Compendium

of the State of the Art on Higher education institutions/Universities Responses to Digitalization (IO1)

Erasmus+

Contents

1 Introduction

The Compendium is the collection of all the best practices that the project partners found out to explore the topic of how the Higher Education Institutions responded to Digitalization.

The Compendium is composed by a first chapter that wants to analyse the context describing the total labour demand expressed on the web (i.e. on the job boards) in the 6 countries, focusing in a second time on the occupational groups defined as high skilled level (i.e. university level).

We have then an Executive Summary that aims at synthetize the contents of each Country report.

The Country Report, which are the core of the compendium, are collected in the Annexes.

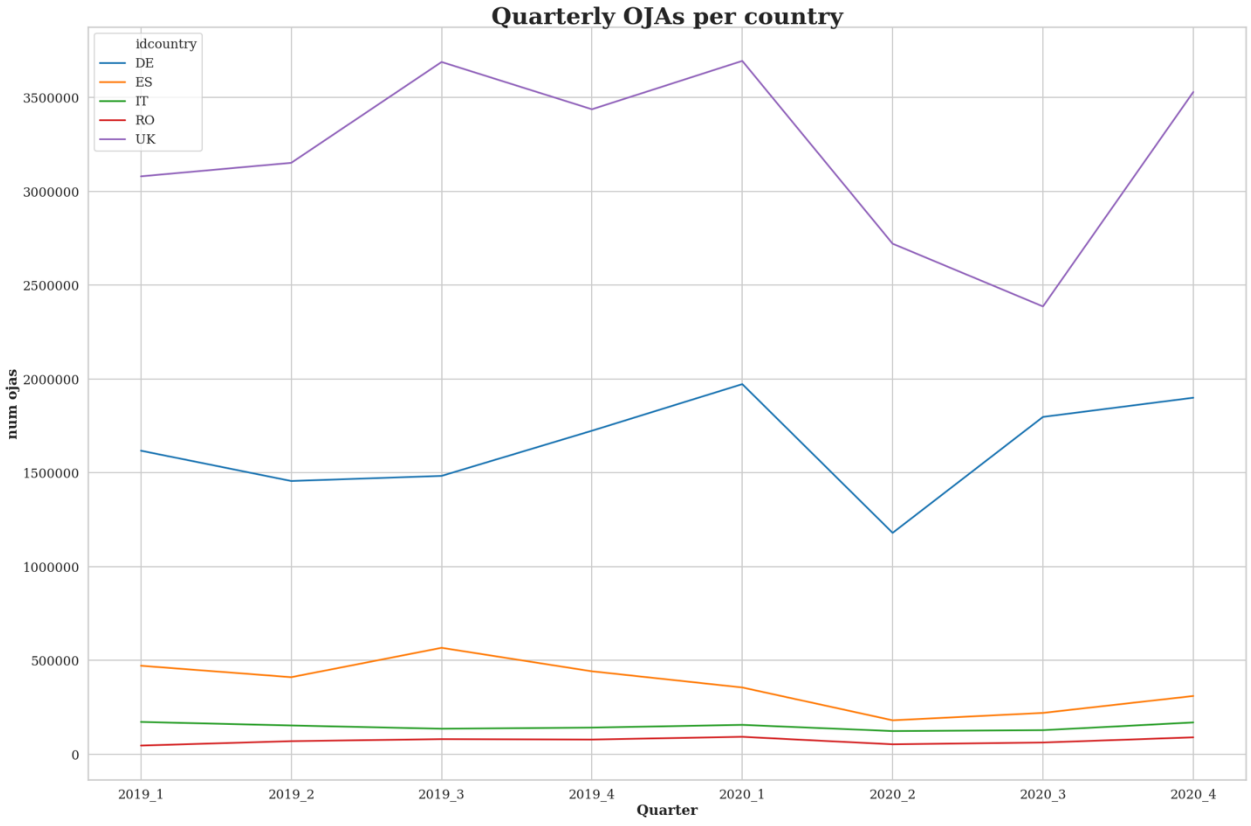
2 Data analysis to contextualize the findings and the practices mentioned in the Country Reports

2.1 Labour market demand

2.1.1 Total labour market demand

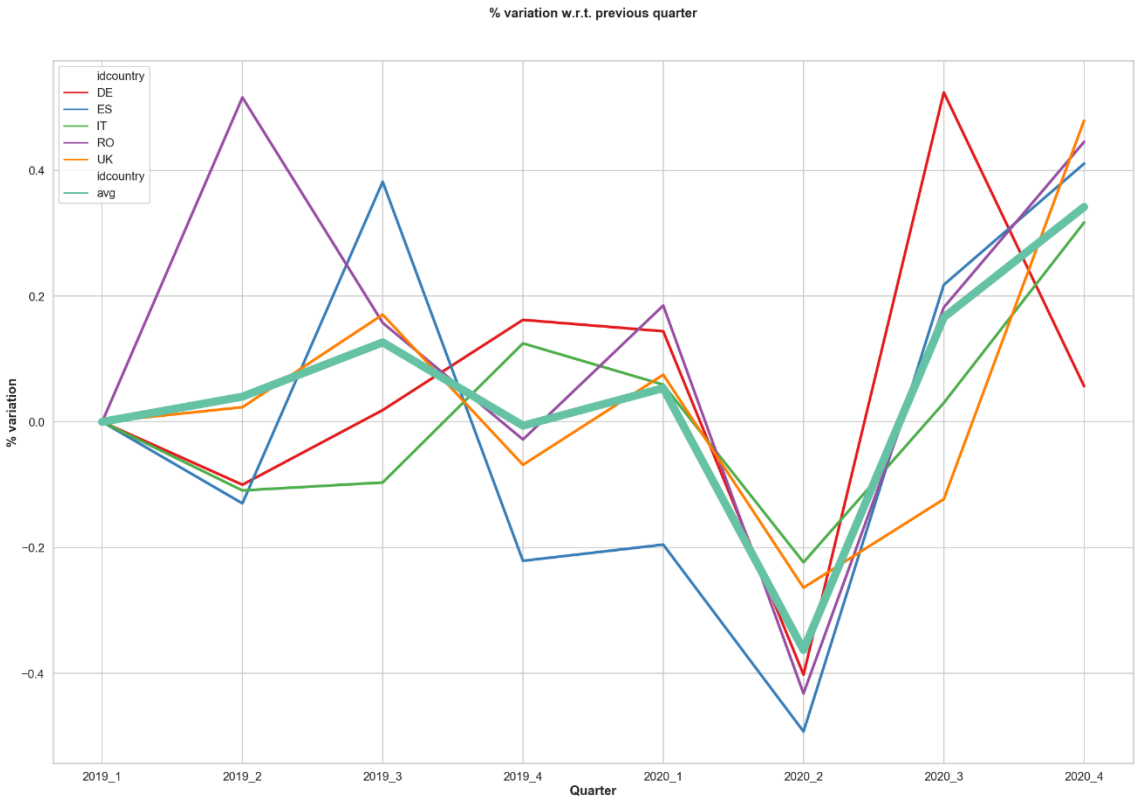
To produce a representative overview of labour demand in the observed countries, we selected only stable sources. We considered 43.5M+ Online Job Adverts collected in 2019 and 2020 in the 6 observed countries (Scotland data are incorporated into UK Job Adverts). The number of OJAs collected quarterly in each country from stable sources is reported in the following table and plot:

idcountry	2019_1	2019_2	2019_3	2019_4	2020_1	2020_2	2020_3	2020_4
DE	1,617,201.0	1,455,561.0	1,482,831.0	1,723,445.0	1,971,855.0	1,179,188.0	1,797,147.0	1,899,329.0
ES	471,038.0	409,985.0	566,561.0	441,355.0	355,212.0	180,309.0	219,620.0	309,815.0
IT	171,477.0	152,777.0	138,045.0	155,283.0	164,475.0	127,742.0	131,605.0	173,332.0
RO	45,560.0	69,068.0	79,949.0	77,708.0	92,091.0	52,312.0	61,834.0	89,367.0
UK	3,079,303.0	3,151,230.0	3,688,701.0	3,436,709.0	3,694,402.0	2,720,240.0	2,385,952.0	3,528,990.0
tot	5,384,579.0	5,238,621.0	5,956,087.0	5,834,500.0	6,278,035.0	4,259,791.0	4,596,158.0	6,000,833.0



Data show a similar trend in all the five countries, with a drop in job openings in the 2nd quarter of 2020. Marked demands rises again in the 3rd quarter of 2020. The upswing is slightly delayed in UK, which has to wait until the last quarter of 2020 to see a new growth in Job Adverts.

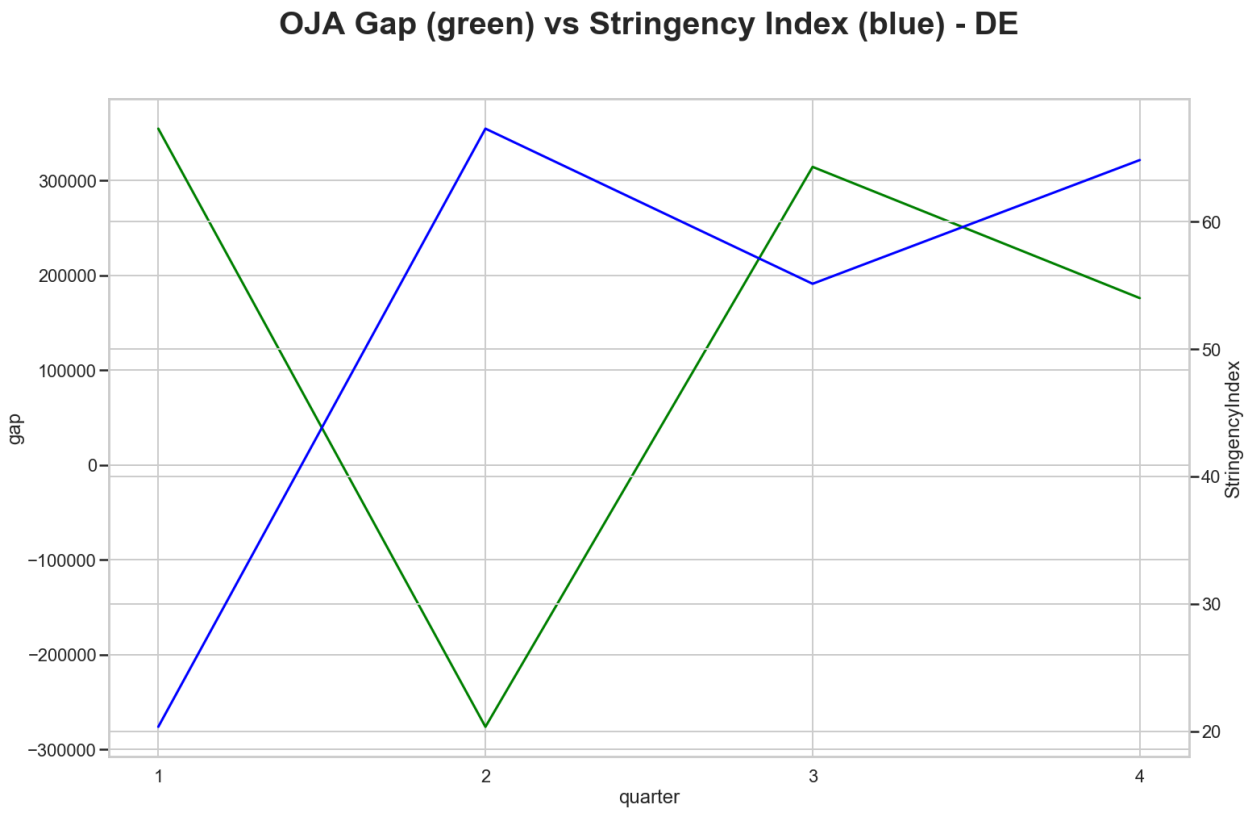
In order to better catch the effects of the COVID-19 pandemics on labour demand, we can observe in the following figure the *OJA drop* in the second quarter of 2020, when the measures to contrast the COVID-19 pandemic started.

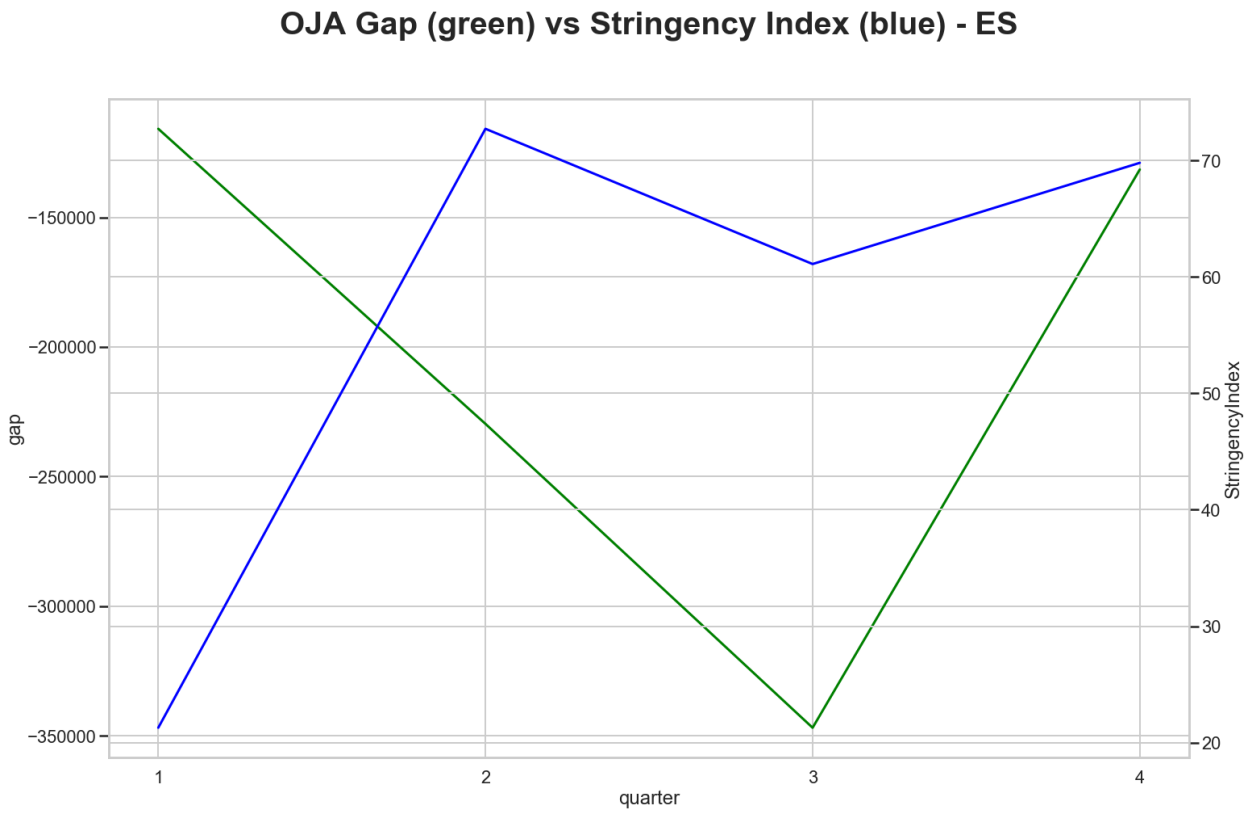


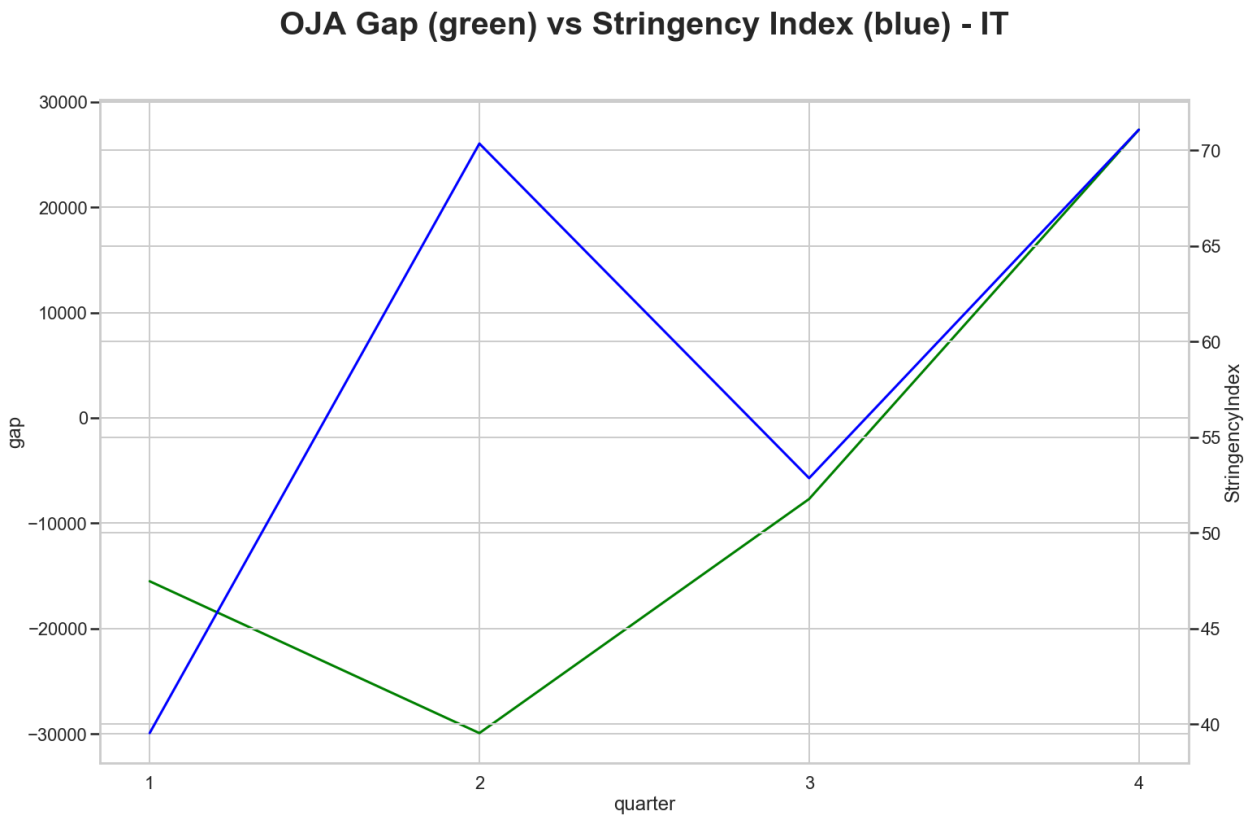
2.1.2 OJA Gap

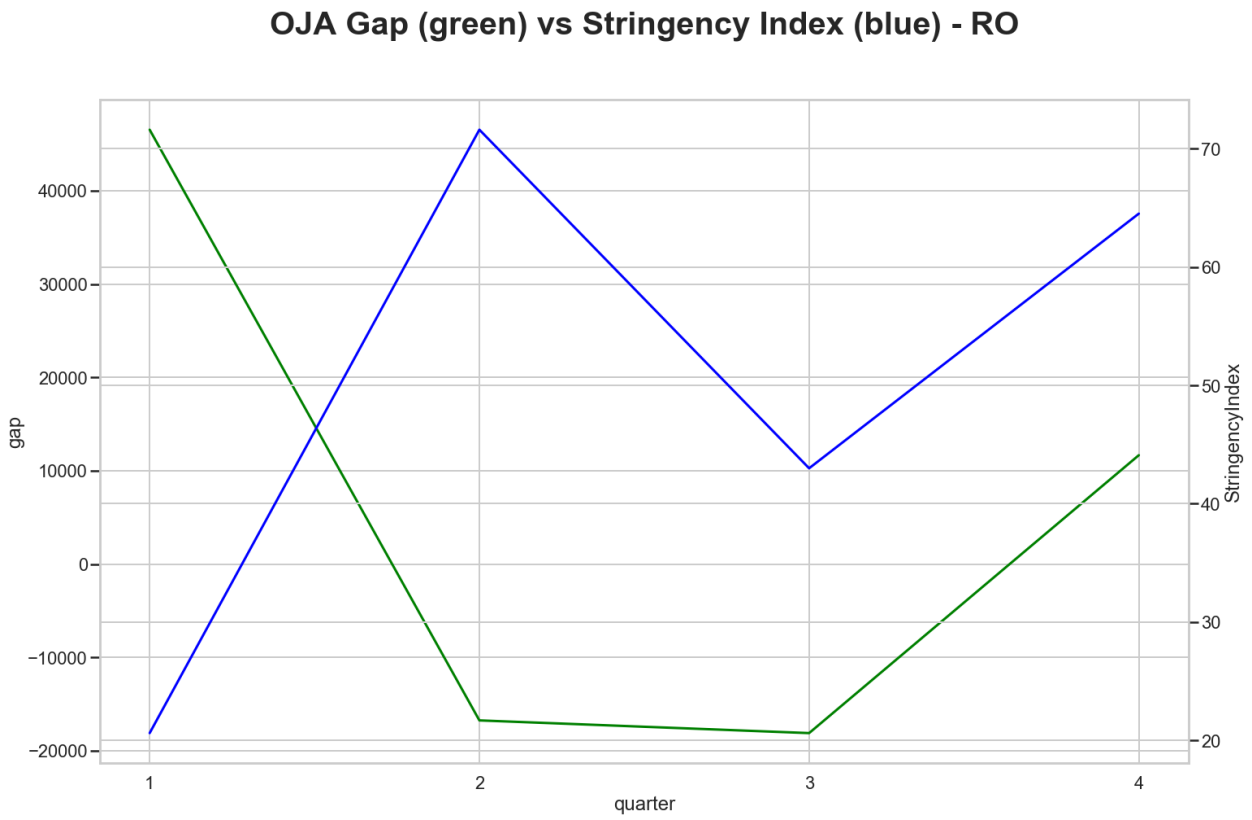
In Figure 1. OJA gap vs Stringency IndexFigure 1 below we can observe the trend of the Job Adverts gap and of the Stringency Index for the observed countries. The **OJA gap** is the difference between the demand in a certain period and the same period of the previous year. A negative value of the OJA gap means that the demand in 2019 was higher than in 2020 in the same quarter. We compute this measure in order to mitigate the seasonality of labour demand. The **Stringency index**, developed by the University of Oxford, is an indicator that tracks the severity of the measures

taken by Governments in response to the COVID-19 outbreak in terms of 'lockdown style' policies that primarily restrict people's behaviour.




OJA Gap (green) vs Stringency Index (blue) - ES
gap
−150000
−200000
−250000
−300000
−350000
StringencyIndex
70
60
50
40
30
20
1
2
3
4
quarter


OJA Gap (green) vs Stringency Index (blue) - IT
30000
20000
10000
0
−10000
−20000
−30000
gap
70
65
60
55
50
45
40
StringencyIndex
1
2
3
4
quarter


OJA Gap (green) vs Stringency Index (blue) - RO
gap
40000
30000
20000
10000
0
−10000
−20000
StringencyIndex
70
60
50
40
30
20
1
2
3
4
quarter

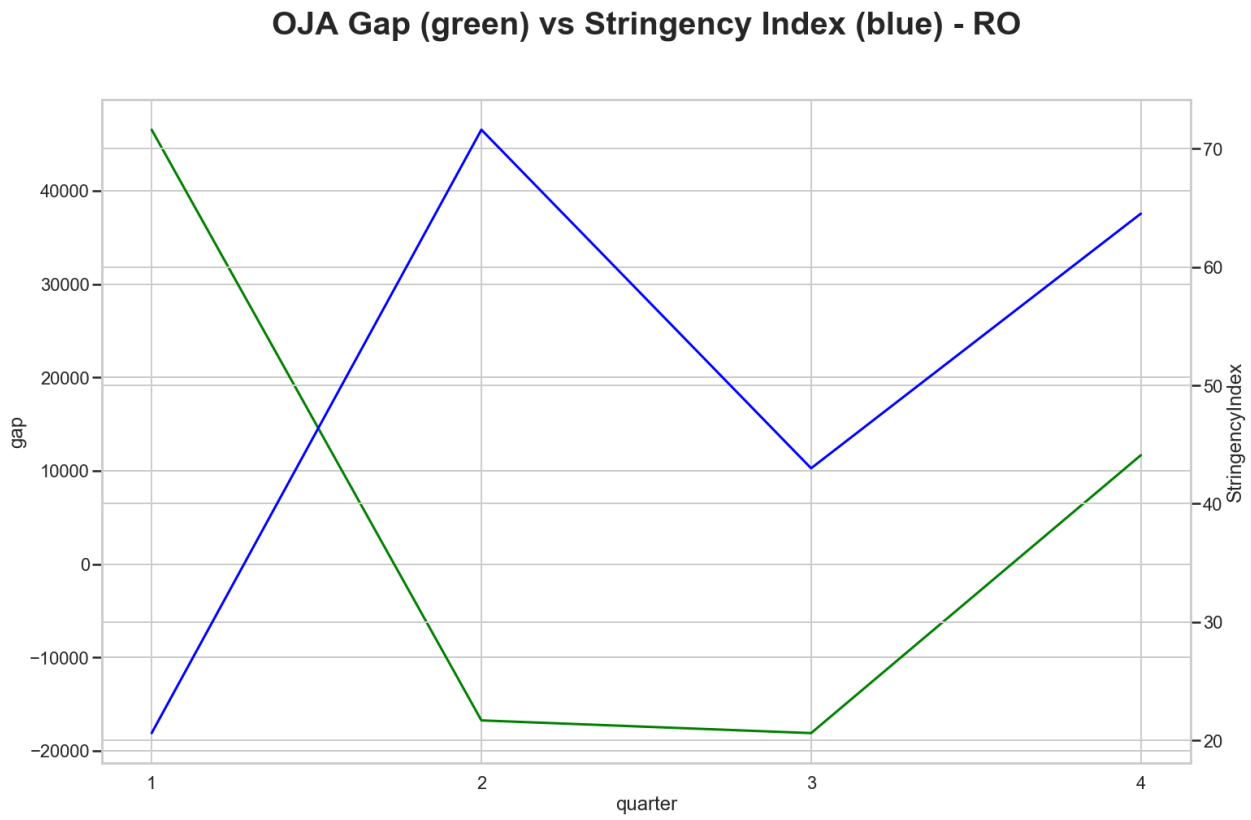
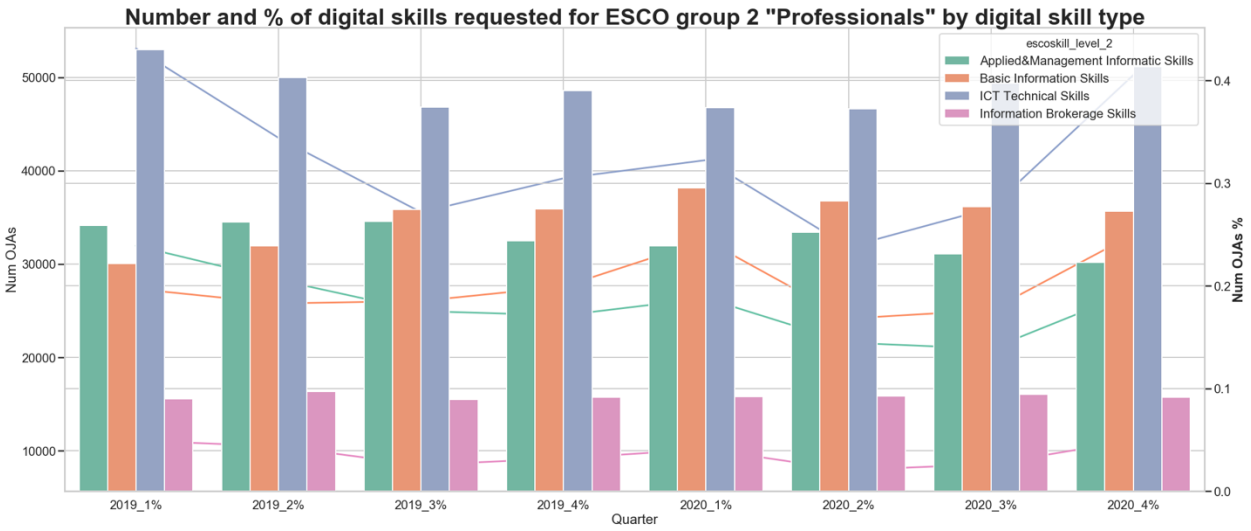
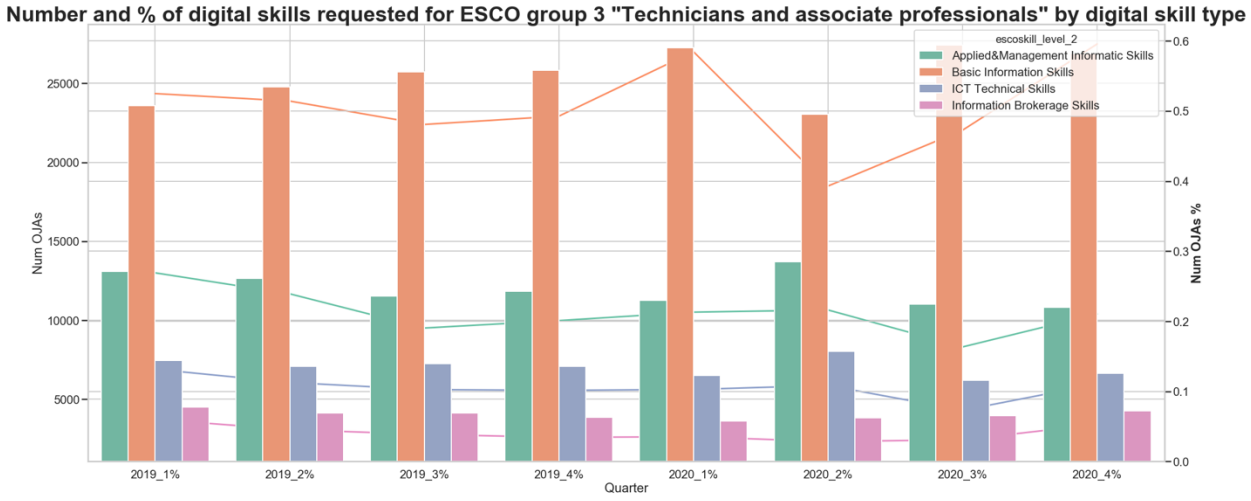


Figure 1. OJA gap vs Stringency Index

2.1.3 Demand by ESCO Professions – digit 1

At the first digit we observe the trend in labour demand for groups 2 and 3, which are *Professional* and *Technicians and Associate Professionals* respectively. Trends are analysed by four ICT macro categories.

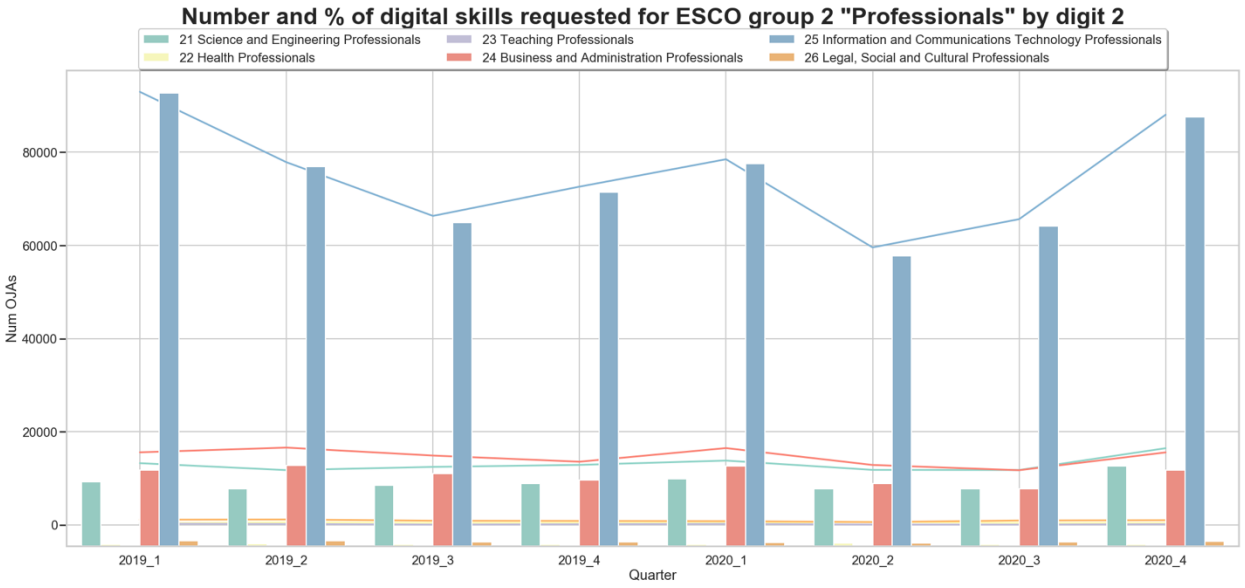


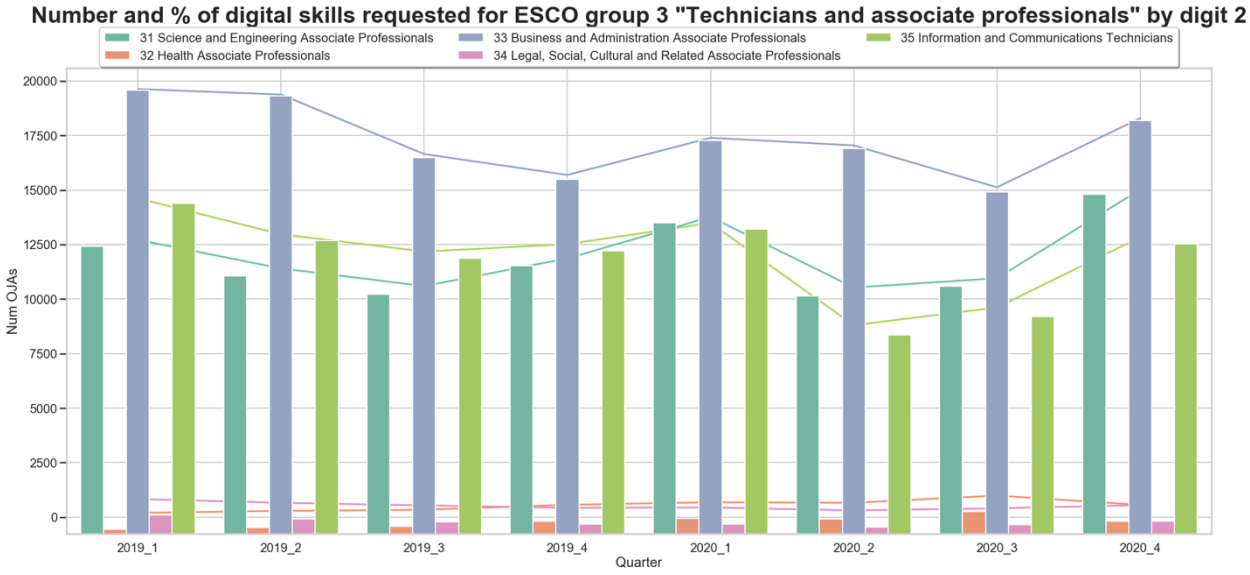


While for *Technicians and Associate Professionals* the demand of *Basic Information Skills* is significantly higher than for the other groups of IT skills, for *Professional* the demand is more balanced, except for *Information Brokerage Skills* which are less required, with only 10% of the total on average.

2.1.4 Demand by ESCO Professions – digit 2

In this section we observe the trend of group 2 and group 3 by digit 2. As we can see from the above figures, group 2 vacancies are dominated by group *25 – Information and Communication Technology Professionals*, with *Science and Engineering Professionals (21)* and *Business and Administration Professional (24)* that complete the quasi-totality of the Job Adverts. Group 3 is more balanced, with the prevalence of four groups: *Science and Engineering Professionals (31), Business and Administration Professional (33)* and *Information and Communication Technology Professionals (35)*. Interestingly, the prevalence for group 3 is of the technicians and associates for the professions that are predominant in group 2.




Number and % of digital skills requested for ESCO group 3 "Technicians and associate professionals" by digit 2
31 Science and Engineering Associate Professionals
32 Health Associate Professionals
33 Business and Administration Associate Professionals
34 Legal, Social, Cultural and Related Associate Professionals
35 Information and Communications Technicians
Num OJAs
20000
17500
15000
12500
10000
7500
5000
2500
0
2019_1
2019_2
2019_3
2019_4
2020_1
2020_2
2020_3
2020_4
Quarter

2.2 Methodological notes:

2.2.1 Data Collection

All the OJAs has been collected within the activities of the research activity of an ongoing EU grant aimed at realising the first EU real-time labour market monitoring system, by collecting and classifying OJAs over all 27+1 EU countries and 32 languages (Real-time Labour Market information on Skill Requirements: Setting up the EU system for online vacancy analysis AO/DSL/VKVET-GRUSSO/Real-time LMI 2/009/16. Contract notice - 2016/S 134-240996 of 14/07/2016).

2.2.2 Stable Sources

We consider as stable sources those which satisfy the following criteria:

- Maximum 10% of missing data
- Maximum 90% of monthly variation
- Maximum 50% of average monthly variation

2.2.3 Granularity

For the analysis, the two working groups based on the occupations system of classification ISTAT (Italian national body of statistics) that, at the fourth level identifies about 800 professions and it briefly describes profiles. This classification system is fully mapped on ISCO-08.

2.2.4 ICT macro skills

We divided the ICT skills into four categories to observe the contribution and the trend of each ICT-category:
(A) Information Brokerage: tools and platforms for data exchange and communication
(B) Basic informatics: ICT specific applications for supporting the individual professional activities
(C) Applied/Management informatics: tools and software used within the organisation for supporting management, operational and decision making processes
(D) Technical: solutions, platforms and programming languages that are strongly related to ICT-specific professions

3 Executive Summary of the Country Reports

3.1 Higher education institutions responses to digitalization. Evidence from six national case studies

As digitalisation disrupts society more and more profoundly, concern is growing about how the labour market will be affected. Various scenarios, oscilates from the most optimistic/utopian, with new jobs created, much more flexible and better paid, to the darkest/dystopian, with millions of jobs lost and people who will no longer be able to make a daily living, possibly with the introduction of a single income as a saving solution. Regardless of the scenario, which is certain at the moment is that the labour force has to permanently train so that they get appropriate skills to meet the demands required by business and industry in the age of digitalisation. This is more important as the EU Member States still face deep digital development gap. The European Commission's Digital Economy Society Index for 2020 (European Commission, 2020) shows that even though several EU countries have registered a notable progress (e.g. Ireland, Netherlands, Malta and Spain), the majority of the countries, which are below the EU average in the level of digitization, have not progressed significantly in the last five years.

In this context, the education sector and education providers play an important role. This study aims to briefly describe current policies and universities responses to digitalisation. It is based on a two-fold approach, namely an extensive desk research, and expert interviews. The desk research consisted of searching and analysing data, reports and surveys about the impact of digitalization on higher education, contextualised according to the national labour market specificities. Expert interviews were employed to explore in-depth certain issues, and also for a deeper understanding of digital strategies developed and implemented by higher education institutions to cope with digitalization challenges, including during pandemic and post-pandemic times, and to provide personalized learning experiences and the digital skills needed by the labour market.

Universities across Europe are undergoing constant transformation in order to adapt better to the needs of the labour market in the context of digitalisation and Industry 4.0. They struggle to implement activities designed to increase the levels of digital competences for employability, upskilling, according with a growing range of employment generated by the digital economy, aligned with the needs of and opportunities offered by the labour market and linked to professional profiles.

In the following sections we present evidences of 6 case studies from Germany, Italy, Romania, Scotland, Spain, and the United Kingdom.

3.1.1 Germany

For Germany with a high level of technological and industrial orientation, digitalisation is of eminent importance for its future competitiveness. Germany only occupies a midfield position in terms of current digitalisation. In European Commission's Index for the Digital Economy and Society, Germany ranks 12th among the 28 EU countries (DESI 2020). 2020 World Digital Competitiveness Ranking weak points are mainly in the technological infrastructure and digital education (IMD, 2020). A major challenge for Germany in shaping the digital change is the increasing demand for ICT specialists. The shaping of digitisation and thus the increasing demand for skilled workers with digital skills is becoming a challenge for the competitiveness of different sectors also public employers even of the 3.8 million SMEs in particular. For the area of technological skills, Stifterverband survey results have been used to derive a demand of around 700,000 people with the relevant skills in the economy alone by 2023. Complex data analysis is the tech skill with by far the largest gap in demand (455,000 people). With the Corona Pandemic, the digital challenges facing institutions in all areas of education become particularly clear. However, digital concepts, instruments and methods have increasingly found their way into personal life and educational institutions, but the potential is far from being fully exploited. This also applies to the current situation and performance of HEIs. With the Digital Agenda the Federal Government presented digital policy guidelines for Germany and defined measures in central fields of action to accompany and help shape digital change. At the same time, a wide range of initiatives and programs at the federal and state level have been launched with the aim of

promoting the development of digital skills in the population. HEIs will be an essential key to managing and shaping digital change and face the challenge of preparing all their students, and other target groups, for the digitalised world of work. With activities such as the promotion of research on digital higher education and programs such as the Quality Pact for Teaching or Advancement through education: Open universities the Federal Government is involved in many different ways in areas that are related to the digitization of HEIs in the broadest sense. Nevertheless, these can only be support impulses from the state, which must be implemented by HEIs in their own concepts. From the preceding observations and general developments, recommendations for promoting digital skills can be derived for HEIs, covering various fields of action: Development of digital strategy; Curricula development; Interdisciplinary and increasingly individualized study concepts; Positioning on the further education market; Regional cooperation and networks, New study formats and New forms of certification.

3.1.2 Italy

In the Digital Economy and Society Index (DESI) of 2020, Italy ranks 25th out of 28 EU Member States. Two indicators are quite positive, connectivity and digital public services, while the others still have low scores. The country is in a good position in terms of 5G readiness, as all pioneer bands have been assigned and the first commercial services have been launched. Moreover, Italy is placed in a relatively high position in the offer of digital public services (e-government). Compared to the EU average, Italy has very low levels of basic and advanced digital skills. These gaps in digital skills are reflected in the modest use of online services, where Italy remains well below the EU average. Compared to the 2018 DESI data where Italy had an overall score of 38.9, the 2019 data show that Italy has grown by 5 points, thus reaching 43.9 points. To improve these values some political initiatives have been activated. In 2012, a process of digital transformation began in Italy. The Italian Digital Agenda (ADI) was established, which was structured around six strategic axes: 1) infrastructure and security, 2) eCommerce, 3) eGovernment, 4) computer literacy and digital skills, 5) research and innovation, 6) smart cities and community. However, it appears that three out of ten people still do not use the internet regularly and more than half of the population does not have basic digital skills. In this context, higher education institutions play

a key role in providing the digital skills required by the labour market in the globalized modern economy. For the first time, Italy has adopted a National Strategy for Digital Skills created to reduce the gap with other European countries. In recent years, alongside the curricular training offer, numerous training initiatives have been developed in the universities, in close collaboration with the private sector, to integrate ICT and specific areas of knowledge. In 2018/2019, there were 320 courses of study (CdS) in the ICT sector out of a total of 10260. Although the number of enrollments shows a positive trend in constant growth, the gap between graduates and the job market demand is very high: according to the estimates of the "Digital Skills Observatory" 2019, in the ICT sector there is a shortage of about 15,000 graduates. These data show the need for a significant number of initiatives aimed at spreading digital culture among different segments of the population (for example, initiatives aimed at bringing female students closer to computer science and engineering studies) and observatories aimed at classifying best practices, projects, and experiences of digital innovation. However, the road is still long, as a crucial element to obtain the expected results from the enhancement of digital skills, it is essential to define curricula firmly anchored to the needs of the labor market and digital citizenship.

3.1.3 Romania

Romania has the highest amount of instruction time (168 hours) allocated for ICT as a compulsory separate subject in upper secondary education (ISCED 3) (European Commission, 2019). Additionally, at the ISCED 5-8 level, basic curricula include courses on digital competencies and advanced digital skills that are provided through the bachelor's, master and PhD programs in Mathematics-and Computer Science. At the moment, Romania holds a favorable position regarding ICT graduates, being ranked fifth in the European Union (5.6 percent compared to the EU average of 3.6 percent of total graduates). However, in terms of employed IT specialists the situation is different, Romania reaching only 2.2 percent compared to an EU average of 3.9 percent (European Commission, 2019). Even though the national curricula oblige educational providers to train digital skills, there is an important gap between what is provided by schools and what is required by labour market. For instance, about 18 percent of companies in Romania mention difficulties in hiring digital experts (PwC, 2019). Digital skills gap is expected to widen more in the

future as automation and artificial intelligence will gradually eliminate repetitive tasks. According to Workforce Disruption Index (PwC, 2019), in the next ten years, the digital transformation generated by new technologies will affect 600,000 jobs in Romania, about 325,000 new jobs will be created over the next decade, while another 275,000 workers should learn new or superior digital skills (upskilling) to maintain or find jobs. Developing courses at the postgraduate level (where the curricula is more flexible), involving the private sector in developing postgraduate courses, a better orientation for optional courses, improving internship schemes and implementing professional and life-long learning schemes and a dual education system are a few types of responses of HEIs in Romania to digitalization. However, several aspects still hamper this process. Even though the Universities have some autonomy, their flexibility in developing the curricula and matching it with real time labour market needs is still limited[1]. At the national level, there still lacks a clearly defined strategy for adapting the educational system to the requirements of the digital age, Romania not having yet a comprehensive strategy on digitalisation of education[2].

3.1.4 Scotland

The government's digital strategy sets out a vision for Scotland as an innovative and productive nation with a thriving and inclusive economy (Scottish Government, 2017). It promises investment in the connectivity, digital infrastructure and digital skills development in order to improve and equalise access to good employment. A highly digitalised economy is considered helpful in creating a low carbon economy by driving efficiencies through technological innovation such as cloud computing, 5G, Internet of Things, and Big Data (SCDI, 2019), and successfully integrating these technologies into new business models, practices and products/services (FutureScot, 2020). According to the Scottish Labour Market Strategy 2014-2024 employment in ICT and digital

[1] Each university is free to decide everything from their management to the organization of classes. However, curriculum is developed in accordance with the framework provided by the Romanian Agency for Quality Assurance in Higher Education (ARACIS) and is based on compulsory and optional disciplines.

[2] In October 2020, the Ministry of Education launched a process of public consultation to develop a national strategy on the digitalization of education.

technology is predicted to increase substantially (from 84,000 to 150,000) by 2024. Forecasts suggest there could be as many as 11,000 job opportunities each year in ICT and digital technology roles (including software, web development, project management and sales), which presents a major employment opportunity for a wide range of groups in the labour market. To support the implementation of the strategy, in August 2018 the UK launched a £1m Digital Skills Innovation Fund to address local or regional digital challenges. In Scotland, important initiatives were set up to tackle the digital skills gaps and reduce digital exclusion, for example, through the creation of multiple digital hubs and centres across the country, new Digital Foundation Apprenticeships made available in three pathways (Hardware, Software and Creative & Digital), and new Digital Skills Partnerships made up of regional businesses, large local employers, charities and public sector organisations (Webb, 2020). Skills Development Scotland, a government agency, continues to drive digital skills training and employment agenda across schools, colleges, universities and work-based sites. Scottish universities recognise their important role in addressing digital skills needs and gaps for enhancement of economic growth. In response, they have increased demand-driven courses across ICT, AI and Cyber Security, and embedded digital skills and competencies across the Higher Education curricula to improve employability of students (Webb et al., 2021). Despite the appetite, for many institutions the implementation of digitalisation is an incremental process. As the world of work is changing quickly, a constant supply of digital (and other) skills is crucial. New strategies and approaches are needed to address a lack of digital skills across existing and new workforce. Universities need to improve their offerings of flexible pathways to degree-level qualification, particularly in response to the impact of the Covid-19 pandemic on society, work and economy.

3.1.5 Spain

Digital transformation is generating a fierce debate among education providers, policymakers, economists and industry leaders about its societal impact. Spain presents risks of profound transformation of its jobs that are higher than those of the more advanced countries, in a context of high unemployment, and it is necessary to adequately adjust the skills and knowledge of citizens and em-ployees to try to avoid market polarization and the tensions between territories. This era

of disruption radically impacts on people's lives, in the ways of working and producing, and in the displacement of some traditional business models to completely new ones. In Spain, the focus of digitalization has been closely linked to the so-called Industry 4.0 or «fourth industrial revolution». In a period of four years, according to the Digital Society in Spain report by Fundación Telefónica, Spanish industrial companies expect that, as a result of digitalization, they will increase their income by around 11% and reduce costs by almost a fifth. Increasing the number of Spanish ICT specialists, narrowing the gender gap and re-skilling the labour force are of great importance, if Spain is to tap into the full potential of the Digital Economy. ICT graduates in Spain account for 3.9 % of the total. Female ICT specialists account for a mere 1 % of total female employment. This situation is exacerbated if people's employability increasingly depends on their level of digital training. Promoting STEM and STEAM vocations is a complex and urgent task, since the latest available data from the Ministry of Education, Culture and Sports show that the number of students enrolled in technical careers such as Engineering and Architecture has decreased by 28% in the last years. More and more tasks and functions are performed by machines. MMC Ventures has identified 1,600 startups directly related to AI in Europe, this is 12 times the figure in 2013. Moreover, the near future brings us 5G technology with faster, much more secure, much simpler, lower latency and, of course, much smarter networks. One of the challenges presented by this digital revolution is social inclusion; we must ensure that it is a digitalization for all, and that no one is left behind in this process of change or is directly or indirectly harmed by technology. The Basque Country is one of the 17 autonomous communities in Spain. The Basque Country also has a Research and Innovation Strategy for Smart Specialisation in place which has identified Energy and Advanced Manufacturing as strategic areas.

3.1.6 United Kingdom

Pre-Brexit and relying mostly on national (UK statistics) we can say that the United Kingdom (UK) compared to EU:

- ranked fifth out of the 28 EU Member States in the European Commission Digital Economy and Society Index (DESI) 2019
- performs particularly well in the use of internet services, where it ranks fifth

- ranks 7th in Integration of digital technology by businesses
- has high use of social media and cloud services
- has low uptake of electronic information sharing
- has average uptake of other technologies
- ranks 11th in Digital public services

The percentage of the population with at least basic digital skills is 71%, compared to an EU average of 57%, and the percentage of those with above basic digital skills is 46%, compared to an EU average of 31%. Since 2019, the UK has seen a slight increase in ICT specialist employment as a percentage of total employment, now 5.1%, compared to an EU average of 3.7%. However, women remain under represented. Despite strong demand for ICT graduates, the UK ranks poorly in the percentage of graduates with an ICT degree.

There is a digital skills gap - where workers simply do not have the skills to meet the demands required by business and industry that is impacting on the country's businesses, commerce and productivity. 88% of organisations across UK are currently lacking in digital skills, with many expecting these shortages to increase.

There have been a plethora of UK-wide policies and strategies which aim to tackle the digital skills gap. The UK's Industrial Strategy makes a commitment to put the UK at the forefront of the Artificial Intelligence (AI) and data revolution and is supported by investment in education institutions to advance use of AI.

Universities are engaging across a number of initiatives which aim to drive uptake and use of ICT, often linked to regional economic growth and digital inclusion.

Higher Education Institutions recognise a need to adapt to better prepare individuals to meet future labour market needs. Greater collaboration with employers, industry and government is needed to help identify and deliver the skills of the future. This includes basic, and specific digital skills, but also the soft skills and competences, and attributes such as resilience, entrepreneurship and creativity which should be embedded into all HE courses, not just in those in ICT.
Higher Education Institutions also need to boost their activity that is 'place-based', in particular more intimate collaboration with employers and engagement with regional SMEs. The unique demographic and business make-up of a region needs to be considered and understood so that smart specialization can be deployed to boost regional innovation and give the region a competitive advantage. Initiatives such as the Data Analytical Skills Escalator described within the Project are an example of how this can happen.

3.2 Conclusions

Digital transformations and technological progresses are notably shaping the skills needed by individuals to actively engage in the world of online work, in a modern economy and, especially, during the Covid-19 pandemic and post-pandemic times. The current Covid-19 pandemic has outburst on the global economy making digitalization even more relevant and a key milestone to overcome these challenges and to enhance the sustainable economic development.
The number of jobs that can be made from home, using digital instruments, will be an important indicator for the economy's performance (Dingel and Neiman, 2020). Countries which will be able to enhance and efficiently use the digital skills of the labor force, will win the economic battle in these times of social distancing.
Based on these facts and amplified challenges, our research was driven by the needs of addressing several EU countries' responses to digitalization, with a particular focus on Germany, Italy, Romania, Scotland, Spain, and the United Kingdom. Moreover, considering the significance of such a topical research subject, we targeted the specific ways in which higher education institutions (HEIs) manage to develop new, innovative and more effective approaches to equipping the labour force with the digital skills required for employability and job security in the digital economy in order to decrease socio-economic welfare gaps and enhance sustainable development.

4 Annexes

I. Germany Country Report

II. Italy Country Report

III. Romania Country Report

IV. Spain Country Report

V. UK Country Report

VI. Scotland Country Report

5 References

5.1 Papers

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