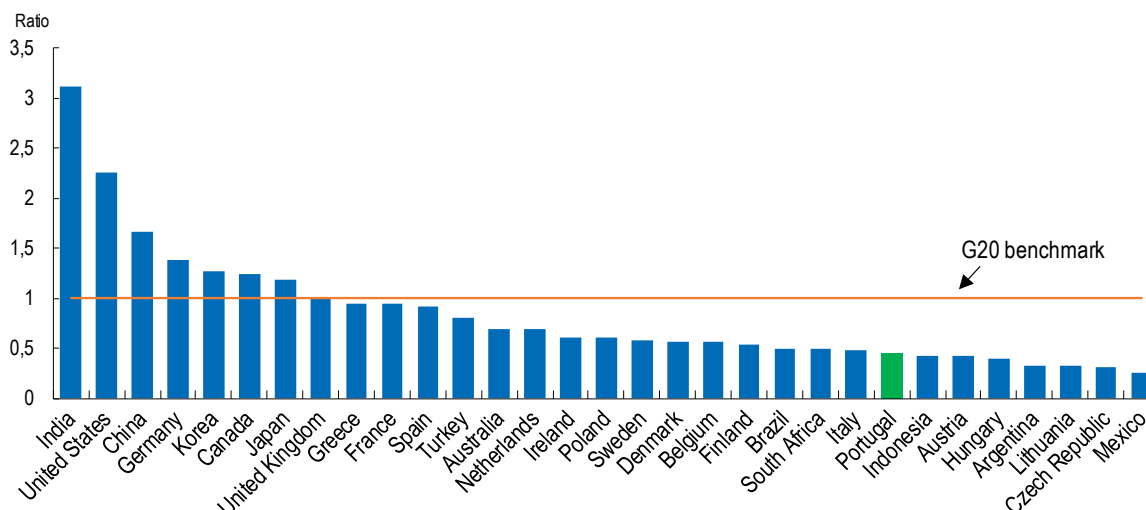
(As a percentage of individuals who use computers or computerised equipment at work, 2018)



Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD (2019), Measuring the Digital Transformation: A Roadmap for the Future, OECD Publishing, Paris, <https://dx.doi.org/10.1787/9789264311992-en>.]

Skills and education are a priority for national AI strategies. AI skills penetration at national level may be measured by analysing the occurrence of such skills in the top 50 most representative skills in LinkedIn profiles, obtained through formal education and training programmes. Reflecting the indicators referred previously regarding skills and education of Portuguese individuals, considering G20 as the benchmark (1.00), Portugal's ratio is low (0.45).

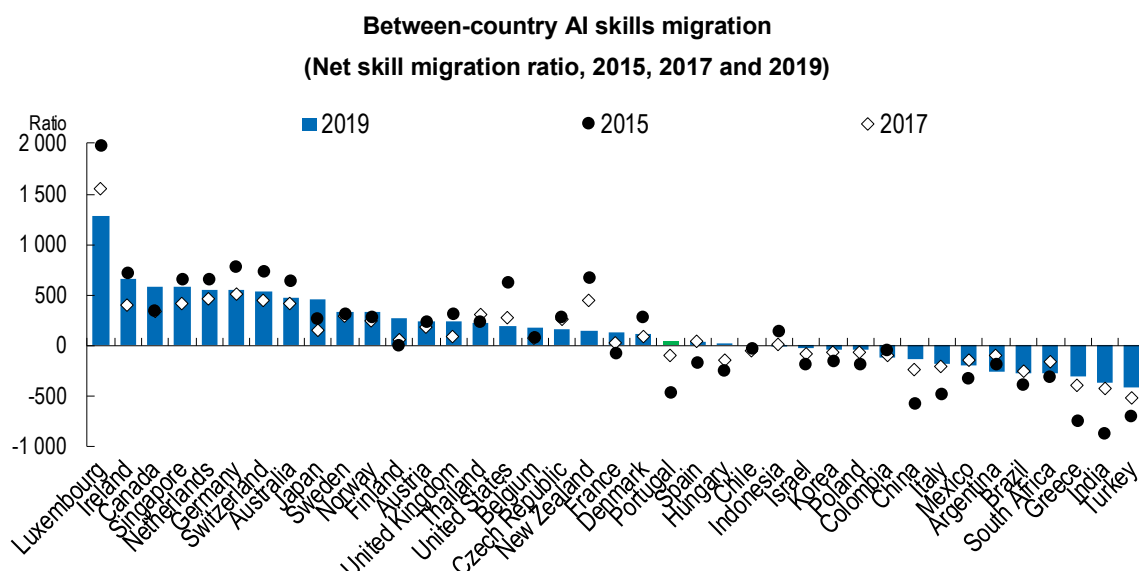
Cross-country AI skills penetration (2015-19)



Notes: Average from 2015 to 2019 for a selection of countries with 100 000 LinkedIn members or more. The value represents the ratio between a country's AI skill penetrations and the benchmark, controlling for occupations. For more information, please see the methodological note at www.oecd.ai. [<https://oecd.ai/methodology>]

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD AI Policy Observatory, www.oecd.ai]

As the migration of researchers and engineers to other countries may cause a shortage of skilled AI workers, this is a concern for many countries. After losing talent with AI skills in 2015 and 2017, the balance in 2019 is positive, albeit small.



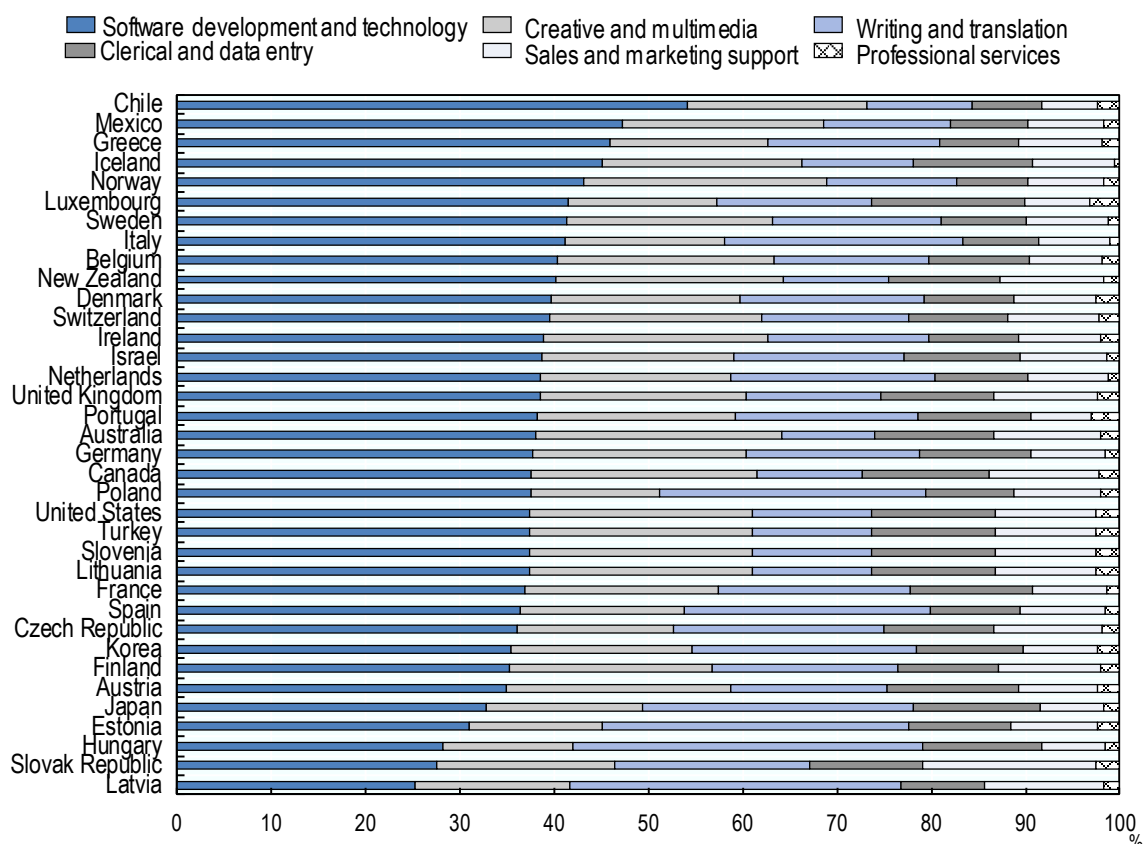
Note: Net skill migration ratio is calculated by dividing net skill flows to a given country by the existing skill stock. Net flows are defined as total arrivals minus departures within the given time period. LinkedIn membership varies considerably between countries, which makes difficult the interpretation of absolute movements from one country to another. To compare migration flows between countries fairly, migration flows are normalised for the country of interest. For example, if country A is the country of interest, all absolute net flows into and out of country A, regardless of origin and destination countries, are normalised based on LinkedIn membership in country A at the end of each year and multiplied by 10 000. Hence, this metric indicates relative talent migration from all countries to and from country A.

StatLink contains more data.

Source: OECD Digital Economy Outlook 2020, OECD, 2020 [OECD AI Policy Observatory, www.oecd.ai]

In Portugal, the main skills demanded on the online labour market are “software development and technology” (38.00%) and “Creative and multimedia” (26.22%), accounting for almost two thirds of the total.

Main skills demanded by OECD countries on the online labour market
(Share of project/task occupations by country of employer)



Notes: Each bar displays employer countries' share of projects/tasks posted on online labour platforms between January and July 2018 by the occupation of project/task. For example, for projects/tasks posted online by employers based in Chile, over 50% of these were related to software development and technology and 20% to creative and multimedia. The Online Labour Index is based on tracking all projects and tasks posted on the five largest English-language platforms, which account for at least 70% of all traffic to online labour platforms. The occupation classification builds on that used by Upwork.com (Kässi and Lehtdonvirta, 2018[48]).

Source: OECD Skills Outlook 2019, OECD, 2019 [Online Labour Index in Kässi, O. and V. Lehtdonvirta (2018[47]), Online Labour Index: Measuring the Online Gig Economy for Policy and Research, <https://mpra.ub.uni-muenchen.de/86627/>.]

Skills and digitalisation are structured in the following scoreboard considering the “skills needed to benefit from digitalisation”, the “exposure to digitalisation” and the “skills-related policies to make the most of digital transformation”. As there is missing information for Portugal, the analysis is only partial.

Portugal is around the median regarding “providing the necessary skills for the next generation”, “teachers’ preparation and training needs” and “initial education” but ranks on the bottom 25% and, hence, there is room for improvement regarding “everyday digital exposure and use” and “effective ICT integration in schools” to provide the necessary skills to make the most of digital transformation and prosper in a digital world.

Scoreboard on skills and digitalisation

	Skills to benefit from digitalisation				Digital exposure			Skills-related policies to make the most of digital transformation				
	Providing the necessary skills to the next generation	A limited share of individuals lacking basic skills		A meaningful share of well-rounded individuals	Everyday exposure and use	Labour market exposure	Workers at risk	Effective ICT integration in schools	Teachers' preparation and training needs	Lifelong learning systems		
		16-29	55-65							Initial education	Advanced education	Learning outside of formal education
Australia					X		.					
Austria									X			
Belgium												
Canada					X			.		X		
Chile					X							
Czech Republic					X							
Denmark					X							
Estonia												
Finland												
France									X			
Germany					X				X			
Greece	X								X	..		
Hungary		..	..	..	X	..	..		..		..	..
Iceland	X	..	..	..	X	..	..		..		..	..
Ireland	X								X			
Israel					X							
Italy									X			
Japan					X							
Korea					X							
Latvia	X	..	..	..	X	..	..		X		..	..
Lithuania	X								X			
Luxembourg	X	..	..	..	X	..	..		..		..	..
Mexico	X	..	..	..	..	..	..		X		..	..
Netherlands												
New Zealand	X				X							
Norway								..				
Poland	X								X			
Portugal		..	..	..	X	..	..		X		..	..
Slovak Republic												
Slovenia									X			
Spain									X			
Sweden												
Switzerland	..	..	..	..	X	..	..		..		..	..
Turkey					X			..	X			
United Kingdom												
United States					X			..	X			

Top 25%

Around median

Bottom 25%

..

Missing data

X

Missing data for underlying indicator(s)

Notes: The scoreboard shows for each sub-dimension countries that perform in the top 25%, bottom 25%, and those around the OECD median. A sharp threshold has been applied and therefore, some countries can be classified in one group (e.g. the bottom 25%) but be close to the other group (e.g. median). For all performance levels (top 25%, around median and bottom 25%), cells that display "X" indicate missing data for underlying indicator(s). Countries are ranked according to the sub-dimensions, which are aggregates of the indicators presented in Annex Table 1.A.1 (see Box 1.1 for details regarding the aggregation and the sub-dimensions of the indicators). For indicators based on the Survey of Adult Skills (PIAAC), data of Flanders is used for Belgium, and of England and Northern Ireland for the United Kingdom.

Source: OECD Skills Outlook 2019, OECD, 2019

Portugal has adopted a range of policy instruments to promote ICT usage in households and by Individuals, especially with focus on increasing digital skills and competence of individuals, including through financial (direct and indirect) and on-financial support measures, and regulation and statutory guidance.

Policy instruments to promote digital uptake by households and individuals
(By type of instrument)

Countries	Financial support		Non-financial support	Regulations and statutory guidance	Total
	Direct	Indirect			
Australia	1	..	2	1	4
Austria	..	1	1	1	3
Chile	..	1	..	..	1
Colombia	1	..	1	..	2
Czech Republic	..	1	..	..	1
Denmark	..	1	2	1	4
Estonia	..	1	1	..	2
Finland	..	1	1	1	3
Israel	..	..	1	..	1
Japan	1	..	2	1	4
Korea	..	..	..	1	1
Latvia	1	..	3	1	5
Lithuania	..	..	1	..	1
Mexico	..	..	2	2	4
Norway	..	..	1	..	1
Portugal	1	1	1	1	4
Slovenia	..	..	1	..	1
Sweden	1	..	..	..	1
Turkey	..	..	1	1	2
United Kingdom	..	..	1	..	1
United States	1	1	..	..	2
Costa Rica	..	1	1	1	3
Russian Federation	3	2	3	2	10
Singapore	1	..	1	1	3
Total	11	11	27	15	64

Note: .. = not available.

Source: OECD Digital Economy Outlook 2020 (based on countries' response to the 2019 OECD Digital Economy Policy Questionnaire), OECD, 2020

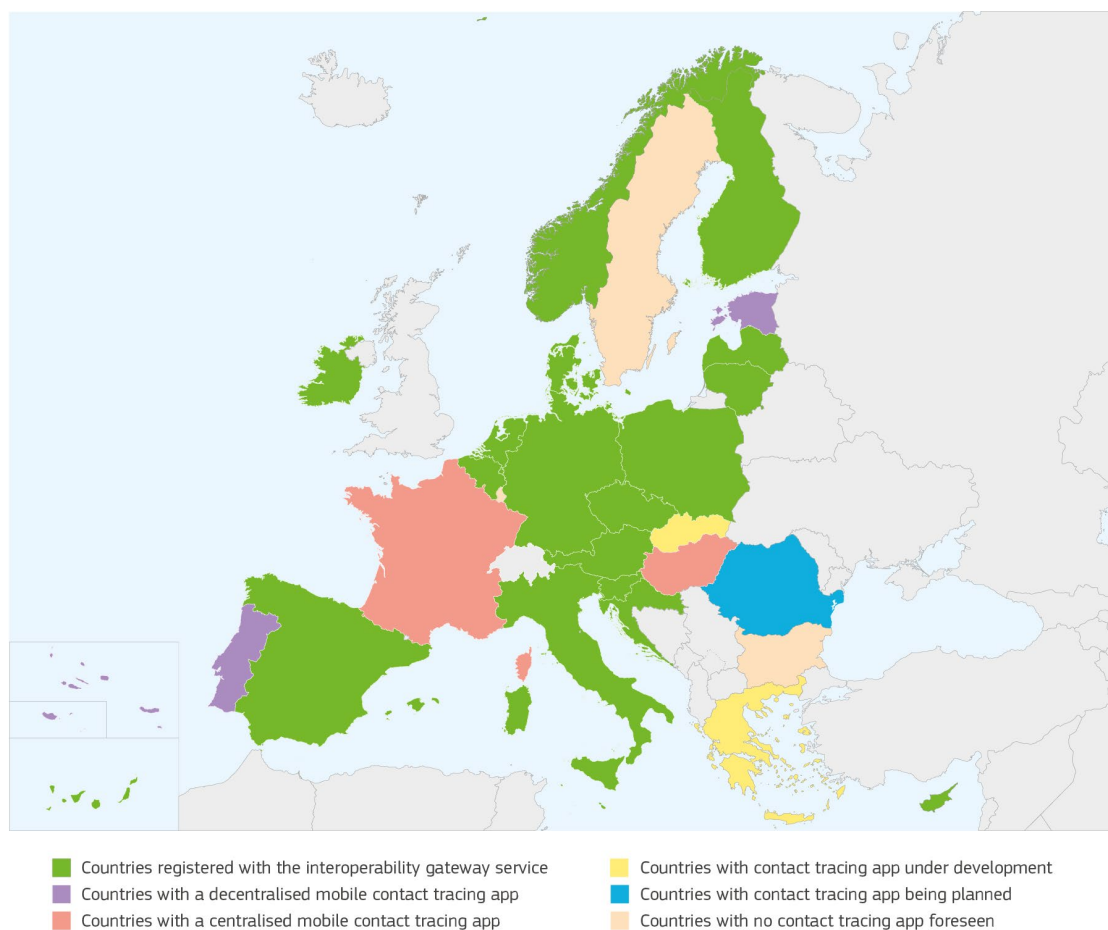
Finally, it is important to point out that enterprises are looking not only for the right technical skills, but also for good soft skills, namely good communication skills and the ability to work with multicultural and geographically dispersed teams.

12. Covid-19

Measures to contain the Covid-19 pandemic led to the rise of a new way of life changed profoundly the way we use digital technologies – from working to learning, from shopping to socializing – and, more than ever, we depend on them as ever.

As other EU Member-States, Portugal introduced as alert and warning apps to trace and help break the chain of coronavirus infections. The app allows users to be warned if they were in contact with someone who tested positive for Covid-19. Although it was thought to be mandatory and it complies with the requirements and recommendations of the National Data Protection Commission (respecting users' privacy and not enabling tracking of people's locations), the Portuguese Government dropped this obligation due to public pressure. The app is nowadays used on a voluntary basis and the number of people registered is low. The Portuguese app, StayAway Covid, is decentralised mobile contact tracing app and, although potentially interoperable, presently it is not able to exchange information with other apps.

Map of contract tracing apps

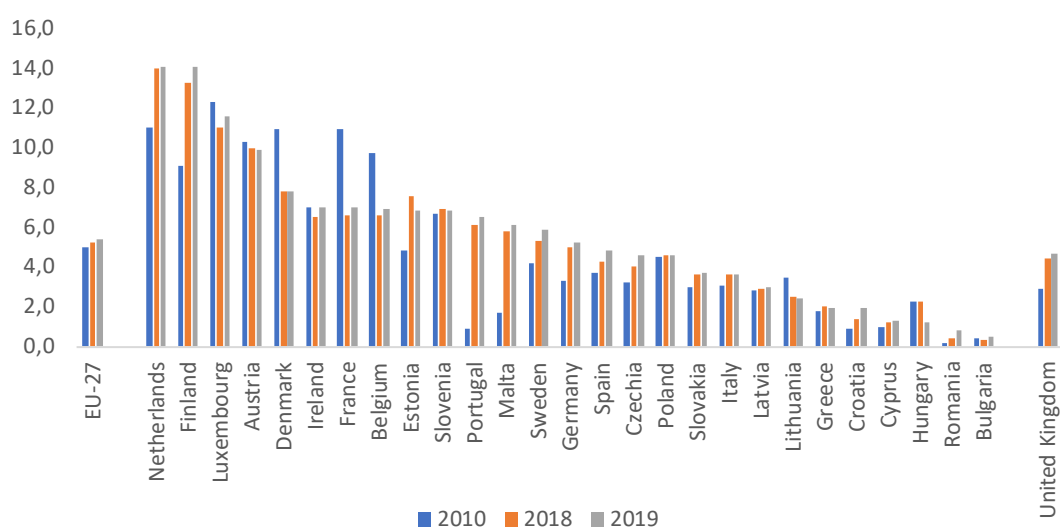


Source: European Commission, 2020 (https://ec.europa.eu/info/live-work-travel-eu/coronavirus-response/travel-during-coronavirus-pandemic/how-tracing-and-warning-apps-can-help-during-pandemic_en)

In a short time, many enterprises and households had to create conditions for telework and for studies at home, with the need for computers, good internet connections and better cybersecurity (because of the higher exposure to digital risks), as well as training to provide skills to cope with this new reality.

Telework in Portugal was already increasing. In 2010, only 0.9% of Portuguese employed persons usually worked from home (EU27 average of 5.0%) and until 2019 the number increased to 6.5%, above the EU27 average (5.4%).

Prevalence of telework across EU Member States (% of Employed persons usually working from home as a percentage of the total employment, 2010, 2018 and 2019)

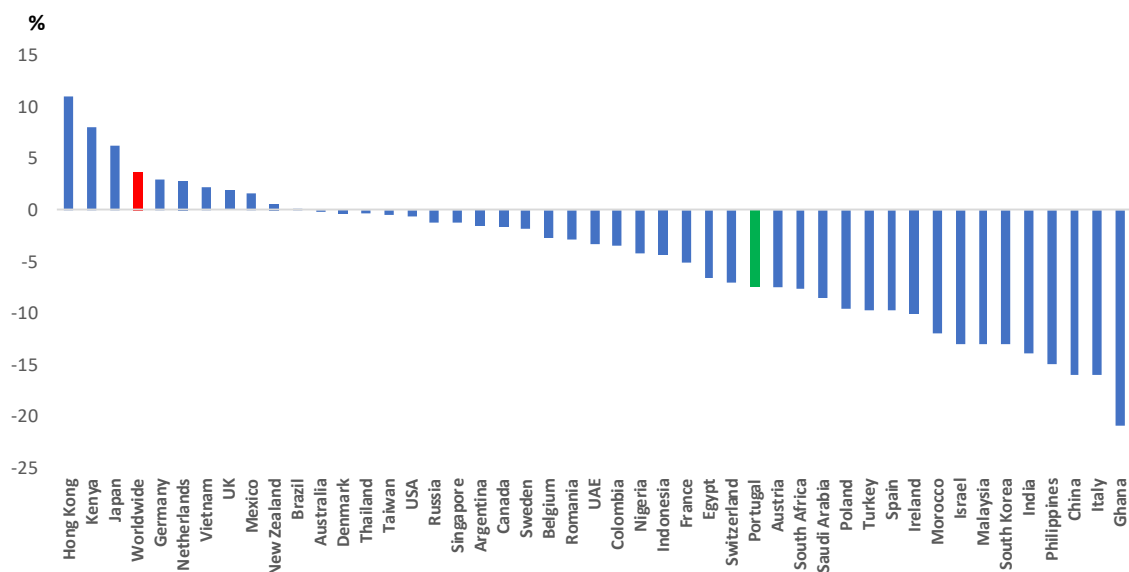


Source : Eurostat (online data code: lfsa_ehomp)

In Portugal, infrastructure was capable to deal with this pressure and working, learning and shopping from home was possible in most of the country (although some difficulties due to geographical access and poverty of households).

According to Ookla, from February to March 2020 there was a reduction in internet speed in many countries. In Portugal, in the beginning of the Covid-19 pandemic, there was a 7.5% reduction in mobile internet speed and a 2.3% increase in fixed internet speed. However, this entity reported that as of July 2020 it stopped updating these data since “internet speeds in most countries have stabilized to pre-pandemic levels”. There were no reports of significant failures in the internet service.

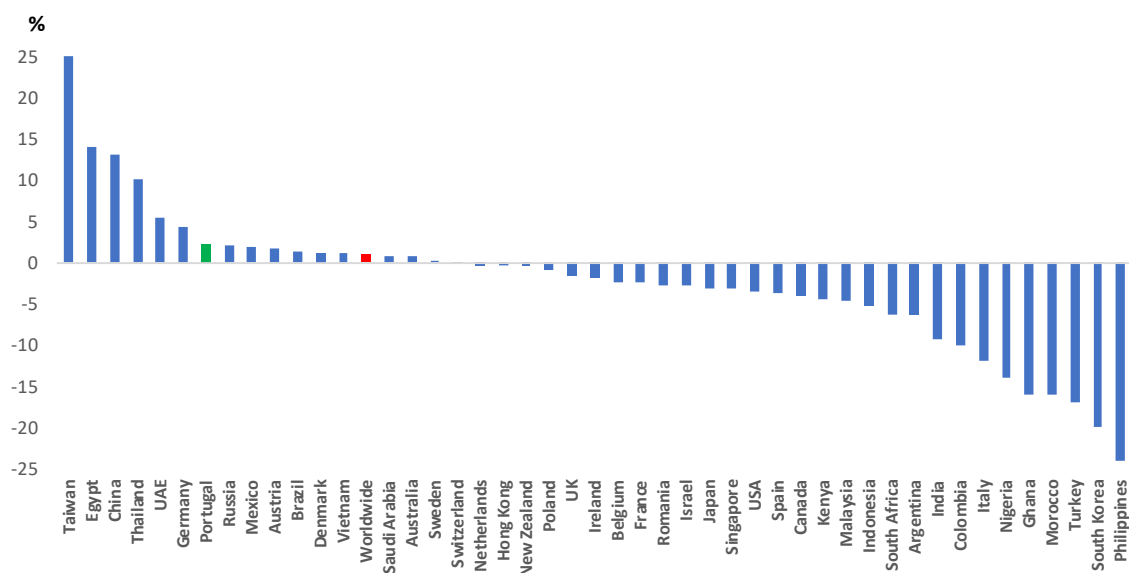
Impact of Covid-19 on mobile internet speeds (Month-on-month change in the average download speed of mobile internet connections from February to March 2020)



Note: Figures compare average download speeds for mobile internet connections in March 2020 to February 2020, except for China where figures compare average download speeds in February 2020 to January 2020 due to the earlier lockdown in mainland China.

Source: Digital 2020 – Ookla (April 2020), We Are Social/Hootsuite, 2020

Impact of Covid-19 on fixed internet speeds (Month-on-month change in the average download speed of fixed internet connections from February to March 2020)



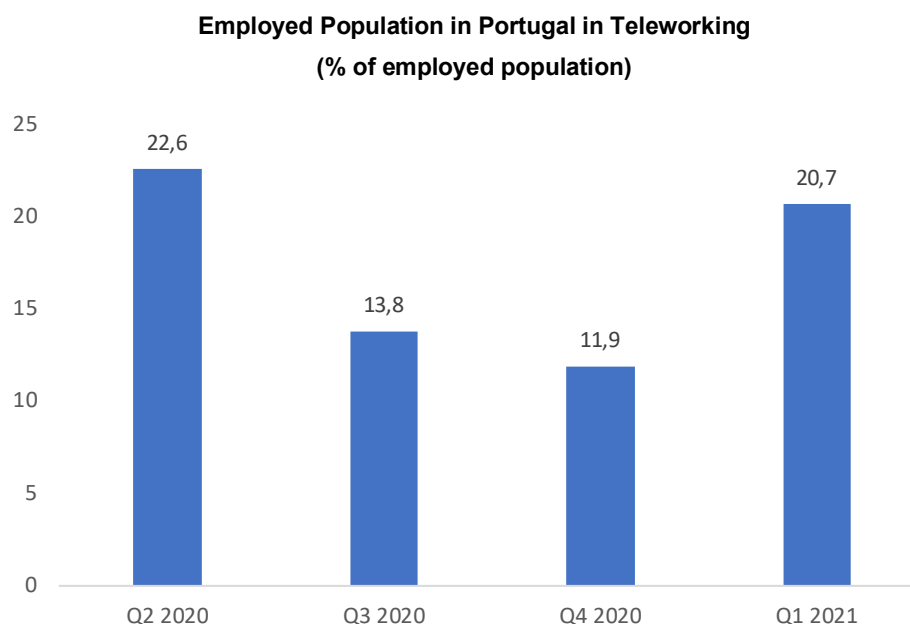
Note: Figures compare average download speeds for fixed internet connections in March 2020 to February 2020, except for China where figures compare average download speeds in February 2020 to January 2020 due to the earlier lockdown in mainland China.

Source: Digital 2020 – Ookla (April 2020), We Are Social/Hootsuite, 2020

The Covid-19 pandemic has created a disruption in the way we work to the point that in many areas teleworking has taken place for longer periods or even permanently. Many functions in the digital area are compatible with fully remote projects.

Despite the resistance to telework that existed before the pandemic, the emergency measures to the Covid-19 pandemics related to lockdown measures, and the urgency to keep the society functioning forced it to become extensively applied. While concerns regarding the right to disconnect, work-life balance, social interaction, and workers' rights emerged telework revealed a critical labour form for organisations during Covid-19 pandemics, promoting feasibility, productivity and greater flexibility for workers, namely cost saving travels.

The employed population who worked always or almost always from home in the reference week and in the three weeks before and that used ICT increased steadily in the periods of greater confinement – 22.6% during the first confinement and 20.7% in the second confinement.

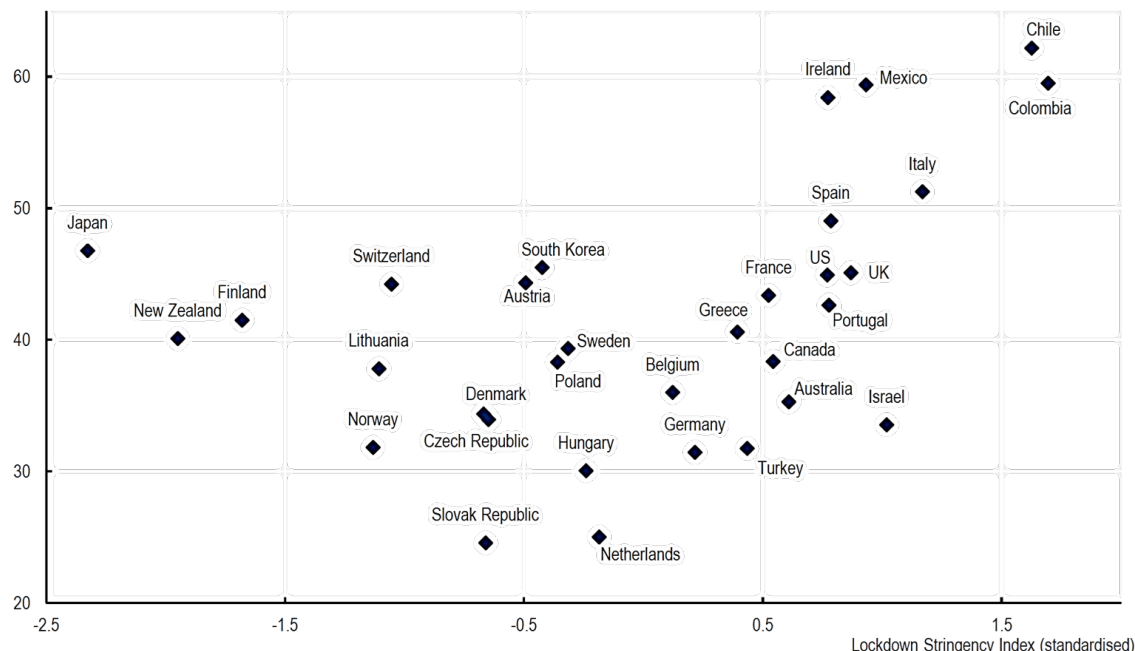


Source: Labour Force Survey, Instituto Nacional de Estatística - Statistics Portugal, 2021

Portugal is one of the countries where, due to the stringency of containment measures, more SMEs increased their use of digital technologies in 2020.

SMEs that increased digitalisation due to containment measures (Share of SMEs that increased digitalisation in 2020 (%) vs. the stringency of containment measures (index))

Share of SMEs increasing digitalisation (%)



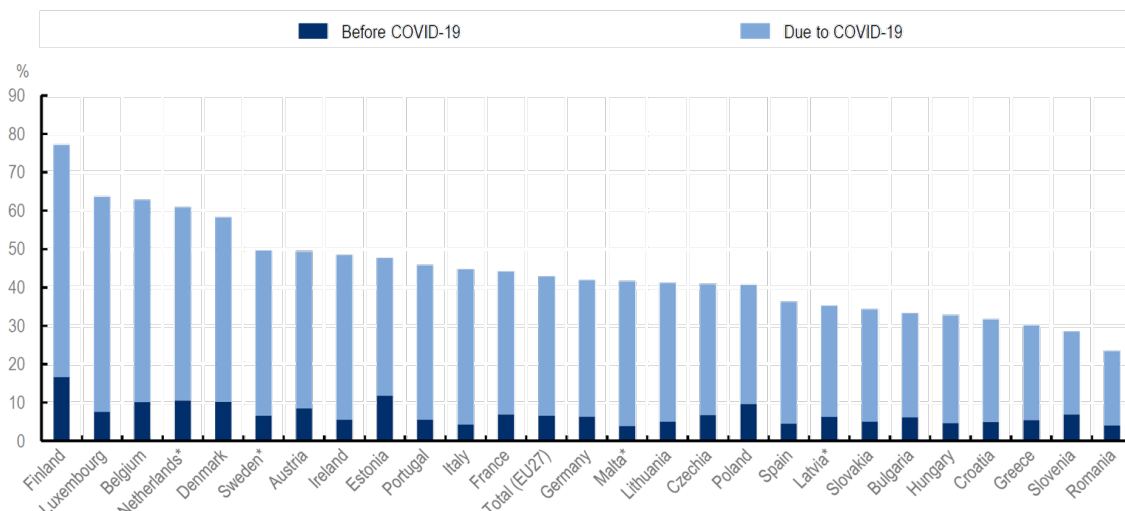
Note: The share of SMEs increasing digitalisation is the share of SMEs in a country that stated it did increase its use of digital technologies since the start of the COVID-19 crisis. The Lockdown Stringency Index is a standardised version (by country) of a Stringency Index, which is an aggregate indicator of the strength of different lockdown measures.

Source: OECD calculations based on Facebook/OECD/World Bank (2020), Future of Business Survey (December) and data from the Oxford COVID-19 Government Response Tracker. Hale, T. et al. (2021), "A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)", <http://dx.doi.org/10.1038/s41562-021-01079-8>.

According to International Labour Organization ("Working from Home: Estimating the worldwide potential", 2020), Portugal has a higher potential for teleworking, for instance, than Germany, France, Spain or Italy. Additionally, the telework uptake grew steadily during the pandemic, with a significative increase in the share of respondents who started working from home because of the pandemic compared to the share of respondents who worked from home several times a month before.

Levels of telework

(Share of respondents who started to work from home before the pandemic and because of it, as compared to the share of respondents who worked from home several times a month before)



Note: The data show the share of EU27 respondents answering “yes” when asked “Have you started to work from home as a result of the COVID-19 situation?” and the share of respondents answering “several times a month” when asked “How frequently did you work from home before the outbreak of COVID-19?”. * : Lower reliability.

Source: Eurofound (2020), “Living, working and COVID-19 dataset, Dublin”, <http://eurofound.link/covid19data>.

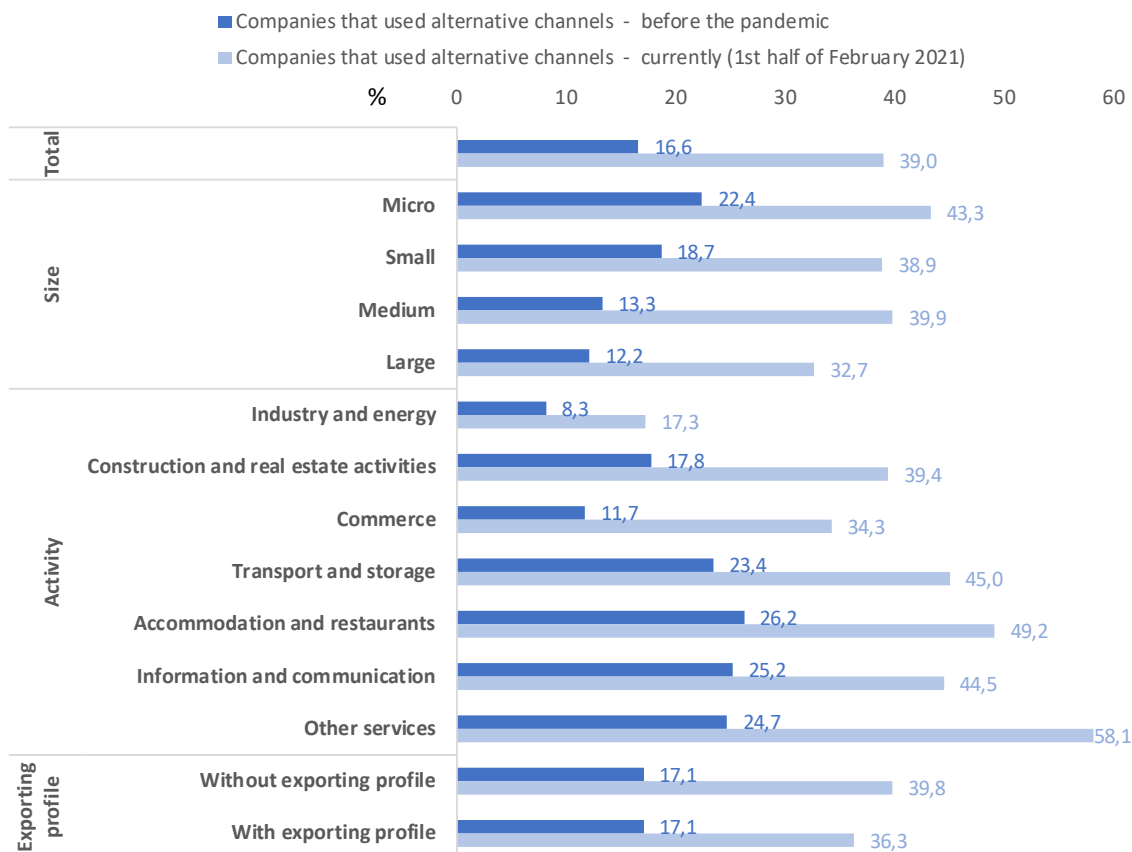
Due to this new paradigm, in which enterprises are increasingly prepared to work remotely, employers have started to have a new perspective when hiring, looking for talent in different geographies, across borders, and this may become a trend. By expanding their geographic hiring scope, enterprises will have access to a broader pool of talent, with diversified qualifications. This is, without a doubt, a challenge for the future and requires an increase in qualifications in Portugal to enable these new job opportunities to be met.

Considering the impact of Covid-19 pandemic on enterprises, the results of the survey conducted by the National Statistics Institute and the Bank of Portugal in first fortnight of February 2021 concluded that:

- Only 13% of enterprises used alternative customer contact channels (e.g., online sales, takeaway, home deliveries, remote service provision);
- 61% of enterprises did not use alternative channels for contacting customers because their activity does not allow it, especially Transport and Storage (83%);
- The average share of turnover generated by these channels increased from 17% before the pandemic to 39% during this period;
- The second sector with the highest percentage of enterprises using alternative customer contact channels was the sector of Information and Communication (20%).

The percentage of turnover generated by enterprises via alternative customer contact channels increased due to the pandemic in total (22.4 percentage points) and all classes of size, activity and export profile, but especially in medium size enterprises (26.5 percentage points), other services (33.4 percentage points) and enterprises without exporting profile (22.7 percentage points)

**Percentage of turnover generated by your enterprise via alternative customer contact channels
(online sales / takeaway / home deliveries / remote service provision) before the pandemic and in
the first fortnight of February 2021**

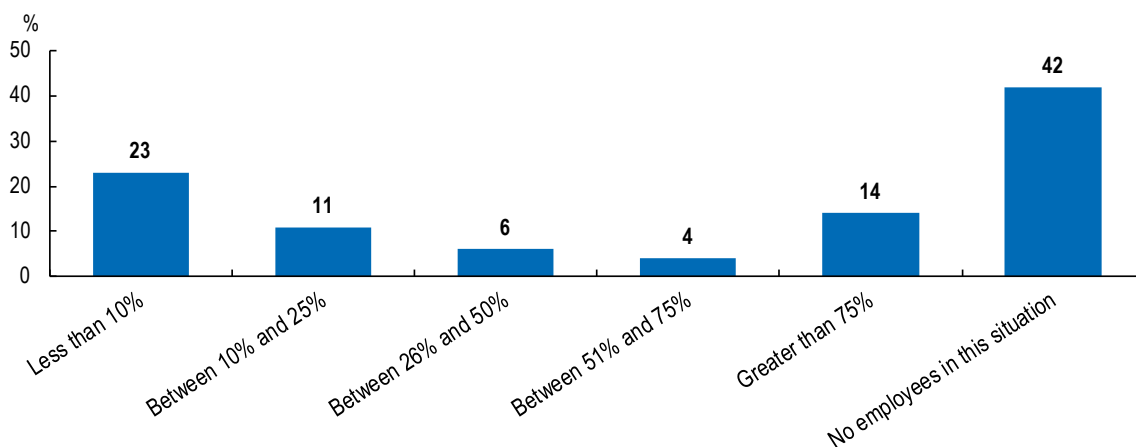


Source: National Statistics Institute and Bank of Portugal, COVID-IREE – *Inquérito Rápido e Excecional às empresas* (February 2021), 2021 (https://ine.pt/ngt_server/attachfileu.jsp?look_parentBoui=483976111&att_display=n&att_download=y)

The survey also concluded that, on the first fortnight of February 2021, 58% of the enterprises had people in telework, 14% of the enterprises had more than 75% of the people in telework and the sector with the highest percentage of people in telework was the Information and Communication sector (86%).

In 89% of enterprises with teleworkers, the number of workers covered in the first fortnight of February 2021 was similar or increased compared to that recorded during the first confinement (first fortnight of April 2020).

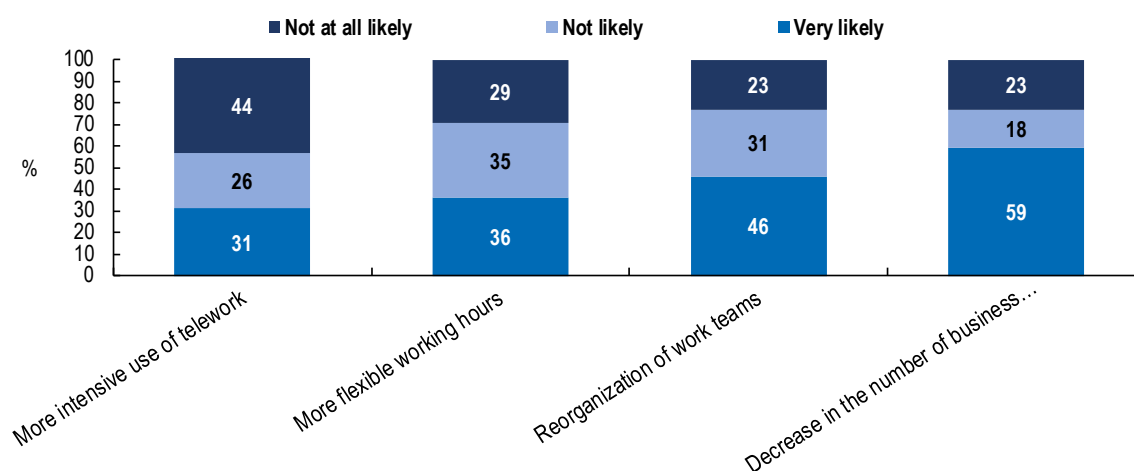
**Quantification of staff working in telework in the first fortnight of February 2021
(% of total enterprises in operation or temporarily closed)**



Source: National Statistics Institute and Bank of Portugal, COVID-IREE – *Inquérito Rápido e Excepcional às empresas* (February 2021), 2021 (https://ine.pt/ngt_server/attachfileu.jsp?look_parentBoui=483976111&att_display=n&att_download=y)

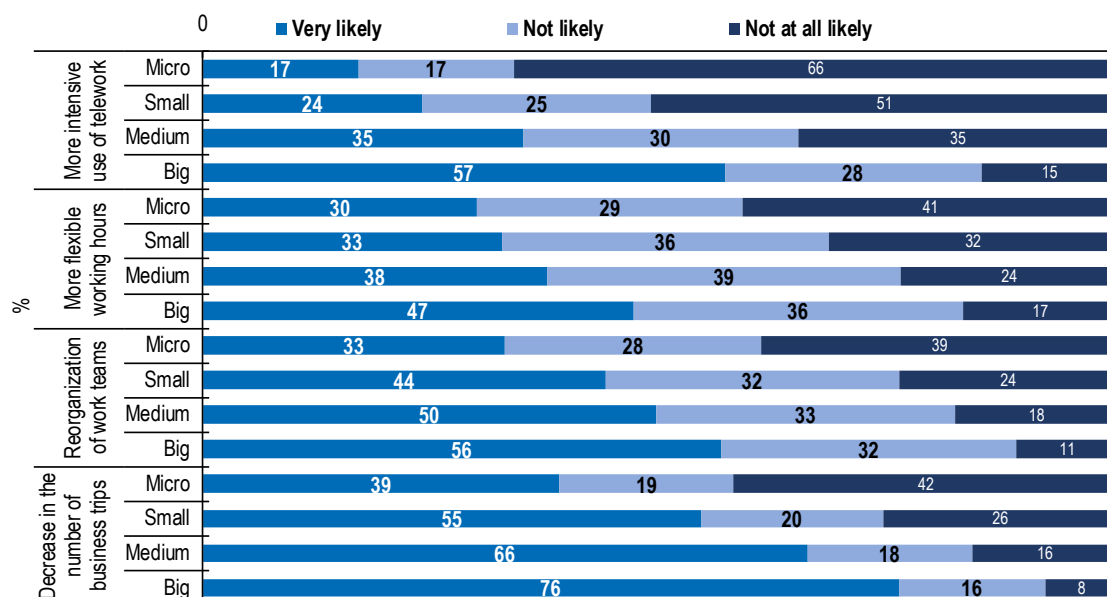
The survey also concluded that 31% of enterprises consider highly likely to intensify the use of telework, 36% flexibilise working hours, 46% reorganise work teams and 59% decreasing the number of business trips. These changes are more likely to happen the larger the size of the enterprise. In terms of sectors, the Information and Communication sector, once again, stands out due to the high percentage of enterprises that consider the possibility of permanently changing their way of working.

**Permanent changes in the way enterprises work due to the COVID-19 pandemic
(as a % of total enterprises)**



Source: National Statistics Institute and Bank of Portugal, COVID-IREE – *Inquérito Rápido e Excepcional às empresas* (November 2020), 2020 (https://www.bportugal.pt/sites/default/files/anexos/documentos-relacionados/iree_20201126.pdf)

Permanent changes in the way enterprises work due to the COVID-19 pandemic
(% of total enterprises, by enterprise size)

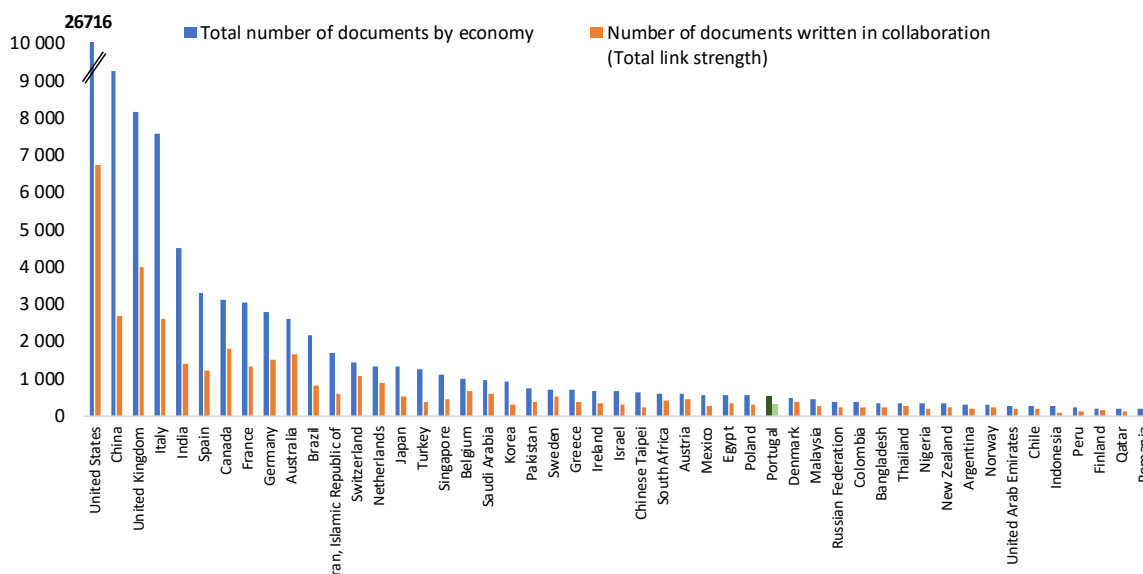


Source: National Statistics Institute and Bank of Portugal, COVID-IREE – Inquérito Rápido e Excepcional às empresas (November 2020), 2020 (https://www.bportugal.pt/sites/default/files/anexos/documentos-relacionados/iree_20201126.pdf)

Regarding school classes during the Covid-19 pandemic, The National Cybersecurity Center published the results of the Cybersecurity and Distance Learning Survey, carried out in partnership with the Directorate-General for Education, to non-higher education teachers, on cybersecurity practices during the first period of confinement in 2020. Among other aspects, this survey shows how, for teachers, the most relevant difficulty in this area is the lack of technological means (37%). (<https://www.cncs.gov.pt/recursos/noticias/ja-se-encontram-disponiveis-os-resultados-do-inquerito-ciberseguranca-e-ensino-a-distancia/>).

During the Covid-19 pandemic, many countries invested in biomedical research regarding SARS-CoV-2, for which digital technologies played an important role. The top 4 countries of origin of research on COVID-19 are responsible for more than 50% documents published on PubMed – United States of America (26.2%), China (9.1%), United Kingdom (8.0%) and Italy (7.5%). All countries have between 25% and 100% of the documents written in collaboration and have established between 1 and 4 clusters and links with other economies, with 8 countries with more than 100 links (United Kingdom – 107, United States of America – 106, China – 103, Italy – 103, France – 103, Germany – 103, India – 101, Australia - 100). Portugal represents about 0.5% of the research on COVID-19, with 540 documents published, of which 311 (57.6% of total) are written in collaboration and established 2 clusters and 82 links with other economies.

International scientific collaboration on COVID-19 biomedical research (January 1 to November 30, 2020)



Source: OECD Science, Technology and Innovation Outlook 2021: Times of Crisis and Opportunity, OECD and OCTS-OEI calculations based on US National Institutes of Health PubMed data, 2020 (<https://pubmed.ncbi.nlm.nih.gov/>)

This unprecedented pandemic crisis required, and will continue to require, the implementation of extraordinary and urgent measures to mitigate the economic and social consequences.

The Portuguese Government adopted measures, since the beginning of the Covid-19 pandemic, to contain the virus spread, strengthen the health system and to ensure the distribution chains essential to the economy functioning. The measures to control the disease, particularly those that required significant restrictions on economic activity and societal life, motivated the approval of a set of exceptional measures, namely to support the liquidity of enterprises and the maintenance of jobs, thus avoiding the irreversible destruction of jobs (notably, the lay-off simplified regime) and productive capacity and limiting the loss of household income. More recently, public policy in the economic dimension focused on the gradual lifting of restrictive measures and the approval of support for enterprises to reopen the activities.

The ability of the Portuguese economy to resume its trajectory of sustainable growth, in a context of balanced public accounts, depends on Europe's response coordination. But, notwithstanding the importance of the measures already adopted, these measures must be combined with structural policies that are critical for the medium and long term and which should focus on increasing competitiveness, productivity and employment, while promoting growth and sustainability of public accounts.

Public policy measures are important to achieve the digital transition, namely through skills, and Portugal has already important support measures in place under the EU's Multiannual Financial Framework (such as the Digital Europe Programme) and direct management programmes (in particular a large part of the NextGenerationEU, notably the Recovery and Resilience Facility). EU policies also provide a landscape for common strategies under the Coordinated plan on Artificial Intelligence, the 5G Europe Action Plan, the European data strategy or the Open Data in Europe. New EU legislation is also being prepared to improve the framework for digitalisation, such as the Digital Single Act.

Remarkably, the Portuguese Recovery and Resilience Plan is steered by national strategies and policies and is in line with the European priority given to climate and digital transitions.

13. Public Policies

This section presents the main public policies in the digital area, in the European Union and, especially, in Portugal, with relevance to the digital transition of companies, citizens and public administration.

EU's Digital Strategy

In February 2020, the European Commission proposed a Digital Strategy (https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/shaping-europe-digital-future_en) to shape Europe's digital future, aiming to promote digital transformation and the use of digital solutions through three pillars.

- **Citizens**
 - Invest in digital skills
 - Promote Cybersecurity
 - Develop trustworthy Artificial Intelligence
 - Accelerate diffusion of ultra-fast broadband
 - Promote innovative solutions based on super-computing capacity
- **Enterprises**
 - Promote start-ups
 - Finance SMEs
 - Strengthen the responsibility of online platforms
 - Guarantee clear rules for online services and fit for the digital economy
 - Ensure fair competition
 - Improve data use and data security
- **Governments**
 - Achieve climate-neutrality by 2050
 - Reduce carbon emissions
 - Guarantee control and protection of data
 - Promote data in Europe to accelerate research in the health sector
 - Fight disinformation

EU's Digital Decade

On 9 March 2021, the Commission presented a vision and pathways for Europe's digital transformation until 2030 ([https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-](https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital)

[decade-digital-targets-2030_pt](#)). These Digitalisation Guidelines for the EU's digital decade is built on four key areas.

- **Digital Skills**
 - ICT Specialists: 20 million + Gender convergence
 - Basic digital skills: min. 80% of the population
- **Digital Infrastructure - Secure and sustainable digital infrastructure**
 - Connectivity: Gigabit for everyone, 5G everywhere
 - Cutting-edge semiconductors: doubling the EU's share of world production
 - Data — periphery and cloud: 10,000 high security peripheral nodes with neutral climate impact
 - Computing: first quantum-accelerated computer
- **Digitalisation of Businesses - Digital transformation of enterprises**
 - Technology adoption: 75% of EU enterprises use cloud computing/AI/Big Data
 - Innovators: growth of booming enterprises and funding to double the EU's 'unicorns'
 - Late users: over 90% of SMEs achieve at least a basic level of digital intensity
- **Government - Digitalisation of public services**
 - Essential public services: 100% online
 - e-Health: 100% of citizens have access to their medical record
 - Digital identity: 80% of citizens use digital identification

In September 2021, European Commission proposed a guide for the Digital Decade (https://ec.europa.eu/commission/presscorner/detail/pt/IP_21_4630) to foster digital transformation of our society and economy by 2030 (). The Commission proposes to create an annual cooperation mechanism with the Member States, consisting of (i) a structured, transparent and shared monitoring system, (ii) an annual report on the state of the Digital Decade, (iii) a multi-year strategic roadmap for the Digital Decade by Member State, (iv) a structured annual framework to discuss and address areas where progress is weak and (v) a mechanism to support the execution of multinational projects.

National Strategy for Digital Transition

The National Strategy for Digital Transition (Estrutura de Missão Portugal Digital, 2020) has as main areas of focus the digital empowerment of people, the digital transformation of companies and the digitalisation of the State, based on three pillars (with sub-pillars) and an additional dimension. The set of 57 measures is as follows.

- **Pillar I - Training and digital inclusion of people**
 - Sub-pillar: Digital education
 - 1. Digitalisation program for schools

- 2. ICT in basic education curricula
 - 3. Programming, robotics and digital literacy
 - 4. Female Engineers for 1 Day Project
- Sub-pillar: Qualification and professional training
 - 5. Intensive and specialized training program in the digital area for 3,000 professionals - UpSkill
 - 6. Digital Guarantee for all unemployed
 - 7. Project-based learning methodologies in TeSP courses
 - 8. In-service teacher training (primary and secondary education)
 - 9. Continuing training of trainers in the field of ICT
 - 10. i4.0 Academies
 - 11. Digital training programs Infoexclusion Zero and AP Digital 4.0
 - 12. Technological Academies
 - 13. Digital and sectorial qualification (training of management and technicians)
 - 14. Learning Factories (human resources training)
 - 15. Coaching i4.0 (training actions with funding component)
- Sub-pillar: Inclusion and digital literacy;
 - 16. Digital inclusion program for 1 million adults
 - 17. Social tariff for access to Internet services
 - 18. Creative Communities for Digital Inclusion
 - 19. "Closing the Gender Gap in Digital Technologies" Action Plan 2030 Agenda
 - 20. NAU Project
- **Pillar II - Digital transformation of the business fabric**
 - Sub-pillar: Entrepreneurship and investment traction
 - 21. e-Residency Program - Digital Identity System
 - 22. Financing and investment support (access, financing and transformation)
 - Sub-pillar: Business fabric (focused on SMEs)
 - 23. Digital Training Program for SMEs in the Interior
 - 24. Disseminate Digital Maturity and Cybersecurity tool
 - 25. Experience i4.0 (sharing business models, value chains and establishing partnerships)
 - 26. Digital connection of SMEs and large companies ("nuclear companies") with suppliers
 - 27. Develop guide and support tools (i.e., contact center) to assist SMEs in the patent registration process
 - 28. Increase the digital presence of SMEs through face-to-face actions, with a funding model dependent on the results obtained, to equip SMEs with skills to use social networks and to sell online
 - Sub-pillar: Transfer of scientific and technological knowledge to the economy;
 - 29. Promotion of Technological Free Zones - ZLT

- 30. Stimulus for innovation (partnerships with technology centers and universities)
- 31. Digital Innovation Hubs for Entrepreneurship
- **Pillar III - Digitalisation of the State**
 - Sub-pillar: Digital public services
 - 32. Digitalisation of the 25 most used public services by citizens and businesses
 - 33. Increase in the offer and translation of digital services of interest to internationalization in ePortugal
 - 34. Program for the Digitalisation of the Governance of the Sea
 - 35. Implementation of electronic processing of administrative offense proceedings (e.g. at the Food and Economic Security Authority)
 - 36. Cloud Strategy for Public Administration
 - 37. Ensure that the websites of Public Administration services and entities
 - 38. Guidance for Usability and Accessibility in a Digital Context (by public and private entities)
 - Sub-pillar: Agile and open central administration
 - 39. Simplification of the contracting of ICT services by the AP
 - 40. Active promotion of telework
 - Sub-pillar: Connected and open regional/local administration
 - 41. Definition and implementation of the National Strategy for Smart Cities - From Smart Cities to Smart Nation
 - 42. Inventory and streamline coordination of the territory through the initiative of the one stop shop for real estate
- **Catalysts: Catalyzing Portugal's digital transition**
 - Regulation, privacy, cybersecurity and cyberdefense
 - 43. Monitoring of the National Cyberspace Security Strategy
 - 44. Innovation risk management (actions to support cybersecurity challenges)
 - 45. Training and organizational adjustment of the national DPO (Data Protection Officer) structure to ensure the evolution of the legal framework for the protection of personal data and ensure the current concerns of preserving the privacy of all citizens
 - 46. Preparation of the Green Book on the Future of Work
 - Circular economy of data
 - 47. Preparation of the II Action Plan of the National Open Administration Network
 - 48. Reduction of legislative and bureaucratic barriers to the free flow of data, without prejudice to the provisions of the regulations in force regarding information subject to special security measures, including classified information and, in line with Regulation (EU) 2018/1807, of the European Parliament and of the Council
 - 49. Development of Ethical Data Use Guide

- 50. Transposition of European Directive 2019/1024 on open data and reuse of public sector information
- 51. Sharing the available information (Open Government Data), publishing it in a structured way so that it can be interconnected (Linked OGD) and the adoption of Big Data technologies
- Connectivity and infrastructure
 - 52. Bella Cable Project
- Disruptive technologies
 - 53. National Strategy for Artificial Intelligence
 - 54. National Strategy for Advanced Computing
- Alignment with the European digital strategy
 - 55. Organization of 2 European Union events in the Digital area (Europe Digital Day and Digital Assembly), in conjunction with the government area of foreign affairs
 - 56. Preparation of the Portuguese presidency of the Council of the European Union in 2021, in conjunction with the government area of foreign affairs
 - 57. Monitoring of European legislative initiatives and assessment of their impact on the execution of this Plan, namely the Digital Services Act

These priority measures and actions were considered essential for the digital transition and result from the use of synergies and the articulation of the various sectorial policies. The Digital Transition Action Plan is monitored by the Portugal Digital Mission Structure, which is responsible for ensuring its global coordination, ensuring articulation with the different structures involved in the implementation of measures, ensuring the reporting of results and promoting it nationally and internationally.

AI Portugal 2030 national strategy

Anticipating that AI technologies will have a significant impact on economic growth, Portugal approved a national AI strategy aligned with the Coordinated Action Plan of the EU and its Member States and included in INCoDe.2030 (the Portuguese initiative to promote digital skills).

The objective of the AI Portugal 2030 national strategy is to mobilize society and companies, including SMEs, public services and all citizens, to build a knowledge-intensive labor market, with companies that produce and export AI technologies, supported by research and innovation communities. The AI will improve the quality of services and the efficiency of processes, namely in the areas of industry, agriculture, climate, transport and cybersecurity. One of the main challenges is the qualification of the workforce in the field of AI.

Recovery and Resilience Plan

The Portuguese Recovery and Resilience Plan (República Portuguesa, 2021) will also be important to foster digital transition, with a budget of approximately 3,674 million euros. The contribution of the plan's total allocation (16,644 million euros, with possibility to access to loans up to 2,300 million euros) to the digital target (digital tagging) is of 22.1%, complying with the minimum threshold of 20.0%.

Digital Tagging Table

Measure / Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Support to Digital Transition (Coefficient)
RE-C01-i01	Primary health care services with more answers — Tele-medicine/tele-healthcare	6	100%
RE-C01-i06	Digital Health Transition	300	100%
RE-C01-i07-RAM	Digitalisation of Madeira's Regional Health Service	15	100%
RE-C01-i08-RAA	Digital Hospital in the Azores	30	100%
RE-C02-i03-RAM	Strengthening of the supply of social housing in the Autonomous Region of Madeira — Information technologies	2	100%
RE-R1-C03-i1	New Generation of Equipment and Social Responses: IT equipment needed to provide social community support services	9	100%
RE-C03-i05	Platform + Access (digital information tools and services for inclusion of people with disabilities)	3	100%
RE-C04-i01	Cultural Networks and Digital Transition	93	100%
RE-C05-i02	Interface mission — Renewal of the scientific and technological support network and guidance for productive fabric — Other areas	104	40%
RE-C05-i03	Research and innovation agenda for sustainable agriculture, food and agro-industry [Innovation Agenda for Agriculture 20 30] — Digital Dimension	12	100%
RE-C06-i01	Modernization of vocational education and training institutions — Equipment for digital skills	521	100%
RE-C06-i04	Youth impulse STEAM — Support enrolment in STEAM courses and enlarge the network of science clubs ("Ciência Viva")	130	100%
RE-C06-i05-RAA	Adult qualification and lifelong learning (ARA) — Support for digital skills	14	100%
RE-C07-i01	Business Reception Areas — Renewable energy production and smart storage (energy systems)	38	40%
RE-C07-i01	Business Reception Areas — Strengthening coverage with 5G	10	100%
RE-C08-i02	Digital Rural Property Registry and Land Cover Monitoring System	86	100%
TC-C10-i01	Blue Hub, Network of Infrastructure for the Blue Economy — Digital infrastructure and equipment	1	100%
TD-C16-i01	Digital Empowerment of Enterprises (Training)	100	100%
TD-C16-i02	Digital Transition of Enterprises	450	100%
TD-C16-i03	Catalyst for the digital transition of enterprises	100	100%
TD-C17-i01	Public Financial Management Information Systems	163	100%
TD-C17-i02	Modernization of the information systems of the Tax and Customs Authority for rural property taxation	43	100%

Measure / Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Support to Digital Transition (Coefficient)
TD-C17-i03	Digital transition of Social Security services	200	100%
TD-C18-i01	Economic justice and business environment (digital transition and resilience of the Portuguese justice IT systems)	267	100%
TD-C19-i01	Redesign of public and consular service— (digitalisation actions to implement the digital by definition paradigm)	165	100%
TD-C19-i02	Sustainable electronic services (reinforcement of data valorization and exploitation by public services, strengthening interoperability and data sharing)	70	100%
TD-C19-i03	Strengthening the overall cybersecurity framework	47	100%
TD-C19-i04	Efficient, secure and shared digital critical infrastructures	83	100%
TD-C19-i05-RAM	Digital transition of Madeira's public administration	78	100%
TD-C19-i06-RAA	Digital transition of the public administration in Azores	25	100%
TD-C19-i07	Public administration empowered to create public value (training actions for public officials with digital skills elements)	88	40%
TD-C20-i01	Digital Transition in Education	500	100%
TD-C20-i02-RAA	Digital Education (Azores)	38	100%
TD-C20-i03-RAM	Programme to accelerate the digitalisation of education (Madeira)	21	100%

Source: Analysis of the recovery and resilience plan of Portugal (European Commission, 2021)

Although there are investments considered in the digital tagging in components located in the Resilience Pillar (about 35%), the main investments are in the Digital Transition Pillar (about 65%).

Considering the components under the Resilience pillar, the highest investments (>50M€) in Digital Transition are:

- Component 1, investment 6 - **Digital Health Transition** (300M€) – Aims to invest in the digital transition in the Health System (<https://recuperarportugal.gov.pt/2021/06/08/investimento-re-c01-i06/>);
- Component 04, investment 1 - **Cultural Networks and Digital Transition** (93M€) - This investment is aimed at modernizing the technological infrastructure of the network of cultural facilities, digitalizing arts and heritage and internationalisation, modernization and digital transition of books and authors (<https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c04-i01/>);
- Component 6, investment 1 - **Modernisation of vocational education and training institutions** — Equipment for digital skills (521M€) (<https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c06-i01/>);
- Component 6, investment 4 - **Youth impulse STEAM** — Support enrolment in STEAM courses and enlarge the network of science clubs (“Ciência Viva”) (130M€) - The investment “Impulso Jovem STEAM” is intended to promote and support initiatives to be developed and implemented by higher education institutions, including universities and polytechnics, in consortium with employers, aimed at increasing the higher education of young people in the STEAM areas (science,

technology, engineering, arts and mathematics)
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c06-i04/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c06-i04/);

- Component 8, investment 2 - **Digital Rural Property Registry and Land Cover Monitoring System** (86M€) - This investment is intended to provide the country with up-to-date and detailed knowledge of the territory, both at the cadastral level and with reference cartography, on which the various national, regional and local planning processes can be based
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c08-i02/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-re-c08-i02/).

The components considered in the pillar of Digital Transition represent a large share of the investments in this area:

- C16 – Enterprises 4.0;
- C17 – Quality and Sustainability of Public Finances;
- C18 – Economic Justice and Business Environment;
- C19 – More Efficient Public Administration – Training, Digitalisation and Interoperability, and Cybersecurity;
- C20 – Digital School.

The aim of component 16 – **Enterprises 4.0** – is to strengthen the digital transition of enterprises and to catch up on the digital transition process, providing access to knowledge and digital technological means.

- Investment 1 - Digital Empowerment of Enterprises (Training) (100M€) – Promoting digital skills and providing a training program in digital technologies for employees in the business sector
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i01/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i01/).
- Investment 2 - Digital Transition of Enterprises (450M€) – Fostering digital transformation of business models and the integration of technology in enterprises, promoting e-commerce by SME, especially micro-SME, developing the entrepreneurial ecosystem and creating conditions for enterprises to develop and test new products and services
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i02/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i02/).
- Investment 3 - Catalyst for the digital transition of enterprises (100M€) – Dematerializing the issue of invoices, creating hubs with a set of services to support the digital transition of enterprises especially with focus on artificial intelligence, high-performance computing and cybersecurity, and investing in certification platforms and training in the areas of cybersecurity, privacy, usability and sustainability
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i03/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c16-i03/).

Component 17 – **Quality and Sustainability of Public Finances** – aims to modernize and simplify public financial management, to increase transparency in the use of public resources, to increase the quality and sustainability of Portuguese public finances, to promote an integrated management of public assets and to improve the performance of social security.

- Investment 1 - Public Financial Management Information Systems (163M€) - Investments in information systems to improve the quality of public finances, implement integrated management solutions and deploy the Budgetary Framework Law (especially the Programme Budgeting)
[\(https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c17-i01/\)](https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c17-i01/).

- Investment 2: Modernisation of the information systems of the Tax and Customs Authority for rural property taxation (43M€) - modernize the infrastructure of the information system for rural property taxation through the digitalisation of information, the reinforcement of the infrastructure, the development of consultation and visualization mechanisms and the development of information system to support the simplified valuation of rural property (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c17-i02/>).
- Investment 3: Digital transition of Social Security services (200M€) – Reorganization and modernization of the Social Security information system, implementing infrastructure and support solutions for Social Security systems, reengineering processes, development and implementation of a new relationship model between citizens/enterprises and social security; and reformulation and adaptation of the workstations (namely to telework) and qualification of professionals (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c17-i03/>).

The objectives of Component 18 – **Economic Justice and Business Environment** – are to facilitate relations of citizens/enterprises with public administration, to reduce administrative and regulatory burden on enterprises (through the reduction of complexities and obstacles to licensing), and to increase the efficiency of administrative and tax courts and to increase the efficiency of courts.

- Investment 1: Economic Justice and Business Environment (267M€) – Investment in digital transition and resilience of the Portuguese justice IT systems, structuring digital platforms, namely of the courts and alternative dispute resolution means, and in strengthening of technological infrastructure and equipment (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c18-i01/>).

Component 19 – **More Efficient Public Administration** – has the objective of providing a better public service, reducing context costs and using technology to strengthen proximity of public services with citizens and enterprises, promote efficiency, modernization, innovation and capacity in the Public Administration through training, digitalisation and interoperability, and cybersecurity.

- Investment 1: Redesign of public and consular service (188M€) – Investment in the acquisition of services for specific projects such as the development of digital public services, of a Single Portal for Digital Services and of a Contact Centre, as well as to expand the service stations for citizens (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i01/>).
- Investment 2: Sustainable electronic services (70M€) - Investment in creating integrated infrastructures for specific purposes, increasing governance and in the capacity of secure data reuse and strengthening the Data.Gov service as an open data portal for the public administration (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i02/>).
- Investment 3: Strengthening the overall cybersecurity framework (47M€) – Investments aiming to increase cybersecurity and information security (implementing national framework, transforming coordination model and creating physical and technological conditions) and to strengthen training in these areas (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i03/>).
- Investment 4: Efficient, secure and shared digital critical infrastructures (83M€) – Investments to make the Government's IT network more resilient and digital, to improve the Emergency

Communications Network, to renew the architecture of information systems and processes associated with emigration, customs and security and to reduce redundancies and bureaucracy of the Security Forces and Services (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i04/>).

- Investment 5: Digital Transition of Public Administration of the Autonomous Region of Madeira (78M€) – Targeted to the Autonomous Region of Madeira, the investment intends to provide high-capacity broadband digital networks, to boost the digitalisation of services and enterprises and to promote new telecom trends (such as 5G networks, IoT ecosystems and the development of smartcities) (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i05-ram/>).
- Investment 6: Digital Transition of Public Administration of the Autonomous Region of the Azores (25M€) – Targeted to the Autonomous Region of the Azores, the investment intends to invest in the streamlining, modernization and digitalisation of public administration, to promote collaboration between citizens, academia and enterprises, and to reinforce investment in qualification, innovation, testing and new and emerging digital technologies (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i06-raa/>).
- Investment 7: Public administration empowered to create public value (88M€) – The objective of the investment is to implement programs aimed at training and qualifying workers and leaders of the public administration, to provide internship programs and to promote more agile and flexible ways of performing work in public functions, namely through telework (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c19-i07/>).

Component 20 – **Digital School** – has the objective of creating conditions for educational and pedagogical innovation, through the development of skills in digital technologies, the reform for digital education and the modernization of the educational system

- Investment 1: Digital Transition in Education (500M€) – The investment aims at removing obstacles to quality internet access in the school environment, removing limitations to the integrated use of technological and digital equipment, eliminating the lack of specialized equipment to develop digital skills, encouraging the pursuit of STEAM careers (promoting equal participation of girls and boys), overcoming the insufficient use of digital educational resources in the teaching-learning process and in the assessment processes, and overcoming the dispersion and inefficiency of the education system's management and information systems (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c20-i01/>).
- Investment 2: Digital Education in the Autonomous Region of the Azores (38M€) – Targeted to Azores, the investment aims to guarantee access to the “information society”, promoting equal opportunities and inducing an improvement in the means of learning, promoting the development of skills, providing the acquisition of equipment, connectivity and licenses to be made available to public schools and generating changes in terms of pedagogical practices and training dynamics (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c20-i02/>).
- Investment 3: Program to accelerate the digitalisation of Education in the Autonomous Region of Madeira (21M€) - This investment aims to implement and develop digital educational and technological resources that promote the creation and use of digital content in the school learning process (<https://recuperarportugal.gov.pt/2021/06/13/investimento-td-c20-i03/>).

Strategy and Transversal Action Plan for the Digital Transformation of Public Administration

Portugal approved the Strategy for the Digital Transformation of Public Administration 2021-2026 and the consequent Transversal Action Plan for the Digital Transformation of Public Administration 2021-2023 (<https://tic.gov.pt/pt/web/tic/estrategia-para-a-transformacao-digital-da-administracao-publica-2021-2026>), in line with the Recovery and Resilience Plan. The Council for Information and Communication Technologies in Public Administration is responsible for coordinating, monitoring and evaluating the implementation of the Strategy and the Action Plan (*Conselho para as Tecnologias de Informação e Comunicação na Administração Pública*, 2021).

The Strategy for the Digital Transformation of Public Administration 2021-2026 has as its vision a «More digital Public Administration: better services, greater value» with the objective of making the Public Administration more responsive to the expectations of citizens and companies, providing simpler services, integrated and inclusive, working more efficiently, intelligently and transparently by exploiting the transformative potential of digital technologies and the intelligent use of data.

This strategy seeks to contribute to the transformation of public administration. By exploring the potential of digital technologies, the objectives are a public administration closer to citizens and companies, providing better services and being more efficient. The strategy is based on six lines of action: (i) creating inclusive digital public services, (ii) enhancing the valuation and use of data, (iii) implementing a cross reference architecture, (iv) fostering ICT skills, (v) improving the use of ICT infrastructure and services and (vi) ensuring data security and citizens' trust in digital processes and public organizations.

The Transversal Action Plan for the Digital Transformation of Public Administration focuses on priority measures to be developed until the end of 2023. At that time, an interim evaluation of the strategy will take place to define the actions to be implemented until the end of 2026. The Transversal Action Plan involves a total investment of almost 650M€, of which about 80% come from the Recovery and Resilience Plan.

In the set of investments aimed at the digital transition, we can identify support for the digitalisation of enterprises, the qualification of workers, vocational education and training for digital skills, and the digital transition of public administration (namely in the health sector). This support is directed not only to companies but also to public entities. These investments in areas that are essential for the business environment, such as the budget, tax, judicial and educational areas, are also important for companies.

14. Final remarks

The Covid-19 pandemic, being a serious public health emergency, had immediate social and economic implications. In fact, it created a recession with a decline in global growth, introduced an enormous shift in markets, and increased the unemployment.

At the same time, Covid-19 accelerated the opportunity and the need of the fourth industrial revolution, changing social interactions and the way we work, study and shop and led to an increase in cyberattacks due to the rise in the use of digital technologies.

Portugal made significant progresses in the digital transition and skills, steered by public policy measures, especially Industry 4.0, the INCoDe.2030, the Digital Transition Action Plan, the ICT Strategy 2020 and the TicAPP (Center for Digital Skills of the Public Administration). The existence of a clear responsibility in terms of digital transition on Government is a positive factor to foster change. The minister of Economy and Digital Transition oversees this pillar. Additionally, and for the first time, there is a Secretary of State just for the political coordination of this agenda, and a mission unit dedicated to project implementation and monitoring.

The European coordinated response to the Covid-19 pandemics brought by the extensive financial resources of Next Generation EU and the reinforcement of the Multiannual Financial Framework 2021-27 budgets places an increased strategic emphasis on the twin transitions of Digital and Green. In line with the preparation of the Member States' Recovery and Resilience Plans, Portugal is addressing structural challenges resulting from the Country Specific Recommendations that the Commission has been highlighting in the context of the European Semester. In this context, the room for improvement in various digital domains (skills, coverage, infrastructure, cybersecurity, public services) is addressed in the RRP investments, placing emphasis on the ability to swiftly and effectively implement this measures.

Notwithstanding the positive evolution, based on the information collected on this economic theme, some challenges remain and must be addressed.

1. Digital uptake by citizens

Regarding citizens, there is a low uptake of digital technologies, despite the positive trend registered in recent years, with the young population and people with a higher level of education standing out in this positive evolution. Individuals in Portugal make little use of the delivery of forms over the internet and provide little information online due to fears about privacy and information security in the use of the internet. This lack of digital technologies use may be delaying the distribution of the benefits of digitalisation. This makes clear the necessity to provide training on digital technologies and awareness campaigns on cybersecurity and privacy issues, namely providing information on the opportunities, risks and consequences of actions performed online.

2. Digital uptake by enterprises

Regarding enterprises, a large part already uses broadband, in particular the larger ones. Still, many enterprises still lack a website, as well as a social media profile, and do not use e-commerce. The investment in ICT is low and the uptake of more sophisticated technologies as big data analytics or cloud computing is more limited to certain types of enterprises and this is an important area for future developments. The investment in Innovation and R&D is also an area deserving attention. ICT security and digital privacy risk management policies should also be a priority for enterprises. It is important that enterprise managers start to consider Cybersecurity and risk management as priorities – digitalisation not only brings opportunities but also threats that must be considered.

3. Active citizenship

Empowering people and organisations to better manage digital risk is essential to support active citizenship and participation in society, and to strengthen trust in digital environments. An empowered population, more capable of dealing with challenges as the need to combat fake news and more informed about their rights and how to protect their privacy, is essential to guarantee a function democracy and social peace.

4. Telework

The pandemic accelerated the trend of increasing work from home, which had been registered since 2009, although many workers are in occupations with no possibility of telework. For those who may work from home, teleworking seems to have come to stay in many organisations, which poses challenges regarding the working conditions, the type of contracts or the costs associated. Telework may introduce some flexibility that allow a better balance between work and family life but the right to disconnect is important to guarantee this balance. Telework may also create new employment opportunities in geographical terms. Obviously, telework does not replace human relationships and it is desirable to have a face-to-face contact (namely to guarantee social integration and to maintain and motivate teams). Negotiation between the Portuguese Government and Social Partners about telework conditions should allow advancing with updated regulation, in line with ILO recommendations. Work is also underway to develop a Green Paper on the Future of Work in Portugal.

5. Education

During the pandemic, policy interventions supported children, teachers and schools to make the most out of digital learning. It is important that Portugal continues to implement policy measures to reach the full coverage of students and teachers with adequate digital resources, namely computers, connectivity, digital education books and other resources. To take full advantage of digital tools in the educational process and in social inclusion measures other dimensions as digital education resources and collaboration tools are crucial.

6. Skills

Skills in Portugal is probably the most important challenge to be addressed to allow the acceleration of the adoption of digital technologies, as many of the other areas of public policies depend on them (e.g., digital uptake, new job opportunities, demand for high-level skills, productivity, civic participation,

cybersecurity). Skills, lifelong learning and career guidance are essential to ensure that citizens and institutions take advantage of the potential of digital technologies and it is important that policy measures focus the investment in skills particularly on smaller enterprises and in specific parts of the population - notably women, elder people and low-income citizens. Finally, to increase people's and organisations' confidence in the digital transformation, it is essential to provide training that allows them to better manage digital security and information security while online (at work, social networks, e-commerce, etc.). Digital Literacy (digital skills) is essential to fight Cyberattacks, in particular the older and less educated population that are potential focuses for the promotion of digital inclusion.

7. Jobs at risk and Reskilling

The concern with the destruction of employment due to digitalisation was already discussed, but the pandemic crisis brought new challenges. Growing digitalisation is changing work paradigm and the lack of skilled employees, namely on digital technologies, is an obstacle to digitalisation. It is important, to guarantee employability, to focus on alternatives that are being created and on reskilling workers to guarantee the qualifications (particularly digital skills) and facilitate transition to new jobs, especially in areas of higher levels of automation.

8. Digital inequality/gap

Many of the changes we are facing seem to be here to stay. Although it is essential to make the best of this rapid digital transition, we must focus particularly in combating its negative effects, such as the growth of digital inequality/gap. In a world increasingly dependent on digital technologies, it is important to guarantee that the digital gap is not widened and that we are advancing on the way to an inclusive recovery that does not leave behind women, older citizens, people with lower incomes or residents in more isolated regions.

9. Public administration and E-government

Although Portugal positions very positively in e-government, there is room to increase the use of digital government and it is important to continue to invest in user-centred digital public services and in making digital government services more user-centred.

10. E-commerce

Although there has been progress in the use of e-commerce, with Portuguese enterprises increasing e-commerce sales particularly because of the Covid-19 pandemic, this is an area where Portugal's performance is weak, particularly regarding smaller enterprises and elder citizens.

11. Technological facilities/infrastructure

The technological infrastructure responded well to the Covid-19 pandemic which led to a rapid increase in the use of digital technologies. As more people and activities go online, Covid-19 pandemic placed unprecedented demand on communication networks. Despite the improvement that has been registered by Portugal, this is an area with potential for investment and innovation in the near future, particularly by boosting connectivity in rural/remote areas. This is particularly important for employment and education to guarantee access to digital media for all workers and students, especially considering situations of greater geographic isolation and social exclusion.

12. Electronic payments

We live in a new era of payments in which electronic payments have gained importance, especially following the Covid-19 pandemic. Electronic payment systems had a strong boost due to the need to increase online purchases as a form of consumption. The MBway is a good example of a Portuguese app that provides safe payment solutions. It is important to continue the actions to encourage greater acceptance and use of electronic payments and to contribute to a greater simplification of authentication and security mechanisms in the use of payment instruments in Portugal. In particular, it is advisable to encourage the actions proposed by the Working Group for the Promotion of Electronic Payments to encourage greater use of electronic payments in Portugal through more secure, efficient and innovative payment solutions in the national market.

13. Trade barriers

With citizens increasingly using e-commerce and the digital transition underway, we have new market opportunities and public policies must pay attention to enterprises by reducing barriers to trade and investment, promoting competition and simplifying administrative procedures.

14. Cybersecurity

Data has become increasingly important for digital transformation and the access to data is essential but with a focus on guaranteeing security and privacy. Data is valuable and it is essential to implement security solutions to guarantee data protection. With the Covid-19 pandemic, cybersecurity registered a significant increase in incidents due to a rapid increase in the use of digital technologies. The investment in ICT security by enterprises, particularly smaller ones, is essential, as the sophistication and diversification of criminality may lead to incidents that could compromise the business strategy and the confidentiality of citizens' data. Moreover, it is important to apply good cybersecurity practices to ensure data privacy (e.g., set strong passwords, take special care when accessing open or unknown Wi-Fi networks and responsibility in managing emails). One of the most important challenge is, again, regarding skills. Training workers (and citizens in general) in digital issues and making them aware of their ICT security obligations can prevent cyberattacks from occurring. Hence, it is increasingly important to have more skilled/prepared human resources. Managers are also a target for digital training as they must be the promoters of a change in mentalities in the way enterprises deal with digital transition, digital rights of consumers, privacy and cybersecurity issues. The National Cybersecurity Strategy aims to address these issues and appropriately focuses on digital literacy among other challenges.

15. Artificial Intelligence and Blockchain

Regarding the regulation of artificial intelligence, Portugal already has a national strategy. The big challenge in the near future will be to guarantee ethical and fundamental rights. Regarding blockchain technology, this can be an important part of the digital economy as a technological basis for dematerialization and digitalisation of systems that will benefit enterprises, public administration and citizens. To promote the adoption of blockchain technology, the state must have a national strategy aimed at the development and implementation of projects that use this technology (including public services based on blockchain – e.g. within the scope of Simplex or public procurement).

16. 5G deployment

Regarding 5G, the auction is ongoing and telecommunications operators have been confirming that they are ready to commercialize 5G services and have already started their campaigns. 5G will enable a new generation of telecommunications, with higher upload and download speeds, and will accelerate the digitalisation of enterprises in sectors as varied as industry, transport, distribution or health (e.g., artificial intelligence or robotization), as well as the digitalisation of the free time of citizens (e.g., smart homes or gaming) or even with applications in both (e.g., smart cities, autonomous vehicles, virtual reality or augmented reality). It is important for Portugal to accelerate the deployment and take-up of 5G, in particular regarding assignment of radio spectrum.

17. Innovation and digital uptake

The effective use of digital technologies and innovation by enterprises harnesses the potential to boost productivity growth. The relation between universities, research centres and enterprises is important to economically value scientific and technological knowledge, enhancing its transfer to enterprises, and Portugal is already addressing this with public policies. However, Portuguese enterprises perform low amounts of expenditure on R&D, with low intensity in ICT, and a low number of patent applications. This context is associated with the small number of medium and large enterprises with the financial capacity to invest in research and technology. Smaller enterprises lack financial capacity and know how that allows them to make research, especially in high-technological areas.

18. Investment

Investment is essential for the development of digital technologies and, in addition to business investment, public investment is crucial in strategic digital areas that have characteristics of public goods (given the need to mitigate risks or ensure investment in areas where the private sector lacks capacity or interest/relevance).

19. Financing of enterprises

Even with the beginning of the pandemic crisis, financing continued to flow in the economy. Financing and financing sources diversification for enterprises is essential to foster digital transition. Improving access to equity finance for SME could allow more intangible investment. Portugal has already in place public policy measures to improve awareness among entrepreneurs on equity and quasi-equity instruments, as well as non-debt funding measures by promoting venture capital. Despite significant improvements in the past, the availability of venture capital financing is still reduced in Portugal. Seeking to fill this financing need, *Banco Português de Fomento* (national promotional bank) supports economic development through the creation and availability of financing solutions that are adequate to the needs and challenges of the business ecosystem, namely to the digital transition of companies.

20. Circular Economy

The transition to a circular economy can benefit from digital technologies. In fact, they facilitate solutions that allow to align the production chains and efficiently manage the production of waste. To this end, public

programs aimed at financing investment in the adoption of circular business models are important (e.g., benefiting from the common interests of enterprises that allow cooperation projects), as well as public programs aimed to overcome barriers to the adoption of the digital circular economy (e.g., that is, policies that promote the adoption of circular business models). This area will benefit from investments foreseen in the Recovery and Resilience Plan that could allow progress with the implementation of these solutions.

Final comments

Although there is space for improve, Portugal has been evolving positively in terms of digitalisation. Considering the current situation in Portugal and the importance of digitalisation for the growth of the economy, the country should continue to invest in initiatives towards the reinforcement of digital skills and policies to promote investment in new technologies. The country should also continue to focus on reducing the risk of cyberattacks, on the privacy of personal data and, simultaneously, on taking advantage of the opportunities that result from the digital transformation (namely through digital literacy, e-commerce and e-government). To respond to these challenges, the chapter on public policy measures seeks to list the main measures implemented and to be implemented in terms of the digital transition.

To this end, it is essential to highlight that the European coordinated response to the Covid-19 pandemics brought by the Next Generation EU and the reinforcement of the Multiannual Financial Framework 2021-27 budget call for an efficient use the European Funds under initiatives such as the PT2030, the Digital Europe Program, the Horizon Europe) and most notably, the Recovery and Resilience Plan. The Plan provides a specific pillar of Digital Transition, which focus on Digital School, Enterprises 4.0 and Digital Public Administration, but also important measures to foster investment and innovation, financing diversification, collaboration networks, as well as green transition (industry decarbonisation, energy efficiency, circular economy) acting to promote the structural transformation of the Portuguese economy.

The concept of resilience, a word that has been used so much in recent times, means in physics the ability of material to return to its initial shape after being subjected to an effort (ability to absorb energy and release it while getting back to its original shape). In our present situation, we do not want to go back to the initial situation, the one we were in before the crisis. Rather, we want to learn from what we have advanced and draw lessons to advance even further.

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