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EU Jobs at Highest Risk of COVID-19 Social Distancing: Will the Pandemic Exacerbate Labour Market Divide?

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ABSTRACT

EU Jobs at Highest Risk of COVID-19 Social Distancing: Will the Pandemic Exacerbate Labour Market Divide?*

This paper employs a skills-based approach to identify individual and job factors most likely to be impacted by social distancing measures and practices due to the Covid-19 pandemic. Using data from the Cedefop European skills and jobs survey, a Covid-19 social distancing risk index (COV19R) is created based on skills descriptors that categorise jobs by their level of physical proximity to others and their digital intensity. It is conservatively estimated that about 45 million jobs in the EU-27 labour market (23% of total EU-27 employment) are faced with a very high risk of Covid-19 disruption and another 22% of the EU workforce – mostly medium- to lower-skilled service provision – is exposed to some significant risk. The burden of the Covid-19 social distancing risk falls disproportionately on vulnerable workforce groups, such as women, older employees, non-natives, the lower-educated, those working longer hours and employed in micro-sized workplaces. The findings call for immediate and targeted policy responses to prevent ongoing job losses and widening of labour market and social inequalities due to the pandemic.

JEL Classification: C21, J01, J24, J28

Keywords: COVID-19, social distancing, risk, skills, EU

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1. Introduction

The coronavirus (Covid-19) crisis has resulted in an unprecedented labour market shock and unemployment crisis. Millions of jobs have been put at risk as a result of the unparalleled social distancing measures enforced across European Union (EU) countries, which have experienced the brunt of the death toll, but also world-wide, during the first months of 2020. The restrictions imposed as part of the confinement measures have had an asymmetric impact, not only on the different economic activities in the labour market, but also on diverse workforce groups. Inequalities between workers were accentuated, exposing the vulnerability of some unprotected groups, such as gig workers (Stephany et al., 2020) and accelerating past trends towards job automation (Frey and Osborne, 2013; Arntz et al., 2016; Nedelkoska and Quintini, 2018; Pouliakas, 2018) and remote working (Eurofound, 2020).

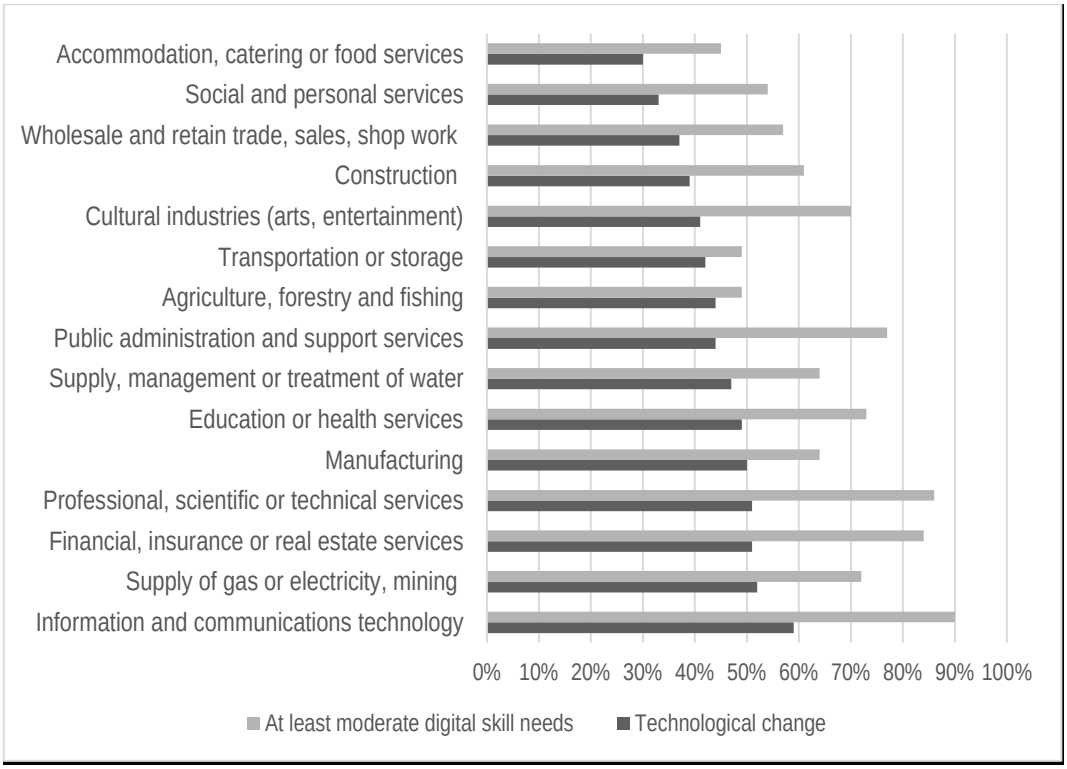
The pandemic has had an unequal impact on different economic sectors and occupations, given their marked variation in digital maturity preceding the Covid-19 shutdown, which may have affected their ability to sustain continued operation via remote meetings, ICT-based work and online customer interaction (e.g. e-commerce). European skills and jobs survey (ESJS) data (Cedefop, 2015; Cedefop, 2018a) had already revealed the wide variation in technological and digital exposure characterising different economic activities in the EU labour market (Figure 1).

But the impact of the pandemic on EU jobs also varies according to a range of other factors, including how 'essential' their services are in terms of meeting basic needs of the population (e.g. medical, food and delivery services), the extent to which they involve working on the move or from different workspaces and their pre-existing employment and institutional structure (Fana et al., 2020). Changed consumer preferences following the Covid-19 experience, such as increasing reliance on e-commerce and altered tastes for goods and services (Carvalho et al., 2020), will also have a significant future impact on employment and how work is carried out in the EU job market, although it is difficult to account for this latter factor in any estimations due to its inherent uncertainty.

As European societies are struggling with the trade-off between lives and jobs (Hamermesh, 2020), namely whether the value of saved lives by prolonging the lock-down and social distancing measures exceeds the associated economic cost of lost jobs and businesses,

identifying the economic sectors and occupations as well as which individual demographic, socioeconomic and job characteristics are associated with a higher risk of impact by the Covid-19 pandemic is critical.

Figure 1. **Technological change and at least moderate digital skill needs by sector, % of EU-27 and UK jobs**



Source: European skills and jobs survey (ESJS)

Overall, it is expected that Covid-19 will bring about marked structural adjustment and protracted disruption in industries and occupations, even more so than a typical economic recession such as the financial crisis of 2008, when it took about eight years for EU unemployment rates to bounce back to pre-crisis levels. Such an exercise may help policy-makers shape both immediate and medium-term policy responses, such as appropriate job activation or reskilling policies (Cedefop, 2018b) as well as other industrial support policies.

This paper aims to provide an assessment of the potential impact of the Covid-19 confinement and social distancing measures on the EU labour market. Using unique data on the skill needs of EU jobs derived from the Cedefop European skills and jobs survey, a skills-based approach is employed that draws a strong theoretical link between the nature of jobs'

skill requirements and the pandemic's repercussions. Specifically, we separate jobs according to whether they involve, on the one hand, physical contact and proximity to others, which is expected to accentuate the continued negative effects of Covid-19. On the other hand, the degree to which some jobs involve a high digital skill intensity level, which proxies for whether they can secure continued remote performance, is considered to be a factor counteracting any negative coronavirus effects both while the crisis unfolds as well as in the medium term. The empirical findings are also validated using complementary data on the job tasks of EU workers from other international data sources, as well as information on skills required by EU employers as advertised in their online job postings.

Section 2 engages in a review of the rapidly developing literature on the impact of the Covid-19 crisis on labour markets, in the EU and worldwide. Section 3 outlines the data and empirical methodology used to derive a Covid-19 social distancing index based on the skills-based theoretical construct. Section 4 describes the distribution of the assessed social distancing risk across economic activities and occupations in the EU labour market and subsequently identifies key individual and job factors susceptible to higher Covid-19 risk. Section 5 concludes.

2. Literature review

Despite the fact that the Covid-19 public health episode and related confinement measures implemented by governments across the world took place in the first quarter of 2020, there is burgeoning research on the topic, as scientists have sought to use any possible data analysis and evidence to understand better and mitigate the adverse consequences of the pandemic. Given the lag in collection and publication of official labour market statistics and lack of clarity on the state of the labour market, many ad hoc targeted surveys have also been carried out.

Focusing on the labour economics literature, several new research studies have sought to provide a preliminary assessment of the impact of the Covid-19 crisis on jobs and workers. Baldwin and Weder di Mauro (2020) provide an overview of the earlier literature on the economic consequences of the pandemic. In a preliminary analysis using a large-scale household survey, Coibion et al. (2020) highlight that job losses in the US are significantly

understated in new unemployment claims. This is because what is by historic standards a massive decline in the employment-to-population ratio has not been mirrored by an equivalent increase in the unemployment rate. The authors attribute this discrepancy to the fact that the rate of inactivity (mostly due to early retirements) has risen, with newly non-employed people not actively seeking work.

In analysis that mirrors the underlying theoretical concept and EU findings in this paper, Béland et al. (2020) build three indices using US data to investigate the short-term impacts of Covid-19 on employment and wages. They classify jobs according to their exposure to disease, proximity to co-workers and the ability to do remote work. Their analysis confirms, exploiting state-level variation, that the pandemic has caused a negative short-term increase in unemployment and decrease in the labour force participation rate and work hours. The authors show that occupations that depend on physical proximity to others are more affected, in contrast to occupations that can be performed remotely. Similar to the findings in this paper, the US evidence warns that the public health crisis will magnify labour market inequalities, as men, younger workers, immigrants, the self-employed and less-educated workers are more likely to be negatively affected by Covid-19.

Adams-Prassl et al. (2020) similarly leverage evidence from real-time surveys from Germany, the UK and the US to show that the labour market impacts of Covid-19 differ significantly across countries and employee characteristics, exacerbating inequalities. Their analysis is based on identifying the share of tasks by occupation that can be done remotely, which is highly predictive of job loss. They show that the negative consequences of the coronavirus outbreak on current and expected job loss and earnings are particularly harsh for women and younger workers, those with less secure work arrangements (such as gig economy workers) and the lower-skilled. Workers on short-time work schemes are substantially less likely to be affected by the crisis, highlighting the importance of the institutional framework underpinning labour markets in different countries.

Mongey et al. (2020) analyse the characteristics of workers in US jobs likely to be initially affected by broad social distancing and later by narrower policies tailored to jobs with low risk of disease transmission. The authors use US Occupational Information Network (O*NET) data to construct a measure of the likelihood that jobs can be performed from home and a measure of low physical proximity to others at work. They confirm that less educated

workers, those with lower income and possession of liquid assets relative to income and renters face higher vulnerability. The study further confirms a negative relationship between working-from-home jobs and declining employment, using March 2020 official labour force data.

Dingel and Neiman (2020) and Redmond and McGuinness (2020) tackle the issue of which workers can potentially work from home. The former authors use relevant indicators from the O*NET surveys and apply a classification method to determine the plausibility that some occupations can be performed remotely. They find that about 34% of US jobs, accounting for 44% of overall wages, can plausibly be performed at home, although this is an upper bound estimate and the share varies considerably across cities and industries. They also show that while most jobs in finance, corporate management and professional and scientific services could plausibly be performed at home, this is not the case in agriculture, hotels and restaurants or retail sectors.

Redmond and McGuinness (2020) highlight as well that homeworking is critical not only for continued economic performance, but to help control another spike in virus cases and alleviate child care pressures caused by school and crèche closures. The authors note that 14% of employees in Ireland currently work from home in some formal capacity, mostly in the education, ICT and finance sectors, while this figure falls to 6% for 'essential' employees and 2% for those in the accommodation and food service sectors. Results from their econometric model indicate that men, Irish nationals, older workers (over 30), full-time employees and those in higher paid occupations have a higher probability of working from home. Couples with children are more likely to work from home, compared to single parents.

Baert et al. (2020) further investigate the expected impact of the Covid-19 crisis on career outcomes and career aspirations. Using a relevant panel of Belgian employees, they note that about a fifth (21%) experience immediate job insecurity due to the crisis and 14% fear they will lose their jobs in the near future. About a quarter (26%), mainly vulnerable workers such as migrants, are concerned about the impact that Covid-19 will have on their promotion prospects. Crucially, the survey highlights that the pandemic may have a permanent imprint on individuals' work-related behaviours and priorities.

In addition to academic research, several international organisations and research institutes have provided estimates of the cost in terms of lost economic output and employment due to the Covid-19 pandemic. A recent analysis by the consultancy firm McKinsey & Company (2020) has calculated that up to nearly 59 million jobs (26% of total employment) across Europe are potentially at risk of reductions in hours or pay, temporary furloughs, or permanent lay-offs. An analysis by the Brookings Institute (Berube and Bateman, 2020) for the US points to a total of 37.2 million people, or 23% of the total US workforce, employed in immediate-risk industries, in which social distancing measures, travel restrictions, and related government actions have already heavily curtailed employment. The International Labour Organization (ILO) has also reported that full or lockdown measures have affected almost 2.7 billion workers (81% of the world's workforce), while about 1.25 billion workers (38% of the global workforce) are employed in sectors facing a severe decline in output and a high risk of workforce displacement (ILO, 2020).

Finally, in a recent report by the European Commission's Joint Research Centre (JRC), Fana et al. (2020) show that Covid-19-related confinement measures had a greater labour market impact in some southern-Europe countries and Ireland. By focusing on sectors that were forcefully shut due to the confinement measures, the authors confirm that the sectoral impact is concentrated on vulnerable segments of the working population, such as the self-employed, those with lower wages and precarious working conditions, as well as women, and young and low-skilled workers.

3. Methodology

3.1 Data and construction of Covid-19 exposure and social distancing index

To assess the potential exposure of EU jobs and changed work behaviours to the Covid-19 pandemic and associated social distancing measures, we employ a skills-based approach to identifying the industries and occupations most likely to be affected. The approach focuses on identifying skills which are descriptors of whether a person's job relies on physical proximity or contact with others, such as having to communicate or work together with co-workers or deal with and provide advice, counsel or care to customers, clients or patients. In addition, the degree to which a given job can be performed via digital technologies, tools or methods is also considered, albeit as a risk-mitigating factor.

The methodology provides crucial insights into which jobs may be at risk of continued disruption in the post-coronavirus era, assuming that in these jobs individuals will continue to practise some social distancing due to ongoing (though potentially less stringent) policy measures, as well as inherent nervousness about being in close proximity to colleagues or clients ([1]).

We use unique information on the skill needs of jobs in EU labour markets from the European skills and jobs survey (ESJS) ([2]), an EU-wide survey developed and financed by the European Centre for the Development of Vocational Training (Cedefop) ([3]). The first ESJS, carried out in 2014, collected data on skill requirements and skill mismatch from a representative sample of adult workers (aged 24 to 65) from the (then) 28 Member States of the EU. The survey was developed by Cedefop, in collaboration with a network of experts on skills and labour markets from academic institutions, the OECD and Eurofound.

The aim of the survey is to help inform the development of European education and training, skills and employment policies. The first survey wave focused on how individuals' qualifications and skills are matched (or not) to the changing skill demands and task complexities of their jobs. The survey also examined the extent to which employees' skills are developed and used in their workplaces over time. A second wave, focused on the impact of digitalisation and the structural impact of the Covid-19 pandemic on EU workers' job tasks

([1]) Our analysis does not try to identify or distinguish economic sectors or occupations according to how 'critical' or 'essential' they may be for the continued operation of labour markets during the pandemic or the degree to which they were covered by the enforced government confinement and social distancing measures, as done, for instance, by Fana et al. (2020). Instead, we follow the approach of Béland et al. (2020) in trying to create an index of Covid-19 social distancing that may be predictive of associated labour market outcomes.

([2]) For full details of the survey see: https://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jo bs-esj-survey; and Cedefop (2015) and Cedefop (2018a). The full microdata set is available for download at: https://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey/access-to-data

([3]) The analysis is supplemented with novel data from online job postings obtained from the Skills online vacancy analysis tool for Europe (Skills OVATE) for robustness purposes. As a follow-up to this research paper, the Skills OVATE data are being analysed in full by Cedefop's skills analysis team to obtain insights into the Covid-19 impact on EU jobs. This analysis benefits from the availability of in-depth and granular information on the skills required by detailed occupations (four-digit level), as advertised by employers in their online job vacancies.

and skill mismatch, will be carried out in 2021, collecting timely information about their use of digital technologies and remote working methods.

A mixed online-telephone methodology ensured that the data collected provided a representative sample of the adult working population in each of the EU-27 countries and the UK ([4]). The survey was carried out using quota sampling by the survey company Ipsos MORI and its network partners in each country. The questionnaire was translated into the national languages of the EU countries using a strict translation protocol and validation by national experts, managed by Ipsos MORI and Cedefop. Prior to administering the survey, extensive cognitive and pilot tests took place to validate the content and validity of the survey instrument.

In total, 48 676 respondents from different demographic groups took part either by telephone (9 154 employees) or online interviewing (39 522 employees). In most EU countries about 1 000 to 1 500 employees were effectively interviewed, although the sample varies between countries. The sample was augmented to 4 000 observations in the case of five large EU labour markets (France, Germany, Spain, Poland and the UK), 3 000 cases for Italy, and 2 000 cases in Greece and Finland, while 500 individuals were surveyed by telephone in each of the three smallest countries (Cyprus, Luxembourg and Malta).

In addition to standard demographic (age, gender, education) and job characteristics (contract type, work hours, wages, occupation, industry), the survey collected extensive information on the skill requirements of EU workers and their skill mismatch. Of particular interest for the purposes of this paper is the set of ESJS questions focused on assessing the importance of information and communication technology (ICT) skills, communication skills (sharing information with co-workers/clients; teaching and instructing people; making speeches or presentations), teamworking skills (cooperating and interacting with co-workers; dealing and negotiating with people) and customer handling skills (e.g. selling a product/service; dealing with people; counselling, advising or caring for customers or clients)

([4]) According to Forth (2016), minimisation of design effects can be achieved in the ESJS by treating its sample design as akin to that of stratified cluster sampling. Further, Cedefop (2015) demonstrates that the ESJS sample produces comparable survey estimates to those originating from other random probability surveys (ESWC, PIAAC) on similarly defined survey items.

for EU workers' jobs. Respondents were asked to assess '*On a scale from 0 to 10, where 0 means not at all important, 5 means moderately important and 10 means essential, how important are the following skills for doing your job?*' (descriptive survey statistics are available in Annex 1) ([5]).

Using the ESJS data on skill needs, EU jobs were categorised according to (a) whether communication, teamworking or customer serving skills are essential for doing them, which raises the chances of social distancing measures having a negative impact on job performance, and (b) whether they require at least a moderate or advanced ICT level to be performed, which should enable an employee to perform his/her job from a distance. A Covid-19 social distancing risk score (COV19R) is derived based on these variables, after assigning equal weights to them, as follows:

$$Cov19R = w_1 com + w_2 team + w_3 cust + w_4 dig \qquad [1]$$

where *com* captures jobs that command a very high (i.e. above median value) importance of communication skills and similarly *team* and *cust* describe those employment posts that demand a very high importance of teamworking skills and customer handling skills, respectively. *dig* is a variable defined as jobs of low digital proficiency, namely those that do not need at least a moderate ICT skill level (e.g. word-processing, using or creating spreadsheets) or advanced ICT level (developing software, programming, using computer syntax or statistical analysis packages) to be performed. w_i = {0…1} are the assigned weights, which in a baseline scenario are equally distributed across the skills descriptors, but tests were also undertaken to ensure that the main findings of the analysis are insensitive to the choice of weighting scheme (Annex 2). The index ranges from a score of 0, indicating jobs that face a very low risk of negative job performance due to social distancing, to a value of 1, which signifies jobs that have a skills profile conducive to Covid-19 and associated social distancing measures negatively impacting the ability of workers to carry out their tasks.

([5]) The survey also collected information on the importance of literacy, numeracy, foreign language skills, problem-solving skills, planning/organisation skills and technical/job-specific skills for job performance and workers' assessed mismatch between their skills and those needed by the job.

3.2 Estimation methodology: determinants of Covid-19 social distancing risk

The COV19R index is first used to examine differences in Covid-19 social distancing risk between economic sectors (one-digit NACE) and detailed (two-digit ISCO) occupation groups in the EU labour market. We subsequently examine the association between higher COV19R exposure and individual demographic, socioeconomic and job characteristics using a multivariate regression framework applied to the following equation:

$$COV19R_i = \beta_0 + \beta_1 d_i + \beta_2 s_i + \beta_3 j_i + \beta_4 C_f + u_i \qquad [2]$$

where the COV19R index is regressed on a set of variables capturing demographics (*d*) (age, gender, native status), skill/education level (*s*) and job (*j*) features (public sector, years of employer tenure, type of contract, workplace size, worksite location, occupation and sector) of worker *i*. The coefficients *β* are estimated on a pooled cross-section of adult employees from all EU-27 countries and the UK after accounting for country-fixed effects (C_f) and u_i is the residual.

Taking into account the bounded nature of the dependent variable, namely that its values range in a {0,1} interval, we use a generalised linear model (GLM) estimator that utilises a logit transformation of the response variable and the binomial distribution, as proposed by Papke and Wooldridge (1996).

4. Empirical findings

4.1 Jobs at most social distancing risk due to Covid-19

Table 1 and Table 2 show the distribution of the computed COV19R score across the different industries and occupation groups of EU adult workers. The sectors and occupations are categorised according to whether they face high, some or low risk, based on whether the COV19R score per sector or occupation is one-standard deviation above or below its mean value.

The analysis reveals that EU jobs in the accommodation, catering or food services sectors, wholesale and retail trade and social and personal services, face the highest risk of Covid-19-related exposure. In such jobs, employees are most likely to engage in intensive communication, teamworking and customer handling tasks, facing greater Covid-19 social

distancing risk. By contrast, employees in utilities, professional and scientific services and ICT industries are more likely to be insulated from exposure to the new coronavirus; it can be reasonably assumed that their economic performance will have been/will be less affected by the current and potentially future Covid-19 disruption.

Table 1. **COV19R score by industry, EU-27 and UK**

Sector of economic activity	*COV19R value*	*Social distancing risk*
Accommodation and food services	0.48	Very high risk
Wholesale and retail trade, sales, shop work	0.44	Very high risk
Social and personal services	0.44	Very high risk
Education or health services	0.41	Some, high, risk
Agriculture, horticulture, forestry or fishing	0.37	Some, high, risk
Cultural industries (arts, entertainment)	0.37	Some, high, risk
Transportation or storage	0.36	Some, high, risk
Financial, insurance or real estate services	0.33	Some, low, risk
Supply, management or treatment of water	0.32	Some, low, risk
Public administration and support services	0.31	Some, low, risk
Construction	0.31	Some, low, risk
Manufacturing	0.30	Some, low, risk
Supply of gas or electricity, mining	0.29	Very low risk
Professional and scientific services	0.29	Very low risk
Information and communication technology	0.28	Very low risk

*Note*s: Very high risk = one s.d. above mean COV19R; Some, high, risk = above mean COV19R but less than one s.d; Some, low, risk = below mean COV19R but less than one s.d; Very low risk = more than one s.d. below mean COV19R.
Source: Own estimates based on the European skills and jobs survey (ESJS).

Similarly, the analysis reveals that workers providing care, sales or other personal services, as well as hospitality and retail managers, health workers and food preparation helpers, have a very high COV19R score. In addition to these 'high-risk' occupations, it is also important to recognise the significant subset of occupations facing 'some, high, risk'; most of these are reliant on the provision of medium- to lower-skilled labour services, such as drivers and vehicle operators, cleaners and helpers, protection workers, street service workers, as well as those in construction and agricultural occupations. On the other side of the spectrum, office workers, clerks (excluding customer service clerks), scientists, engineers and ICT workers are less susceptible to the social distancing impact of Covid-19. This is a reflection of their jobs involving less physical proximity and contact with others (both immediate colleagues and external customers/clients/ patients/students) and a higher reliance on digital tools and technologies.

Focusing only on those occupation groups that face a very high risk of Covid-19 social distancing risk, we can conservatively estimate that about 45 million jobs in the EU-27 labour market (23% of total EU-27 employment) are potentially at high risk of reduced work hours, pay, lay-offs and continued work disruption in the post-coronavirus era ([6]).

Table 2. **COV19R score by occupation groups, EU-27 and UK**

2-digit ISCO group	*COV19R value*	*Social distancing risk*
Care workers	0.53	Very high risk
Sales workers	0.52	Very high risk
Personal service workers	0.49	Very high risk
Hospitality & retail managers	0.49	Very high risk
Health professionals	0.47	Very high risk
Food preparation helpers	0.46	Very high risk
Health associate professionals	0.44	Very high risk
Drivers & vehicle operators	0.42	Some, high, risk
Cleaners and helpers	0.41	Some, high, risk
Customer clerks	0.41	Some, high, risk
Protection workers	0.41	Some, high, risk
Street services workers	0.40	Some, high, risk
Agricultural labourers	0.40	Some, high, risk
Farm workers and gardeners	0.40	Some, high, risk
Construction workers	0.39	Some, high, risk
Business managers	0.39	Some, high, risk
Teaching professionals	0.38	Some, high, risk
Forest & fishery workers	0.37	Some, high, risk
CEOs, officials & legislators	0.37	Some, high, risk
Other elementary workers	0.36	Some, low, risk
Legal & social professionals	0.36	Some, low, risk
Technical labourers	0.36	Some, low, risk
Assemblers	0.36	Some, low, risk
Office associate professionals	0.35	Some, low, risk
Technical managers	0.35	Some, low, risk
Handicraft & printing workers	0.33	Some, low, risk
Machine & plant operators	0.33	Some, low, risk
Metal & machinery workers	0.33	Some, low, risk
Legal & social associate professionals	0.32	Some, low, risk
Electro-engineering workers	0.32	Some, low, risk
Office professionals	0.27	Very low risk

([6]) An upper estimate, one which also considers occupations facing some, above average, social distancing risk would indicate that about 88 million EU workers, accounting for about 45% of total EU-27 employment, could be potentially affected by some continued negative productivity effects.

Other support clerks	0.27	Very low risk
Office clerks	0.26	Very low risk
Accounting clerks	0.25	Very low risk
Science & engineering technicians	0.23	Very low risk
Researchers & engineers	0.23	Very low risk
ICT technicians	0.23	Very low risk
ICT professionals	0.20	Very low risk

Notes: Very high risk = one s.d. above mean COV19R; Some, high, risk = above mean COV19R by less than one s.d; Some, low, risk = below mean COV19R by less than one s.d; Very low risk = more than one s.d. below mean COV19R.

Source: Own estimates based on the European skills and jobs (ESJS).

4.2 Determinants of Covid-19 social distancing risk

The estimated coefficients following the estimation of equation (2) using a generalised linear modelling approach are shown in Table 3. Three empirical specifications are estimated. First, only key individual demographics are taken into account (column 1). The job characteristics of employees are subsequently accounted for (column 2) while, finally, (endogenous) information on whether an individual's workplace experienced any changes in technologies or other workplace practices, which are subject to organisational policy, is added to the equation.

Table 3 **COV19R determinants, generalised linear model (GLM) regression estimates, EU27 & UK**

VARIABLES	(1) Demographic	(2) Job	(3) Organisational changes
Male	-0.41***	-0.40***	-0.40***
	(0.012)	(0.013)	(0.013)
Age: 30-39	-0.03	-0.02	-0.02
	(0.021)	(0.021)	(0.021)
Age: 40-54	0.02	0.03	0.03
	(0.020)	(0.021)	(0.021)
Age: 55-65	0.06**	0.07***	0.09***
(ref: 24-29)	(0.024)	(0.026)	(0.026)
ISCED: Medium	-0.23***	-0.14***	-0.16***
	(0.019)	(0.020)	(0.020)
ISCED: High	-0.45***	-0.27***	-0.30***
(ref: Low)	(0.019)	(0.022)	(0.022)
Non-native	0.09***	0.06***	0.07***
	(0.019)	(0.020)	(0.020)
Public sector		-0.01	-0.00
		(0.016)	(0.016)
Hours		0.00***	0.00***

		(0.001)	(0.001)
Part-time contract		0.03	0.04*
		(0.021)	(0.021)
Years of employer tenure		-0.00	-0.00**
		(0.001)	(0.001)
More than one site		0.10***	0.08***
		(0.014)	(0.014)
Site varies		0.19***	0.18***
(ref: one site)		(0.028)	(0.028)
Size: 10-49		-0.03*	-0.03*
		(0.017)	(0.017)
Workplace size: 50-99		-0.07***	-0.06***
		(0.022)	(0.022)
Workplace size: 100-249		-0.13***	-0.12***
		(0.022)	(0.022)
Workplace size: 25-499		-0.16***	-0.16***
		(0.027)	(0.027)
Workplace size: 500+		-0.08***	-0.08***
(ref: 1-9)		(0.022)	(0.022)
ISCO: Professionals		-0.35***	-0.31***
		(0.026)	(0.026)
ISCO: Technicians and associate professionals		-0.33***	-0.30***
		(0.027)	(0.027)
ISCO: Service and market sales		0.22***	0.26***
		(0.028)	(0.028)
ISCO: Clerical support		-0.46***	-0.42***
		(0.027)	(0.027)
ISCO: Skilled agriculture, forestry and fishing		0.01	0.07
		(0.078)	(0.077)
ISCO: Building, crafts or related trades		-0.05	0.03
		(0.032)	(0.032)
ISCO: Plant and machine operators		0.04	0.12***
		(0.032)	(0.032)
ISCO: Elementary workers		-0.12***	-0.04
(ref: Managers)		(0.035)	(0.035)
Changing technologies			-0.03**
			(0.013)
Changing work methods			0.10***
			(0.013)
Changing products/services			0.12***
			(0.014)
Changing clients/customers			0.29***
			(0.014)
Sector dummies	x	x	x
Country dummies	x	x	x
Constant	-0.13***	-0.45***	-0.61***
	(0.046)	(0.062)	(0.062)
AIC	1.000	0.976	0.970
Observations	48,676	47,251	47,251

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: European skills and jobs survey (ESJS)

The results highlight an issue of significant concern for policy-makers: it is estimated that the burden of the Covid-19 social distancing risk falls disproportionately on vulnerable groups of the employee population. Given the nature of the skills composition of Covid-19-exposed jobs, it is found that, ceteris paribus, women are more likely to be affected than men, as is also the case for older 'silver' workers, although the impact is likely to be higher on new and less experienced job entrants ([7]). The lower-skilled segment of the employee population also faces a significantly higher Covid-19 social distancing risk, in contrast to adult workers with higher levels of educational attainment. Non-natives are observed to have higher vulnerability, which can be attributed to the fact that their jobs involve both greater interpersonal communication and deficient digital skill needs compared to equivalent native workers. This finding is particularly important in light of urgent human resource shortages and policy reactions to make better use of refugees' and immigrants' potential and skills in the fight against Covid-19.

Individuals faced with more challenging work conditions ([8]) are also found to have a higher COV19R risk; for instance, employees who work longer hours and from multiple work sites are likely to be in greater danger of Covid-19 exposure. Those employed in micro-sized workplaces (one to nine employees) are in a particularly vulnerable position compared to individual employers in larger-sized enterprises.

The estimates in column (3) further highlight that individuals working in organisations that increased the amount of contact with clients and customers and/or altered their product and service provision have a higher Covid-19 social distancing risk. In contrast, organisations that changed the technologies (ICT systems, machines) used by their workforce have a lower mean COV19R risk score. This potentially highlights that firms that invested in more digital

([7]) Our finding that the COV19R risk is higher for older workers may appear to contradict what has been reported in related literature, namely that younger workers predominantly face greater impact by the crisis. However, these studies do not concurrently consider years of tenure with the current employer while they adopt a sectoral distribution approach, in contrast to the individual level used in this study. Neither do they account for the digital skill requirement of jobs that can be performed remotely, which is heavily biased against older workers.

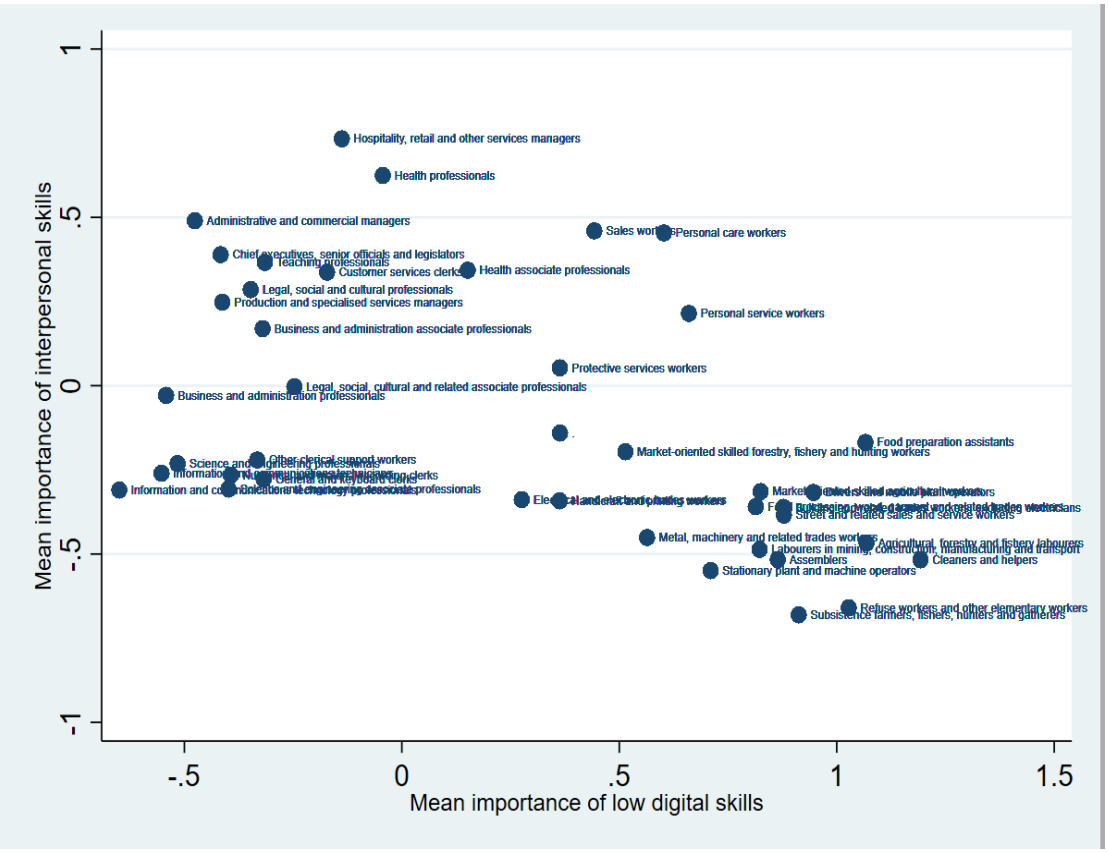
([8]) The analysis has also examined other job-related factors, such as the duration or precarity of the employment contract, but since no statistically significant association was found, such variables were excluded from the specification.

technologies prior to the coronavirus pandemic could have proactively shielded their staff from its adverse consequences.

4.3 Breakdown of Covid-19 social distancing risk

To investigate further any heterogeneity in the association between individual determinants and the COV19R scores, we broke down the index into its individual parts. Principal component analysis (Figure 2; also see Annex 3) highlights that the COV19R index can be loaded on two summative factors which broadly capture the interpersonal component of jobs (communication, teamwork and customer handling) and their digital skill requirement. We hence replicated the estimation of equation (2) using the same set of explanatory factors, albeit using the two derived factors of the COV19R index as dependent variables.

Figure 2. **Scatter diagram of two main principal components of COV19R index by two-digit ISCO group, EU-27 and UK**



Source: European skills and jobs survey (ESJS).

Table 4 demonstrates that women are more exposed to COV19R primarily because of the greater interpersonal element of their jobs, but also as they are less reliant on higher digital skills. The greater exposure of older, non-native and lower-educated employees is, in contrast, driven solely by their lower digital skill use. This highlights that a key policy response to shielding such vulnerable individuals against the negative impact of future public health crises is to invest further in strengthening digital skills use in workplaces (Cedefop, 2016). Workers with more years of tenure with their current employer are in posts that demand a higher digital skill level on average, while those operating from more than one site engage more in interpersonal tasks. The contribution of all remaining determinants to the COV19R index is found to be, to varying degree, a reflection of their association with both of its components.

Table 4. **Multivariate regression analysis of COV19R factors, OLS, EU-27 and UK**

VARIABLES	**(1) Higher interpersonal skill needs**	**(2) Lower digital skill needs**
Male	-0.39***	-0.09***
	(0.013)	(0.009)
Age: 30-39	-0.02	0.01
	(0.021)	(0.014)
Age: 40-54	0.00	0.04***
	(0.021)	(0.014)
Age: 55-65	0.01	0.11***
(ref: 24-29)	(0.027)	(0.018)
Non-native	0.02	0.08***
	(0.020)	(0.014)
ISCED: Medium	0.03	-0.28***
	(0.020)	(0.015)
ISCED: High	0.02	-0.48***
(ref: Low)	(0.023)	(0.016)
Public sector	-0.01	0.00
	(0.016)	(0.011)
Hours	0.01***	-0.00***
	(0.001)	(0.000)
Part-time contract	-0.05**	0.11***
	(0.021)	(0.014)
Years of employer tenure	0.00	-0.00***
	(0.001)	(0.001)
More than one site	0.12***	-0.01
	(0.013)	(0.009)

VARIABLES	(1) Higher interpersonal skill needs	(2) Lower digital skill needs
Site varies	0.13***	0.10***
(ref: one site)	(0.030)	(0.020)
Size: 10-49	-0.03	0.00
	(0.018)	(0.012)
Size: 50-99	-0.04**	-0.02
	(0.022)	(0.015)
Size: 100-249	-0.10***	-0.03**
	(0.022)	(0.015)
Size: 25-499	-0.10***	-0.05***
	(0.026)	(0.017)
Size: 500+	-0.04*	-0.02
(ref: 1-9)	(0.022)	(0.014)
ISCO: Professionals	-0.37***	-0.00
	(0.027)	(0.014)
ISCO: Technicians and associate professionals	-0.40***	0.06***
	(0.027)	(0.015)
ISCO: Service and market sales	-0.19***	0.67***
	(0.030)	(0.019)
ISCO: Clerical support	-0.51***	-0.01
	(0.027)	(0.015)
ISCO: Skilled agriculture, forestry and fishing	-0.59***	0.93***
	(0.082)	(0.059)
ISCO: Building, crafts or related trades	-0.63***	0.88***
	(0.033)	(0.023)
ISCO: Plant and machine operators	-0.66***	1.07***
	(0.034)	(0.023)
ISCO: Elementary workers	-0.86***	1.11***
(ref: Managers)	(0.037)	(0.023)
Industry dummies	x	x
Country dummies	x	x
Constant	0.30***	-0.17***
	(0.064)	(0.040)
Observations	47 251	47 251
R-squared	0.12	0.30

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Source: European skills and jobs survey (ESJS).

4.4 Robustness analysis

Given that the COV19R index used in this paper was constructed by relying on workers' subjective assessment of the interpersonal and digital skill needs of their jobs, we further

examined the sensitivity of the main construct. First, we corroborated that the main findings of the analysis are not altered when the equal weighting scheme assumption, applied to equation (1), is employed, as can be seen in Annex 2.

Second, we examined the association of the derived COV19R index with alternative or external descriptors of skill needs in jobs. The first set of alternative variables was constructed from within the ESJS data set and is based on identification of the relevant interpersonal and digital tasks carried out by EU employees, as contained in uniquely detailed job descriptions provided by a subset of the ESJS sample. The second set of external descriptors was obtained by merging relevant information on interpersonal and digital skill needs as advertised in online job vacancies and contained in the Cedefop Skills OVATE data set ([9]).

Finally, we also examined the association of the COV19R index with the task-based measures of different two-digit occupation-by-sector combinations, as developed by the European Foundation for the Improvement of Living and Working Conditions (Eurofound, 2016).

We first exploited the fact that the ESJS microdata contains detailed work descriptions (e.g. *'*head of public administration: I answer emails and authorisations. Meetings with colleagues'; 'sales representative: relationships with clients'; 'driving instructor: teach people to drive'; 'nursery teacher: helping the children', etc.) for about 14 097 respondents ([10]) from all EU-27 countries (plus the UK) ([11]) (circa 29% of the total ESJS sample). Using appropriate natural language processing techniques, we cleaned the text strings and subsequently identified cases whose job descriptions involve keywords, syntax and clues that correspond

([9]) Methodology and results of the Skills OVATE data: https://www.cedefop.europa.eu/en/data-visualisations/skills-online-vacancies

([10]) The final number of cases with valid detailed job descriptions was derived after a number of steps had been taken to 'clean' the respective variable; in particular, all entries were first made upper case, multiple blank spaces and punctuation were made visible and amended, while missing values (including anomalous entries such as '??', "…", "") were made visible and dropped. Several redundant answers (such as 'null', 'null.', 'no', 'none of your business', 'no comment', 'I don't know', 'nothing', 'I don't want to disclose', 'N/A', 'not applicable', etc.) were identified and deleted.

([11]) A notable feature of these detailed data capturing adult workers' job profiles is that the survey company Ipsos MORI used national linguists to translate the information from the respective national language of each respondent into English.

to the main skill categories used to construct the COV19R index, namely communication, customer handling, teamworking and digital skills ([12]).

An interpersonal skills variable (txt_interper) was hence created (for about 7% of the total ESJS sample) by isolating job descriptions encompassing strings such as 'customers, clients, customer service/visits, sell, service, sale, contacts with people/colleagues/staff/employees, teamwork(ing), working with colleagues, advise, counsel, negotiate, convince, communicate, talk/speak to, contact with, instruct, care, attend to, teaching, students, etc'. In a similar manner, some jobs that use digital technologies (txt_digit) were recognised (for about 5% of the ESJS sample) by the use of keywords such as 'computer, PC, laptop, online, websites, internet, email, digital, programmer, programming, software, digitalise, database', in the available work descriptions ([13]).

Similarly, we aggregated the bag of detailed skills-related terms available in the Skills OVATE data set into four higher hierarchical skill categories of interest for our analysis, namely 'assisting and caring', 'communication, collaboration and creativity', 'information and communication technologies' and 'working with computers'. We subsequently computed the share of these skills categories as a proportion of the total bundle of skills advertised per each two-digit occupation and matched these shares to the corresponding ESJS microdata.

Finally, we used data from the Eurofound European jobs monitor database. As explained in Eurofound (2016), a data set containing descriptions of the task intensity of jobs i.e. all two-digit occupation-by-sector combinations in Europe, was constructed from various international sources – Eurofound's European working conditions survey, the OECD's Survey of adult skills (PIAAC), the American O*NET database and the EU labour force survey (LFS). This is based on a task framework (Fernandez-Macias and Bisello, 2016) that classifies and measures tasks along two main dimensions, the content of the tasks themselves and the

([12]) Such a procedure, using regular expressions (regex) commands, is similar to the one employed by Pouliakas (2018), who matched detailed jobs from the ESJS with the Frey and Osborne (2013) training set of minor automatable and non-automatable occupations, to enable estimation of the relationship between the latent automatability of jobs and their skill needs.

([13]) It is reasonable to expect that while a non-trivial 29% of the total number of respondents provided a detailed job description, some bias exists in the distribution of respondents who provided such information, especially among online respondents. This is because it was only requested in the survey conditional on individuals being unable to accurately identify their one- or two-digit occupation group in the main survey questions asking them to do so.

methods and tools used to perform them. The content part of the task framework identifies three main classifications of task content: physical, intellectual, and social, each with various sub-indicators. The methods and tools of work capture the extent to which workers use machine or ICT tools. The task indices are an aggregate measure based on data from 15 Member States (EU-15).

For the purposes of our analysis, we merged the Eurofound task data set with the ESJS data at the two-digit occupation-by-sector level and related the two relevant measures of social tasks and use of ICT methods with the COV19R measure.

Table 5 shows the empirical relationship between the derived COV19R index used in this paper with the three alternative/external measures of interpersonal and digital skill needs as described above ([14]). It is confirmed that the COV19R measure based on the subjective assessment of the importance of social and digital skills by adult workers has strong robustness, given that it is significantly correlated with skill needs information extracted from workers' detailed task descriptions, measured task indicators from international data sets, as well as employers' advertised skills in online job postings.

Table 5. **Robustness of COV19R index, OLS, EU-27 and UK**

Variables	**(1) ESJS**	**(2) Skills OVATE**	**(3) EJM**
Skill needs based on workers' detailed task descriptions			
txt_interper	0.09***		
	(0.005)		
txt_digit	-0.02**		
	(0.006)		
Share of skill in total skills advertised in employers' online job vacancies			
Assisting & caring		0.26***	
		(0.074)	
Communication & collaboration		0.24***	
		(0.063)	
ICTs		-0.25***	
		(0.054)	

([14]) The relevant glm estimates are available upon request; OLS estimates are presented in Table 5 for clarity of the (marginal) partial correlations.

Variables	(1) ESJS	(2) Skills OVATE	(3) EJM
Working with computers		-0.62***	
		(0.057)	
Tasks based on European jobs monitor task indicator dataset			
Social: Serving			0.45***
			(0.018)
Methods: Teamwork			-0.002
			(0.01)
Tools: ICT			-0.073***
			(0.015)
Individual factors	x	x	x
Job factors	x	x	x
Constant	0.39***	0.41***	0.21***
	(0.014)	(0.018)	(0.021)
Observations	47 251	47 234	38,486
R-squared	0.09	0.15	0.16

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Regressions control for all individual and job-related explanatory variables as shown in column (2) of Table 3.

Source: European skills and jobs survey (ESJS); Skills online job vacancies analysis tool for Europe; European job monitor tasks indicator data set.

5. Conclusions

The coronavirus (Covid-19) crisis has resulted in an unprecedented labour market shock and unemployment crisis and is expected to bring about marked structural changes and protracted disruption for EU jobs and skills in the short to medium term. In addition to the immediate negative shock experienced as part of the confinement measures implemented to stem the first wave of the coronavirus infection, continued negative repercussions are expected due to the prolonged influence that both forced and inherent social distancing practices may have on workers' job performance and productivity. The pandemic is also expected to have an asymmetric impact, not only on different economic activities and occupations in the labour market, but also on diverse workforce groups.

This paper has employed a skills-based theoretical and empirical approach to identifying the industries and occupations in the EU job market most likely to be impacted by social distancing measures and practices due to the Covid-19 pandemic. Using unique data on the skill needs of EU jobs from the Cedefop ESJS, a Covid-19 social distancing risk index (COV19R)

is created based on skills descriptors distinguishing jobs according to whether they rely on physical proximity or contact with others, and whether they are of low digital intensity.

Based on the classification of jobs and industries using the new index, it is conservatively estimated that about 45 million jobs in the EU-27 labour market (23% of total EU-27 employment) are faced with a very high risk of Covid-19 disruption, while another 22% of the workforce is also exposed to a considerable degree. The empirical estimates reveal that the burden of the Covid-19 social distancing impact falls disproportionately on vulnerable workforce groups, such as women, older employees, non-natives and the lower-educated. The risk is also higher for those in more challenging job conditions, such as working longer hours or from multiple sites, or those employed in micro-sized workplaces.

The findings raise significant concerns for policy-makers and call for immediate and targeted policy responses, including job activation, reskilling and job support initiatives, which will prevent ongoing job losses and the widening of labour market and social inequalities due to the pandemic. Continued monitoring and anticipation of Covid-19 risk will be necessary for the foreseeable future and more investment in digital skills training and digital infrastructure is imperative. However, a key issue of concern, according to our findings, is that the most-at-risk population groups identified are traditionally the ones most difficult to target with job reintegration and skilling policies, even at times of strong labour markets. In addition, countries that have sought to tackle high unemployment rates in the past by promoting low-skilled work and activities are bound to find that their labour markets will be particularly susceptible to a sustained negative aftermath of the new social and labour market reality caused by the Covid-19 pandemic.

References

Adams-Prassl, A.; Boneva, T.; Golin, M.; Rauh, C. (2020). *Inequality in the impact of the coronavirus shock: evidence from real time surveys*. IZA DP No 13183.

Arntz, M.; Gregory, T.; Zierahn, U. (2016), *The risk of automation for jobs in OECD countries*, *OECD social, employment and migration working papers, No 189*. Paris: OECD Publishing.

Baert, S.; Lippens, L.; Moens, E.; Sterkens, P.; Weytjens, J. (2020). *How do we think the Covid-19 crisis will affect our careers (if any remain)?* IZA discussion paper; No 13164. https://covid-19.iza.org/publications/dp13164/

Baldwin, R.; Weder di Mauro, B. (2020). *Economics in the time of Covid-19: a new eBook.* VoxEU column. https://voxeu.org/article/economics-time-covid-19-new-ebook

Béland, L.; Brodeur, A.; Wright, T. (2020). *The short-term economic consequences of Covid-19: exposure to disease, remote work and government response.* IZA discussion paper; No 13159.

Berube, A.; Bateman, N. (2020). *Who are the workers already impacted by the Covid-19 recession*? Report for Brookings. https://www.brookings.edu/research/who-are-the-workers-already-impacted-by-the-covid-19-recession/

Carvalho, V. M. et al. (2020). *Tracking the Covid-19 crisis with high-resolution transaction data.* Cambridge working papers in economics; CWPE2030.

Cedefop (2015). *Skills, qualifications and jobs in the EU: the making of a perfect match? Evidence from Cedefop's European skills and jobs survey*. Luxembourg: Publications Office of the European Union. Cedefop reference series; No 103. http://www.cedefop.europa.eu/en/publications-and-resources/publications/3072

Cedefop (2016). *The great divide: digitalisation and digital skill gaps in the EU workforce*. #ESJsurvey insights; No 9. Thessaloniki: Cedefop. https://www.cedefop.europa.eu/files/esj_insight_9_digital_skills_final.pdf

Cedefop (2018a). *Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey*. Luxembourg: Publications Office of the European Union. Cedefop reference series; No 106. http://www.cedefop.europa.eu/en/publications-and-resources/publications/3075

Cedefop (2018b). *From long-term unemployment to a matching job*. Luxembourg: Publications Office of the European Union. Cedefop reference series; No 107. https://www.cedefop.europa.eu/en/publications-and-resources/publications/3076

Coibion, O.; Gorodnichenko, Y.; Weber, M. (2020). *Labor markets during the Covid-19 crisis: a preliminary view.* Working paper.

Dingel, J.; Neiman, B. (2020). *How many jobs can be done at home? Covid Economics: Vetted and real-time papers*. No 1, pp. 16-24. https://cepr.org/content/covid-economics-vetted-and-real-time-papers-0

Eurofound (2016). *What do European do at work? A task-based analysis: European jobs monitor 2016*, Luxembourg: Publications Office of the European Union

Eurofound (2020). *Telework and ICT-based mobile work: flexible working in the digital age*. New forms of employment series. Luxembourg: Publications Office of the European Union.

Fana, M.; Tolan, S.; Torrejón, S.; Urzi Brancati, C.; Fernández-Macías, E. (2020). *The Covid confinement measures and EU labour markets*. Luxembourg: Publications Office of the European Union. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120578/jrc120578_report_covid_confinement_measures_final_updated_good.pdf

Fernandez-Macias, E. and Bisello, M. (2016). *A framework for measuring tasks across occupations*, https://voxeu.org/article/framework-measuring-tasks-across-occupations

Forth, J. (2016). *Evaluation of design effects in the European skills and jobs survey.* UK: National Institute of Economic and Social Research (NIESR).

Frey, C.; Osborne, M. (2013). *The future of employment: how susceptible are jobs to computerisation*. Oxford: University of Oxford.

Hamermesh, D. (2020). *Trading off lives for jobs*. IZA world of labor, https://wol.iza.org/opinions/trading-off-lives-for-jobs

ILO (2020). *ILO monitor: Covid-19 and the world of work. Second edition.* https://www.ilo.org/global/about-the-ilo/WCMS_740877/lang--en/index.htm

McKinsey and Company (2020*). Safeguarding Europe's livelihoods: mitigating the employment impact of Covid-19*. https://www.mckinsey.com/industries/public-sector/our-insights/safeguarding-europes-livelihoods-mitigating-the-employment-impact-of-covid-19

Mongey, S.; Pilossoph, L.; Weingberg, A. (2020). *Which workers bear the burden of social distancing measures?* NBER working paper series; No 27085.

Nedelkoska, L.; Quintini, G. (2018). *Automation, skills use and training.* OECD social, employment and migration working papers; No 202. Paris: OECD Publishing.

Papke, L. E., and J. M. Wooldridge. 1996. Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics* 11: 619–632.

Pouliakas, K. (2018). Automation risk in the EU labour market: a skill-needs approach. In: Hogarth, T. (2018) (ed). *Economy, employment and skills: European, regional and global perspectives in an age of uncertainty*. Rome: Fondazione Giacomo Brodolini. Quaderni series.

Redmond, P.; McGuinness, S. (2020). *Who can work from home in Ireland,* Dublin: Economic and Social Research Institute (ESRI) working paper.

Stephany, F.; Dunn, M.; Sawyer, S.; Lehdonvirta, V. (2020). *Distancing bonus or downscaling loss? The changing livelihood of US online workers in times of Covid-19.* SocArXiv papers. https://doi.org/10.31235/osf.io/vmg34

Annex 1.
Sample descriptive statistics

Table A1. **Sample descriptive statistics, EU-27 and UK**

	Mean	s.d.	Min	Max
Male	0.560	0.496	0	1
Age band				
30-39	0.310	0.463	0	1
40-54	0.441	0.496	0	1
55-65	0.133	0.339	0	1
Education level				
Medium	0.417	0.493	0	1
High	0.457	0.498	0	1
Non-native	0.102	0.303	0	1
Public sector	0.269	0.444	0	1
Part-time	0.155	0.361	0	1
Years of employer tenure	10.209	9.127	1	50
Site: More than one site	0.606	0.489	0	1
Site: It varies	0.055	0.229	0	1
Firm size				
1-9	0.213	0.409	0	1
10-49	0.275	0.446	0	1
50-99	0.126	0.332	0	1
100-249	0.125	0.331	0	1
250-499	0.075	0.263	0	1
500+	0.155	0.362	0	1
Hours of work	38.530	11.352	1	68
Workplace changes (in previous five years)				
Technologies (ICT systems, machines)	0.451	0.498	0	1
Work methods and practices	0.478	0.500	0	1
Products and services	0.308	0.462	0	1
Customers and clients	0.288	0.453	0	1
Occupation group (one-digit ISCO)				
Managers	0.074	0.262	0	1
Professionals	0.214	0.410	0	1
Technicians and associate professionals	0.158	0.365	0	1
Service and market sales workers	0.143	0.350	0	1
Clerical support	0.213	0.410	0	1
Skilled agricultural, forestry and fishing	0.008	0.088	0	1
Building, crafts or a related trades	0.072	0.259	0	1
Plant and machine operators and assemblers	0.066	0.248	0	1
Elementary	0.045	0.207	0	1

	Mean	s.d.	Min	Max
Economic activities (one-digit NACE)				
Public administration and support services	0.117	0.321	0	1
Agriculture, forestry or fishing	0.021	0.142	0	1
Supply of gas or electricity, mining or quarrying	0.019	0.137	0	1
Supply, management or treatment of water	0.010	0.100	0	1
Manufacturing	0.140	0.346	0	1
Construction	0.060	0.238	0	1
Wholesale and retail trade	0.106	0.308	0	1
Accommodation, catering or food service	0.033	0.180	0	1
Transportation or storage	0.060	0.237	0	1
Information and communications technology	0.064	0.246	0	1
Financial, insurance or real estate services	0.055	0.228	0	1
Professional, scientific or technical services	0.065	0.247	0	1
Education or health-related services	0.155	0.362	0	1
Cultural industries (arts, entertainment)	0.021	0.142	0	1
Social and personal services	0.058	0.234	0	1
Other	0.016	0.124	0	1

Source: European skills and jobs survey (ESJS)

Table A2. **Descriptive statistics of COV19R by factors, EU-27 and UK**

	Mean	s.d.
COV19R	0.354	0.300
COV19R components		
Very high importance of communication skills in job (*com*)	0.341	0.474
Very high importance of customer handling skills in job (*cust*)	0.419	0.493
Very high importance of teamworking skills in job (*team*)	0.334	0.472
Low or no need for digital skills in job (*dig*)	0.321	0.467
COV19R by individual/job factors		
Male	0.315	0.309
Female	0.404	0.286
Age group		
24-29	0.363	0.306
30-39	0.338	0.299
40-54	0.359	0.300

	Mean	s.d.
55-65	0.368	0.294
Education		
High	0.324	0.297
Medium	0.374	0.303
Low	0.398	0.287
Born in country		
Non-native	0.377	0.301
Native	0.351	0.299
Firm size		
1-9	0.396	0.303
10-49	0.368	0.302
50-99	0.345	0.296
100-249	0.320	0.293
500+	0.320	0.294
Occupation group (one-digit ISCO)		
Managers	0.383	0.298
Professionals	0.326	0.299
Technicians and associate professionals	0.304	0.299
Service and market sales workers	0.502	0.303
Clerical Support	0.294	0.291
Skilled Agricultural, Forestry and Fishing	0.385	0.273
Building, Crafts or a Related Trades	0.356	0.271
Plant and machine operators and assemblers	0.376	0.265
Elementary	0.387	0.265

Source: European skills and jobs survey (ESJS)

Annex 2.
Sensitivity of COV19R index to weighing scheme

Table A3. **Mean and standard deviation of COV19R by two-digit ISCO, alternative weighting schemes, EU-27 and UK**

Weighting scheme (*wi* = *wcommunicate, wcustomer, wteam, wdigital*)	**Mean COV19R by two-digit ISCO**	**S.D. COV19R by two-digit ISCO**
Equal balance across four individual skills components of index (*wi* = 0.25, 0.25, 0.25, 0.25)	0.354	0.093
Smaller weight of importance of low digital skills component; more weight on interpersonal skills (*wi* = 0.30, 0.30, 0.30, 0.10)	0.360	0.091
Equal weight between group of interpersonal skills and digital skills (*wi* = 0.16, 0.17, 0.17, 0.50)	0.343	0.129
Equal weight on communication and digital skills, higher weight on customer handling and teamworking skills (*wi* = 0.15, 0.35, 0.35, 0.15)	0.363	0.093

Source: European skills and jobs survey (ESJS)

Annex 3.
Principal component breakdown of COV19R index

Table A4. **Principal component analysis of skills components of COV19R, EU-27 and UK**

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.86993	.870798	0.4675	0.4675
Comp2	.999136	.283069	0.2498	0.7173
Comp3	.716066	.301203	0.1790	0.8963
Comp4	.414864	.	0.1037	1.0000
Principal components (eigenvectors)				
High importance communication skills (*com*)	0.6267	0.0186	-0.2114	0.7498
High importance customer handling skills (*cust*)	0.5047	-0.0214	0.8433	-0.1836
High importance teamworking skills (*team*)	0.5874	0.1439	-0.4854	-0.6314
Low or no need for digital skills (*dig*)	-0.0863	0.9892	0.0928	0.0738

Source: European skills and jobs survey (ESJS)