

# Wage inequality and poverty effects of social distancing in Europe<sup>1</sup>

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## Abstract

The “social distancing” measures taken to contain the spread of COVID-19 impose economic costs that go beyond the contraction of GDP. Since different occupations are not equally affected, this supply shock may have distributional implications. Here, we evaluate the potential impact of enforced social distancing on wage inequality and poverty across Europe. We compute a Lockdown Working Ability (LWA) index which represents the capacity of individuals to work under a lockdown given their teleworking index –that we obtain for European occupations using 2018 EU-LFS– and whether their occupation is essential or closed. Combining our LWA index and 2008 EU-SILC, we calculate individuals’ potential wage losses under six scenarios of lockdown. The Lockdown Incidence Curves show striking differential wage losses across the distribution, and we consistently find that both poverty and wage inequality rise in all European countries. These changes increase with the duration of the lockdown and vary with the country under consideration. We estimate an increase in the headcount index of 3 percentage points for overall Europe, while the mean loss rate for the poor is 10.3%, using the 2 months lockdown simulation. In the same scenario, inequality measured by the Gini coefficient increases 2.2% in all Europe, but more than 4% in various countries. When we decompose overall inequality in Europe into between- and within-countries components, both elements significantly increase with the lockdown, being the change of the latter more important.

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## 1. Introduction

The dramatic and unprecedented intensity of the shock due to the Covid-19 pandemic has highlighted the importance of measuring the economic consequences of “social distancing”. The lockdown measures implemented in many countries around the world will likely have a significant negative impact on their GDP (IMF, 2020). Thus, the latest forecasts collected by Consensus Economics point towards expectations of a sharp mean decline in GDP of 5.7% in the euro area this year (see also Florian et al., 2020). However, the effect of the pandemic will not only take place at the aggregate level and is likely to have distributional implications (Furceri et al., 2020). The social distancing imposed by governments to limit the spread of the pandemic has caused an asymmetric effect on the labour market: discounting essential occupations like health services and food sales, only the jobs not closed by the lockdown that can be done from home (“teleworkable”) will be not impeded. This asymmetry of the supply shock implies that the economic costs of social distancing could be significant, not only in terms of negative GDP growth rates but also in terms of higher wage inequality and poverty rates. In this paper, we analyse the potential effects of social distancing on wage inequality and poverty in absence of any public policy across Europe.

Recent studies have provided estimates of the supply shock caused by the emergency regulation imposed to contain the spread of Covid-19 (Dingel and Neiman, 2020; Hicks, 2020; and Koren and Petö, 2020) They have evaluated the possible economic consequences of social distancing –without considering the subsequent effects that may occur on the demand side– by calculating to what extent occupations can be performed from home (teleworking). Mongey et al., 2020 find that workers with less ability to work from home had been indeed more unable to follow the ‘stay at home advice’ -using geolocation data- and that they have suffered higher unemployment increases. In a more comprehensive analysis, del Rio-Chanona et al. (2020) provide quantitative predictions of first order supply and demand shocks associated with the Covid-19 pandemic. These studies, mainly focused on the U.S. economy, have analysed the consequences of social distancing in the job market, at the occupation and industry levels, without delving into the study of wage inequality. We find two exceptions. First, Irlacher and Koch (2020) obtain a substantial wage premium (higher than 10%) in a Mincer regression for German workers performing their job from home and a lower share of teleworkable occupations in poorer German regions. Second, Brunori et al. (2020) study the short-term effects that

two months of lockdown have had on the Italian income distribution. By using a static microsimulation model, they find a non-negligible increase of poverty and inequality in Italy.

To estimate the impact of social distancing on wage inequality and poverty across Europe, we focus on the supply-side reductions due to the closure of non-essential occupations and workers not being able to perform their activities at home. Despite their relevance, our analysis does not consider the demand-side changes due to individuals' response to the pandemic, nor the subsequent second-order effects in supply (additional reductions as shortages propagate through supply chains) and in demand (as workers who are laid off or at risk experience a reduction in income). While these demand and second order effects are difficult to estimate at this early stage, the first order restrictions imposed in the lockdown provide a clear framework to study the consequences for inequality and poverty of having a particular productive structure. Under a lockdown, the asymmetry of the supply-side restrictions may affect economies in a different way just because their productive structure is not the same: countries who are specialised in outdoor and non-essential activities like tourism and construction will, in principle, suffer more from the lockdown. We thus restrict ourselves to measuring the potential impact on wage inequality and poverty of enforced social distancing.

In general, if occupations with higher wages are more teleworkable, we should observe an increase in wage inequality due to lockdown within each country analysed. However, whether this happens, and the intensity of this change, will depend on the structure of the economy and the extent of essential and closed occupations under the lockdown. The wide set of European countries in our sample –with a variety of productive structures– will also allow us to test if different productive structures imply different potential effects on wage inequality and poverty under lockdown and compulsory social distancing. Note that if that is the case, inequality would not only increase within countries, but also between nations, which could exacerbate the problem of cohesion in Europe.

The first step to measure the changes in wage inequality and poverty across Europe due to lockdown is to calculate the index of teleworking at the occupational level. Dingel and Neiman (2020) found that 37 percent of jobs in the United States can be done entirely from home. What is the share of occupations that allow teleworking in Europe? Following these authors, we use fifteen questions from the Occupational Information Network (O\*NET) database (compiled by the United States Department of Labour) such as, 'is the

work done outdoors?’ or, ‘does it require significant physical activity?’ to calculate the probability of teleworking for each occupation. We then use the 2018 European Union Labour Force Survey (EU-LFS) occupational structure to translate these probabilities into the European context. Finally, we match the EU-LFS occupation teleworking index and the 2018 European Union Statistics on Income and Living Conditions (EU-SILC), which provides detailed information on wage at the individual level. After this procedure, we have for every worker in the EU-SILC database the individual index of teleworking (according to her occupation) and the wage.

A lockdown implies that some activities –like healthcare or food chain related jobs– will become essential while others will be closed. When the occupation is essential, workers will be not affected by lockdown regardless of their capacity to work from home. When a certain economic activity is closed –like hospitality– working is not at all possible, and teleworking does not matter. For the remaining economic activities, only teleworking is allowed. Consequently, during the lockdown we need to adjust our index of teleworking for the workers whose occupation is essential or closed, to obtain an individual measure that summarizes the capacity of each worker to keep active under the lockdown. We will call this measure Lockdown Working Ability (LWA) index.

The next step is to calculate the potential wage loss due to the lockdown. Because not all workers are able to perform their job at home and some activities are closed, there will be wage reductions for a significant part of the labour force. To simulate these wage losses, we consider six possible scenarios: *i*) one month of lockdown; *ii*) two months of lockdown; *iii*) four months of lockdown; *iv*) one month of lockdown and six months of only partial functioning of the closed activities (80% of capacity); *v*) two months of lockdown and six months of partial functioning of the closed activities; and, *vi*) four months of lockdown and six months of partial functioning of the closed activities. With this proposal we intend, on the one hand, to measure the effect of enlarging the lockdown and, on the other hand, to calculate the impact of medium-term regulation imposed to contain the spread of Covid-19 during the de-escalation. Although each European country may have followed slightly different lockdown and de-escalation strategies, the core of the social distancing enforcing policies has been similar in most of them. For that reason, and to ensure that in our analysis differences across countries are exclusively due to their productive structure, we simulate the same six scenarios for all European countries.

The last step is to measure the changes in wage inequality and poverty across countries, and the variation of wage inequality between and within-countries due to the lockdown. For this task, we first compute the Lockdown Incidence Curve (LIC), which represents the relative change in the wage of individuals ordered by centiles, and the related changes in the mean ‘growth’ rate of the poor (Ravallion and Chen, 2003) and headcount index. Then, we use the Gini coefficient and the Mean Logarithmic Deviation (MLD) to calculate the changes in wage inequality. The first measure is a popular index of inequality which is widely used in the literature, while the second measure fulfils some properties which are necessary for our analysis of inequality decomposition. In particular, the MLD is the only inequality index that is additively decomposable into a between-group and a within-group component (Bourguignon, 1979; Shorrocks, 1980) and has a path-independent decomposition (Foster and Shneyerov, 2000).

Our first result is that average teleworking varies significantly not only across countries, going from 0.24 in Romania to 0.48 in Denmark, but also by gender, type of work (full or part time), type of contract (permanent or temporary) and level of education. Secondly, the average of teleworking in a country is positively correlated with the average annual salary, while within-countries inequality of teleworking is negatively associated with the average annual salary. The positive correlation of teleworking and wages is found not only at the country level but also at the individual level.

When the lockdown scenarios are in place, and only essential and non-closed teleworkable occupations can work, we estimate that poverty increases for the headcount index and the mean loss rate of the poor in all countries for all simulations. For example, under a lockdown of two months, we observe that the headcount index increases 3 percentage points in overall Europe, while the mean loss rate for the poor increases 10.3%. However, these changes vary greatly with the country under consideration. The same patterns are observed when we represent the LICs across Europe. According to these curves, the highest increases in poverty are found in Cyprus, while the smallest ones happen in Romania regardless of the simulation scenario assumed. Likewise, wage inequality increases for the Gini coefficient and the MLD in all countries for all simulations. For example, under a lockdown of two months, the changes in the Gini and MLD indices are 2.2% and 10.1% for Europe as a whole, respectively. We thus find that poverty and inequality changes are sizeable in all countries and they increase with the duration of the lockdown and the partial closure of some activities.

When we decompose overall inequality in Europe, both within countries and between countries inequality increase with the duration of the lockdown and the partial closure of some activities, producing a double process of divergence in wage inequality in Europe. But this increase in wage dispersion is not symmetric, and the within-countries inequality component increases more than the between-countries inequality component (5.0% and 2.4% respectively, under a lockdown scenario of two months). Although cohesion between European countries decreases with the lockdown, the main wage inequality change happens within European countries.

The rest of the paper is structured as follows. In Section 2 we present the databases used to calculate our teleworking index and comment on the values of this index for the European countries. The methodology applied to calculate the changes in wage inequality is described in Section 3. In Section 4 we highlight the main results obtained for Europe. Finally, Section 5 concludes.

## **2. The databases and the index of teleworking in Europe**

In this study we use three different databases, all of them necessary for our combined analysis of working ability during the lockdown and changes in wage. First, we obtain information about the key attributes and characteristics of occupations from the American O\*NET database, necessary to assess occupational teleworking ability. Second, we use the latest 2018 wave of EU-LFS (2020 release) –with detailed employment and occupational information for European countries– to accurately obtain occupational teleworking information for the European occupational categories. Finally, this information is combined with the rich socioeconomic data –crucially, salaries– from the 2018 wave of EU-SILC (2020 release). Before we explain the procedure followed to calculate the teleworking index, the above-mentioned databases are described in detail.

### **2.1. The databases**

The O\*NET database is the primary project of the O\*NET program promoted by the US Department of Labour, and replaces the Dictionary of Occupational Titles (DOT), which was used for earlier research. O\*NET analysts at the Department of Labour assign scores to each task according to standardized guidelines to describe their importance within each occupation. Thus, O\*NET is a source of occupational information, providing data on key

attributes and characteristics –from which teleworking capacity can be derived– for 968 occupations, based on the Standard Occupation Classification 2010 (ONET-SOC2010). Therefore, for this information about occupations to be used in our analysis, we will have to translate O\*NET-SOC2010 data into European codification ISCO-08 used in EU-LFS (at the 3-digit level) and EU-SILC (at the 2-digit level).

EU-LFS, which we will use to translate O\*NET teleworking indices into European coding, compiles national labour force surveys carried out by the national statistical authorities and is homogenised by Eurostat. This database includes information on the labour market status of the 28 European Union countries, plus Norway, Switzerland, Iceland, Turkey, and Macedonia. These last three countries are not considered in our analysis, as they are not included in the current EU-SILC 2020 release that we use for our wage inequality analysis. Malta is also discarded because the occupation variable is only available at the International Standard Classification for Occupations (ISCO-08) 1-digit level, lacking enough precision for our analysis (see Table A1 in Appendix A).

In this work, we use EU-LFS (2018) where employment is measured according to the International Labour Organization (ILO) definition.<sup>2</sup> Occupations are coded at the 3-digit level (ISCO-08) and industries are coded at the 1-digit level with the Nomenclature Statistique des Activités Economiques dans la Communauté Européenne (NACE) revision 2.<sup>3</sup> We drop the occupation “Subsistence farmers, fishers, hunters, and gatherers” (ISCO-08 63), since employment occurs only in a small number of countries (suggesting classification problems), and the industry “Activities of extraterritorial organisations and bodies” (NACE. Rev.2 U) because the number of observations is scarce. We also discard “Armed forces occupations” (ISCO-08 0) as O\*NET does not facilitate information on those occupations and “Unpaid family workers” that has very few observations. While EU-LFS is the best database to map the occupations (and teleworking indices) from O\*NET it lacks the wage information crucial for our inequality analysis. For this reason, we will merge EU-LFS teleworking indices for each ISCO-08 occupation with the EU-SILC database which provides detailed microdata on wages.

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<sup>2</sup> Employment –and therefore occupational shares– can be measured either by thousands of persons employed (given by the EU-LFS survey weights) or by thousands of weekly hours worked (EU-LFS survey weights multiplied by usual weekly hours), we use the former definition in our EU-LFS analysis.

<sup>3</sup> For Bulgaria, Poland, and Slovenia occupations are coded at the ISCO-08 2-digit level. Industries are not disaggregated for Denmark (see Table A1). We describe the set of industries NACE (1-digit level) and of occupations ISCO-08 (2-digit level) in Tables B1 and B2, respectively (see Appendix B).

EU-SILC encompasses homogeneous surveys on living conditions implemented by the national institutes of statistics under the coordination of Eurostat. Collected data contains information on a wide range of socioeconomic items, including occupation, industry and salary at the personal level. Taking advantage of this information, we will sample active workers –employees and self-employed– who declare to be working at least part time at the time, and who have a greater than zero salary during the reference year. This excludes unemployed and retired workers, and people under the legal working age of 16. For our salary variable, for each individual we have aggregated yearly cash and in-kind gross employee income and gross self-employed income. Employee income is defined as ‘the total remuneration payable by an employer to an employee in return for work done by the latter during the income reference period’, while self-employed income is the gross income received during the reference year as a result of their current or former involvement in self-employed work. As for the occupational information, this is typically coded at the 2-digit level (ISCO-08), while industries are coded at the 1-digit level (NACE Rev.2) in EU-SILC.<sup>4</sup> Consequently, we have to aggregate the occupations at the 3-digit level (ISCO-08) in EU-LFS to the 2-digit level (ISCO-08) before we can match both databases (see Table A1 in Appendix A).

## 2.2. Measuring teleworking

Following Dingel and Neiman (2020), the responses to two O\*NET surveys were used: “work context” and “generalized work activities”.<sup>5</sup> From “work context” the following items were retained:<sup>6</sup>

- How frequently does your current job require electronic mail? (Q4)
- How often does your current job require you to work outdoors? (Q17)
- How often is dealing with violent or physically aggressive people part of your current job? (Q14)
- In your current job, how often do you wear common protective or safety equipment such as safety shoes, glasses, gloves, hearing protection, hard hats, or life jackets? (Q43)

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<sup>4</sup> For Germany and Slovenia occupations are coded at the ISCO-08 1-digit level (see Table A1).

<sup>5</sup> Mongey et al. (2020) propose a variant of the teleworking index in Dingel and Neiman (2020) and a measure of low physical proximity to others at work.

<sup>6</sup> The possible answers for each item are: 1 (never), 2 (once a year or more but not every month), 3 (once a month or more but not every week), 4 (once a week or more but not every day) and 5 (every day).

- How much time in your current job do you spend walking or running? (Q37)
- How often does your current job require that you be exposed to minor burns, cuts, bites, or stings? (Q33)
- How often does your current job require that you be exposed to diseases or infection? (Q29)

From “generalized work activities” the following items were considered:<sup>7</sup>

- How important is Performing General Physical Activities to the performance of your current job? (Q16A)
- How important is Handling and Moving Objects to the performance of your current job? (Q17A)
- How important is Controlling Machines and Processes [not computers nor vehicles] to the performance of your current job? (Q18A)
- How important is Operating Vehicles, Mechanized Devices, or Equipment to the performance of your current job? (Q20A)
- How important is Performing for or Working Directly with the Public to the performance of your current job? (Q32A)
- How important is Repairing and Maintaining Mechanical Equipment to the performance of your current job? (Q22A)
- How important is Repairing and Maintaining Electronic Equipment to the performance of your current job? (Q23A)
- How important is Inspecting Equipment, Structures, or Materials to the performance of your current job? (Q4A)

For each question, occupations are classified as “able to work from home” if answers are 1, 2 or 3, and as “cannot be performed at home” if answers are 4 or 5. Finally, occupations are classified as “able to telework” if they are categorised as “able to work from home” in the 15 questions.

A total of 968 occupations of O\*NET were categorised as teleworkable or non-

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<sup>7</sup> The possible answers for each item are: 1 (not important), 2 (somewhat important), 3 (important), 4 (Very important) and 5 (extremely important).

teleworkable in this way. We then map O\*NET-Standard Occupation Classification (O\*NET-SOC2010) to the corresponding US-SOC10 (at the 6-digit level). Next, to obtain results for Europe, we use the ILO crosswalk to translate all US-SOC10 occupations into the EU-LFS occupations (ISCO-08 at the 3-digit level). This mapping between SOC10 and ISCO-08 is far from trivial because it is an unbalanced ‘many-to-many’ match, and correspondence needs to take into account relative weighting of related occupations. For this task, we use the Occupational Employment Statistics (OES) 2018 (which uses US-SOC 10 at the 6-digit level) and has the US employment weights for each occupation. Thus, we can map US-SOC10 occupations in OES (at the 6-digit level) to the ISCO-08 occupations (at the 3-digit level) in EU-LFS, a process which allocates US’s employment across ISCOs in proportion to European employment shares. This mapping of 6-digit SOC to 3-digit ISCOs (and the corresponding teleworking value for each occupation) is common to all European countries, but the posterior calculation of the weighted teleworking average for each 2-digit ISCO is country-specific, based on the labour weights of the different 3-digit occupations included in each 2-digit code . Finally, we impute the teleworking index based on EU-LFS at the 2-digit ISCO level to each occupation in EU-SILC at the 2-digit ISCO level.

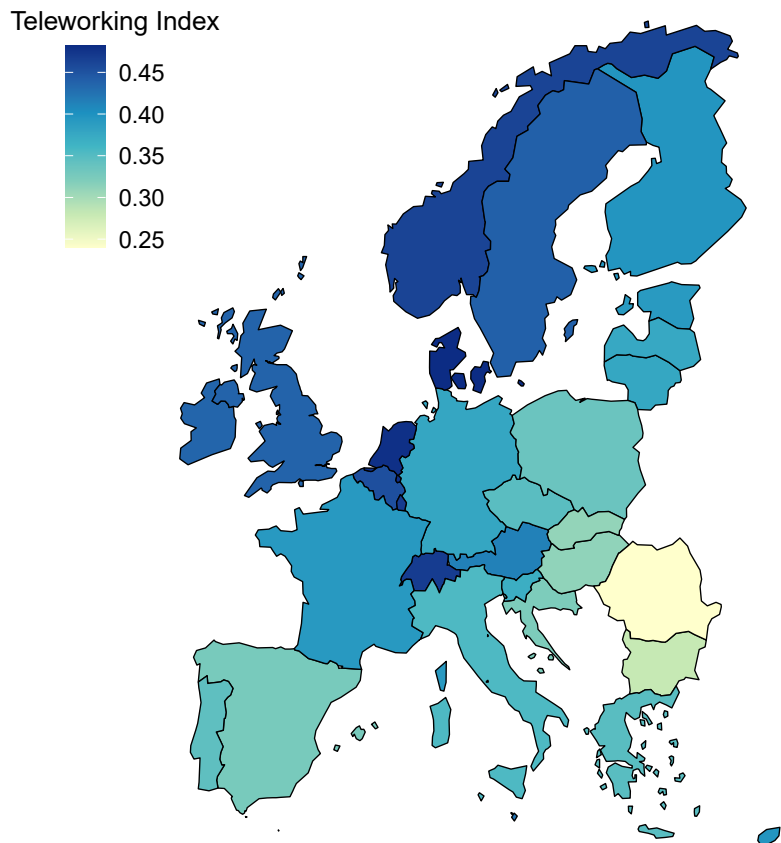
### 2.3 Teleworking in Europe

In Figure 1 and Table 1 we show the average index of teleworking across Europe. It is observed that teleworking varies significantly across countries: Denmark (0.48), Luxembourg (0.47), Switzerland (0.47) and Norway (0.46) are the countries best prepared for teleworking, while Romania (0.24), Bulgaria (0.28), Slovak Republic (0.31) and Hungary (0.31) show the lowest average teleworking index. It appears therefore that occupational structures in Northern Europe are more prepared for social distancing than in Southern Europe and, especially, than Eastern Europe.

Table 1 shows that the index of teleworking varies significantly not only by countries but also by gender, type of contract (permanent or temporary), type of work (full or part time), and level of education. According to their occupational index of teleworking, women are less affected by social distancing than men in all European countries but the Netherlands, where both sexes have the same capacity to work from home. By type of job, as might be expected, temporary and part-time workers are worse prepared for teleworking than their permanent and full-time counterparts. Only in Austria, Denmark and the UK have temporary workers a higher capacity to telework than permanent workers –implying that,

in these countries, temporary contracts are relatively more used in highly teleworkable occupations— while only in Czech Republic, Croatia and Slovak Republic part-time workers are better prepared for working at home than full-time workers.

**Figure 1.** Average index of teleworking across European countries.



Sources: Authors' analysis from O\*NET, EU-FLS (2018), and EU-SILC (2018).

Finally, there is a very strong positive relationship between the level of education and the value of teleworking in all European countries. By levels of education, the capacity of working from home for a worker with primary education is highest in Norway (0.33) while for a secondary or tertiary education worker is maximum in Luxembourg (0.43 and 0.72, respectively). This positive relationship between education and teleworking implies that workers with high education, who tend to earn higher salaries, are likely to be less

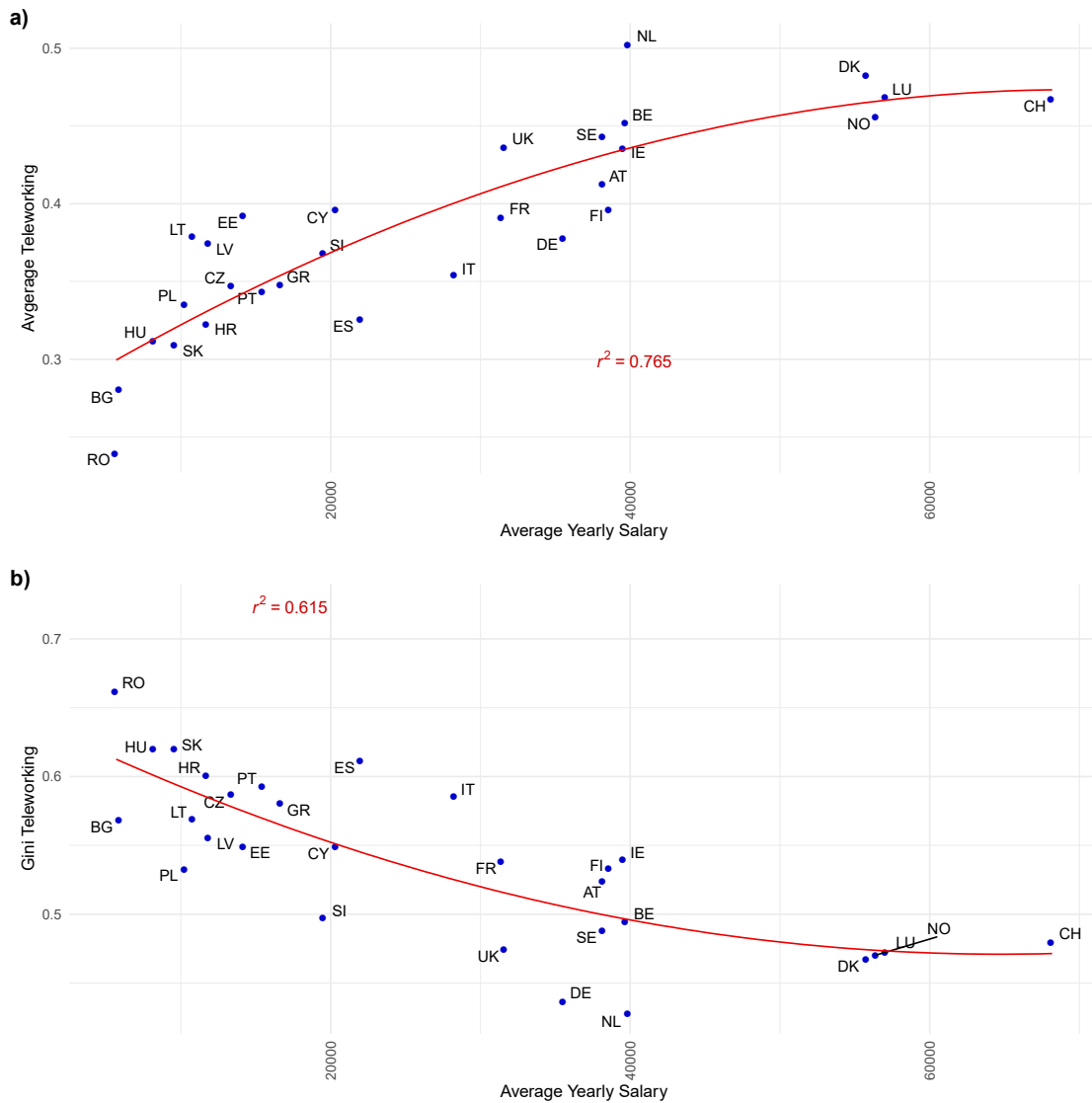
affected by social distancing. However, as governments declare some activities as essential or closed under a lockdown, this outcome might not be straightforward.

**Table 1.** The teleworking index in Europe.

Country	Teleworking	Gender		Type		Contract		Education		
		Male	Female	Permanent	Temporary	Full	Part-time	Low	Medium	High
Austria	0.414	0.380	0.454	0.416	0.477	0.415	0.410	0.146	0.322	0.618
Belgium	0.453	0.420	0.490	0.468	0.370	0.473	0.399	0.145	0.297	0.640
Bulgaria	0.281	0.222	0.347	0.282	0.176	0.284	0.211	0.051	0.172	0.585
Switzerland	0.468	0.454	0.485	0.487	0.429	0.478	0.444	0.194	0.411	0.605
Cyprus	0.397	0.319	0.483	0.429	0.272	0.402	0.346	0.082	0.259	0.632
Czech Republic	0.348	0.300	0.407	0.349	0.331	0.345	0.406	0.082	0.253	0.650
Germany	0.378	0.352	0.407	0.379	0.336	0.394	0.338	0.174	0.316	0.571
Denmark	0.481	0.423	0.544	0.488	0.570	0.487	0.432	0.236	0.376	0.643
Estonia	0.391	0.325	0.459	0.381	0.355	0.394	0.364	0.103	0.251	0.596
Spain	0.326	0.292	0.367	0.367	0.222	0.339	0.232	0.096	0.238	0.531
Finland	0.397	0.350	0.446	0.419	0.391	0.407	0.302	0.201	0.236	0.612
France	0.392	0.330	0.458	0.427	0.310	0.403	0.340	0.189	0.274	0.590
Greece	0.348	0.293	0.424	0.450	0.269	0.356	0.264	0.102	0.249	0.594
Croatia	0.322	0.254	0.405	0.342	0.216	0.322	0.334	0.066	0.215	0.660
Hungary	0.312	0.233	0.400	0.329	0.199	0.317	0.230	0.083	0.189	0.677
Ireland	0.436	0.396	0.484	0.455	0.313	0.474	0.311	0.192	0.310	0.563
Italy	0.355	0.302	0.427	0.376	0.249	0.361	0.318	0.139	0.365	0.613
Lithuania	0.377	0.310	0.443	0.383	0.232	0.382	0.310	0.085	0.168	0.645
Luxembourg	0.469	0.447	0.497	0.482	0.343	0.483	0.402	0.172	0.435	0.718
Latvia	0.375	0.307	0.439	0.369	0.196	0.377	0.357	0.096	0.221	0.641
Netherlands	0.478	0.479	0.477	0.510	0.448	0.506	0.443	0.234	0.362	0.663
Norway	0.462	0.425	0.502	0.471	0.421	0.471	0.390	0.328	0.369	0.607
Poland	0.336	0.264	0.419	0.384	0.243	0.339	0.289	0.079	0.180	0.637
Portugal	0.344	0.292	0.397	0.362	0.296	0.350	0.241	0.142	0.368	0.654
Romania	0.240	0.194	0.306	0.276	0.160	0.253	0.079	0.078	0.127	0.687
Sweden	0.439	0.390	0.494	0.459	0.383	0.454	0.376	0.219	0.356	0.630
Slovenia	0.369	0.308	0.440	0.383	0.311	0.371	0.327	0.064	0.221	0.656
Slovak Republic	0.310	0.242	0.389	0.317	0.232	0.310	0.325	0.083	0.204	0.645
United Kingdom	0.437	0.414	0.462	0.452	0.460	0.465	0.363	0.226	0.324	0.572
Europe	0.380	0.337	0.429	0.393	0.293	0.387	0.346	0.148	0.282	0.599

To end the description of our teleworking index across Europe, we estimate now the correlation between teleworking and the average salary by countries. In Figure 2 (panel a) we observe that the average of teleworking in a country is positively correlated with the average annual salary in that country. Likewise, inequality of teleworking (Gini coefficient) is negatively associated with average annual salary (Figure 2, panel b). Therefore, European countries with higher average salaries seem to be potentially less sensitive to social distancing measures. Again, the existence of activities that are essential or closed under the lockdown will make us arrive at more nuanced findings in terms of the estimated effect on wage inequality, as we will see.

**Figure 2.** Teleworking and average salaries in Europe.



Sources: Authors' analysis from O\*NET, EU-FLS (2018), and EU-SILC (2018).

### 3. Methodology

Teleworking capacity is not the only determinant of workers ability to effectively work and keep their wage during the lockdown period. We need to take into account that some occupations are not affected by the lockdown because they are considered essential –like healthcare or agriculture– while others are fully closed to contain the spread of Covid-19, like accommodation or entertainment. Based on the decisions made by the governments in Italy (Gazzetta Ufficiale della Repubblica Italiana, 23<sup>rd</sup> February and 25<sup>th</sup> March, 2020) and Spain (Boletín Oficial del Estado, 14<sup>th</sup> March and 29<sup>th</sup> March, 2020), thus far, two of

the most affected countries by the pandemic in the world, we have defined the essential and closed occupations at the ISCO-08 2-digit level and NACE (Rev.2) 1-digit level (see the details in Appendix B).<sup>8</sup>

Thus, occupations in “Agriculture, forestry and fishing”, “Public administration and defense”, and “Human health and social work” are considered entirely essential, while “Transportation and storage”, “Information and communication”, and “Financial and insurance services” are classified as partially essential. On the other hand, “Wholesale and retail trade”, “Accommodation and food service activities”, “Arts, entertainment and recreation”, “Other service activities”, and “Activities of households” as Employers are assumed to be closed. In Appendix B (Tables B3-B7) we give a detailed description of our classification of essential and closed occupations by industries.

Having calculated the teleworking index and identified the essential and closed occupations, we construct the Lockdown Working Ability (LWA) index. This measure summarizes the capacity of individuals to work under a lockdown taking into account not only the value of their occupation’s teleworking index, but also if such occupation is essential ( $e$ ) or closed ( $c$ ). The key idea is that essential workers can work during the lockdown (to the extent that their occupation is essential) regardless whether the occupation can be teleworked or not. On the contrary, workers in closed activities cannot work at all to the extent that their overall activity has been closed. In all remaining cases, working capacity will depend on the share of that occupation that can be teleworked.

Formally, the first step in constructing the LWA index requires to split the population of  $n$  workers into three groups according to the occupation  $o_i$  of each worker  $i \in \{1, 2, \dots, n\}$ . If the individual has an occupation that is neither essential nor closed, the value of her  $LWA_i$  index will be equal to the value of her index of teleworking,  $T_i \in [0,1]$ . If the person has an essential job ( $o_i = e$ ), we will compute the LWA index as  $LWA_i = E_i + (1 - E_i)T_i$ , where  $E_i \in (0,1]$  is the essentiality score given to the occupation of the individual. Thus, for partially essential occupations ( $E_i < 1$ ), the non-essential share of the occupation ( $1 - E_i$ ) can work during lockdown only to the extent that it is teleworkable. Finally, if the person has a job that is closed ( $o_i = c$ ), we will calculate the

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<sup>8</sup> Given the level of disaggregation available in EU-SILC for some particular countries, we have defined essential and closed occupations at the ISCO-08 1-digit level and NACE (Rev.2) 1-digit level for Bulgaria, Slovenia and Poland (see Tables B5 and B6 in Appendix B), and only at the ISCO-08 2-digit level for Denmark (see Table B7 in Appendix B).

LWA index as  $LWA_i = (1 - C_i)T_i$ , where  $C_i \in (0,1]$  is the value given to the closed occupation of the individual. In partially closed occupations ( $C_i < 1$ ), the non-closed share of the occupation ( $1 - C_i$ ) can work to the extend that is teleworkable. In summary, the Lockdown Working Ability index is calculated as follows:

$$LWA_i = \begin{cases} E_i + (1 - E_i)T_i & o_i = e \\ (1 - C_i)T_i & o_i = c \\ T_i & o_i \neq e, c \end{cases}, \quad (1)$$

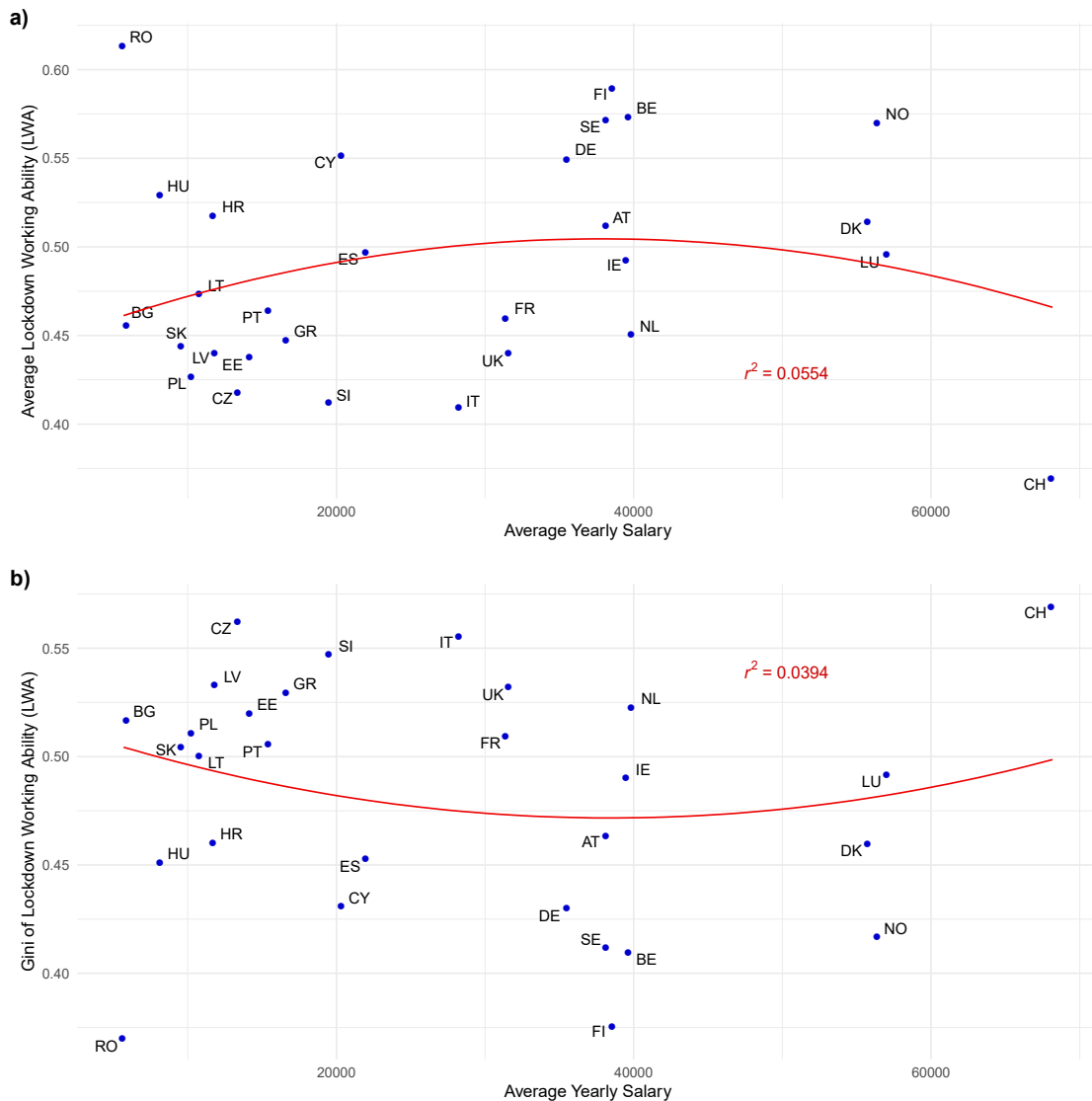
for all  $i \in \{1, 2, \dots, n\}$ .

In Section 2 we showed that the average of teleworking in a country is strongly correlated with the average annual salary of that country. Thus, we argued that, in principle, workers from countries with high average salaries would be less affected by social distancing hinting a potential increase in inequality. However, when we consider the essentiality status of some occupations and the closure of some others under a lockdown, the above correlation vanishes. As we show in Figure 3 (panel a), the correlation between the LWA index and the average annual salary in a country is positive but very small (see the large dispersion of points around the fitted curve). In the same manner, the correlation between the inequality of the LWA index (according to the Gini) and the average annual salary in a country is negative but again very small (Figure 3, panel b). Once essential and closed occupations are considered, the changes in wage inequality caused by the lockdown are difficult to foresee.

The next step is to calculate the potential wage loss due to the lockdown for every individual in the population. We adopt six possible scenarios. In the first three cases we assume three different temporal lengths for the lockdown: *i*) one month; *ii*) two months; and *iii*) four months. In the remaining three cases we add to *i*, *ii*, and *iii* an additional period of six months during which closed occupations can be developed only at 80% of full capacity. The idea behind these last three scenarios is that governments may not allow a fully functioning of closed occupations after the lockdown to avoid a new outbreak of the virus. We simulate the same six scenarios for all European countries so differences across countries are due to their distinct productive structures. Thus, we isolate our

analysis from other potential causes like the particular mitigation measures adopted by each European government.

**Figure 3.** Lockdown Working Ability (LWA) and average salaries in Europe.



Sources: Authors' analysis from O\*NET, EU-FLS (2018), and EU-SILC (2018).

Using the LWA index, we calculate the wage loss ( $wl$ ) experienced by every individual during the lockdown according to the six simulated scenarios described. For the cases *i*, *ii*, and *iii* the equation we estimate is the following:

$$wl_{it} = w_{it-1} \cdot D_t(1 - LWA_i), \quad (2)$$

where  $w_{it-1}$  is the annual wage of individual  $i$  in period  $t - 1$  (before the lockdown) and  $D_t$  represents the duration of the lockdown in annual terms, i.e.,  $D_t = \frac{1}{12}$  for one month,  $D_t = \frac{2}{12}$  for two months, and  $D_t = \frac{4}{12}$  for four months.

For the cases  $iv$ ,  $v$ , and  $vi$  we apply the same equation (2) unless the individual has a closed occupation, in which case, we need to additionally consider the wage loss due to the imposed partial functioning of 80% of their occupation (20% closure) for six additional months. The relevant equation for scenarios  $iv$ ,  $v$ , and  $vi$  is:

$$wl_{it} = w_{it-1} \left[ D_t \cdot (1 - LWA_i) + 1_c \cdot \frac{6}{12} \cdot 0.2 \right], \quad (3)$$

where  $1_c = \begin{cases} 1 & \text{if } o_i = c \\ 0 & \text{if } o_i \neq c \end{cases}$  is the indicator function.

The estimated wage loss of each individual in the population will allow us to analyse the changes in poverty and inequality across Europe under the lockdown. A first view of these changes between dates  $t - 1$  (pre-lockdown) and  $t$  can be achieved by representing the loss rate ( $l$ ) in the wage of every worker caused by the lockdown, i.e.,  $l_{it} = \frac{w_{it} - w_{it-1}}{w_{it-1}} = \frac{wl_{it}}{w_{it-1}}$ , since  $w_{it} = w_{it-1} - wl_{it}$ . For this task we first order the workers by their pre-lockdown wage  $w_{it-1}$  and group them into centiles ( $q$ ), obtaining the mean loss rate  $l_{qt}$  at each centile. The result is the Lockdown Incidence Curve (LIC) where it is easy to appreciate which part of the wage distribution (low, middle, high) suffers the largest relative wage losses.<sup>9</sup> It can be proved that if  $l_{qt}$  is an increasing (decreasing) function

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<sup>9</sup> This curve is an adaptation to our framework of the Growth Incidence Curve (GIC) proposed in Ravallion and Chen (2003). For a view on the literature that studies the capacity of economic growth to reduce poverty see also Kakwani and Pernia (2000), Kakwani and Son (2008) and Duclos (2009), among others.

for all  $q$  then inequality falls (rises) with the lockdown for all inequality measures satisfying the Pigou–Dalton transfer principle.<sup>10</sup>

Closely related to the LIC we have the mean loss rate for the poor.<sup>11</sup> Let  $H(z)$  denote the headcount index defined as the proportion of workers whose salary is less than  $z$ , where  $z$  is the poverty line (60% of the median wage in our case). Then, the mean loss rate for the poor ( $P$ ) is defined as the area under the LIC up to the headcount index divided by the headcount measure and it can be expressed as:

$$P = \frac{1}{H(z)} \sum_{q=1}^{H(z)} l_q. \quad (4)$$

When  $l_q < 0$  for all  $q < H(z)$  one can conclude that the lockdown was poverty augmenting. For the analysis of poverty, we will represent the LICs for the set of European countries and compute the  $P$  index and the relative change in  $H(z)$  for the six scenarios of lockdown. To calculate the absolute change in  $H(z)$ ,  $\Delta^A H(z) = H_t(z) - H_{t-1}(z)$ , we maintain constant the poverty line  $z$  before the lockdown.

After gaining some understanding about the changes in poverty caused by the lockdown, we estimate the changes in wage inequality. Of all the possible inequality indices that fulfill the basic principles found in the literature on inequality (progressive transfers, symmetry, scale invariance and replication of the population) we adopt the Gini coefficient ( $G$ ) and the MLD index. The first measure is the most popular index of inequality and can be expressed as follows:

$$G(w) = \frac{1}{2n^2\mu} \sum_{i=1}^n \sum_{j=1}^n |w_i - w_j| \quad (5)$$

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<sup>10</sup> This result comes from well-known results on tax progressivity and inequality. See, for example, Eichhorn et al. (1984).

<sup>11</sup> This measure is an adaption to our context of the mean growth rate for the poor proposed in Ravallion and Chen (2003). It is equivalent to the rate of change in the Watts index of poverty (Watts, 1968) normalized by the headcount index. Zheng (1993) identifies a large set of axioms for which the Watts index emerges as the unique poverty measure.

where  $w$  represents the wage distribution,  $w_i$  is the salary of individual  $i$ , and  $\mu$  is the mean wage of the economy. Absolute changes in wage inequality are measured as the difference  $\Delta^A G = G(w_t) - G(w_{t-1})$ , where  $w_{t-1}$  is the pre-lockdown wage distribution and  $w_t$  is the wage distribution under a given scenario (cases  $i-vi$ ). Meanwhile, relative changes in wage inequality are measured as percentages of pre-lockdown inequality, i.e.,  $\Delta^R G = \frac{G(w_t) - G(w_{t-1})}{G(w_{t-1})} \times 100$ .

Unfortunately, the broadly used Gini index is not additively decomposable into a between-group component and a within-group component. Its decomposition includes also a residual term which cannot be assigned to the between-group or the within-group component. For this reason, we use the MLD index in the last part of our analysis, where we decompose the overall estimated change of inequality in Europe into its between-countries and within-countries components. The MLD belongs to the Generalized Entropy class which is the only class of inequality indices that is additively decomposable into a between-group and a within-group component (Bourguignon, 1979 and Shorrocks, 1980). Moreover, the MLD has a path-independent decomposition, so the result of the decomposition is independent of which component (between-group or within-group) is eliminated first (Foster and Shneyerov, 2000). In addition, the MLD is the only measure that respects both the principle of transfers -the cornerstone of the literature on inequality measurement- and the principle of monotonicity in distance (Cowell and Flachaire, 2018).<sup>12</sup> The MLD ( $T$ ) is defined as:

$$T(w) = \frac{1}{n} \sum_{i=1}^n \ln \left( \frac{\mu}{w_i} \right). \quad (6)$$

Absolute and relative changes in wage inequality measured by the MLD index will be denoted by  $\Delta^A T = T(w_t) - T(w_{t-1})$  and  $\Delta^R T = \frac{T(w_t) - T(w_{t-1})}{T(w_{t-1})} \times 100$ , respectively.

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<sup>12</sup> Some standard inequality measures like the Gini coefficient can be written as ratios, where the denominator is the mean (see equation (4)). As a result, when earnings move away from equality, both the numerator and denominator can change in the same direction and such inequality measures may decrease (instead of increase) in some cases. This undesirable behaviour is not shared by inequality indices whose denominator is the median. Unfortunately, these indices do not fulfil the principle of transfers, only the MLD satisfies both principles, transfers and monotonicity in distance, simultaneously.

Now, let  $w = (w^1, \dots, w^M)$  be a partition of wage into  $M$  groups (countries),  $\mu_m$  the mean of the wage distribution  $w^m$  and  $n_m$  the population size associated with the wage distribution  $w^m$ , where  $n = \sum_{m=1}^M n_m$ . Then, taking advantage of the additive decomposability property of the MLD and grouping workers by countries, the MLD index can be exactly decomposed as follows:

$$T(w) = T(\mu_1 1^{n_1}, \mu_2 1^{n_2}, \dots, \mu_m 1^{n_m}) + \sum_{m=1}^M \frac{n_m}{n} T(w^m), \quad (7)$$

where  $1^n$  is  $n$ -coordinated vector of ones. Expression (6) provides a breakdown of overall wage inequality into between-group and within-group terms. The between-group component  $T(\mu_1 1^{n_1}, \mu_2 1^{n_2}, \dots, \mu_m 1^{n_m})$  is the level of wage inequality that would arise if each worker in a country enjoys the mean wage of the country, and the within-group component  $\sum_{m=1}^M \frac{n_m}{n} T(w^m)$  is the weighted sum of wage inequalities within different countries. In this manner, the two components of overall wage inequality can be disentangled in our analysis.

#### 4. Inequality changes in Europe

How large are the wage losses experienced by workers during the lockdown? In which part of the wage distribution will the highest wage losses take place? To give an answer to these questions we have calculated the LIC for the set of European countries and simulation cases. In Figure 4 we represent the LICs for a subset of countries under two months of lockdown (case *iii*).<sup>13</sup> First, we show the LIC for three countries, Romania, Poland and Slovakia, where the main wage losses take place at the upper part of the wage distribution (Figure 4, panel a). Second, we represent the LIC for Norway and Greece, two countries where wage losses are distributed quite equally across percentiles (Figure 4, panel b). In the third graph we show the two countries in Europe where wage losses are more concentrated at the bottom of the wage distribution, Cyprus and Ireland (Figure 4, panel c). Finally, we highlight the LIC for Germany, the UK and France (Figure 4,

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<sup>13</sup> Lockdown Incidence Curves have been smoothed using local polynomial regression with span 0.75 and degree 2.

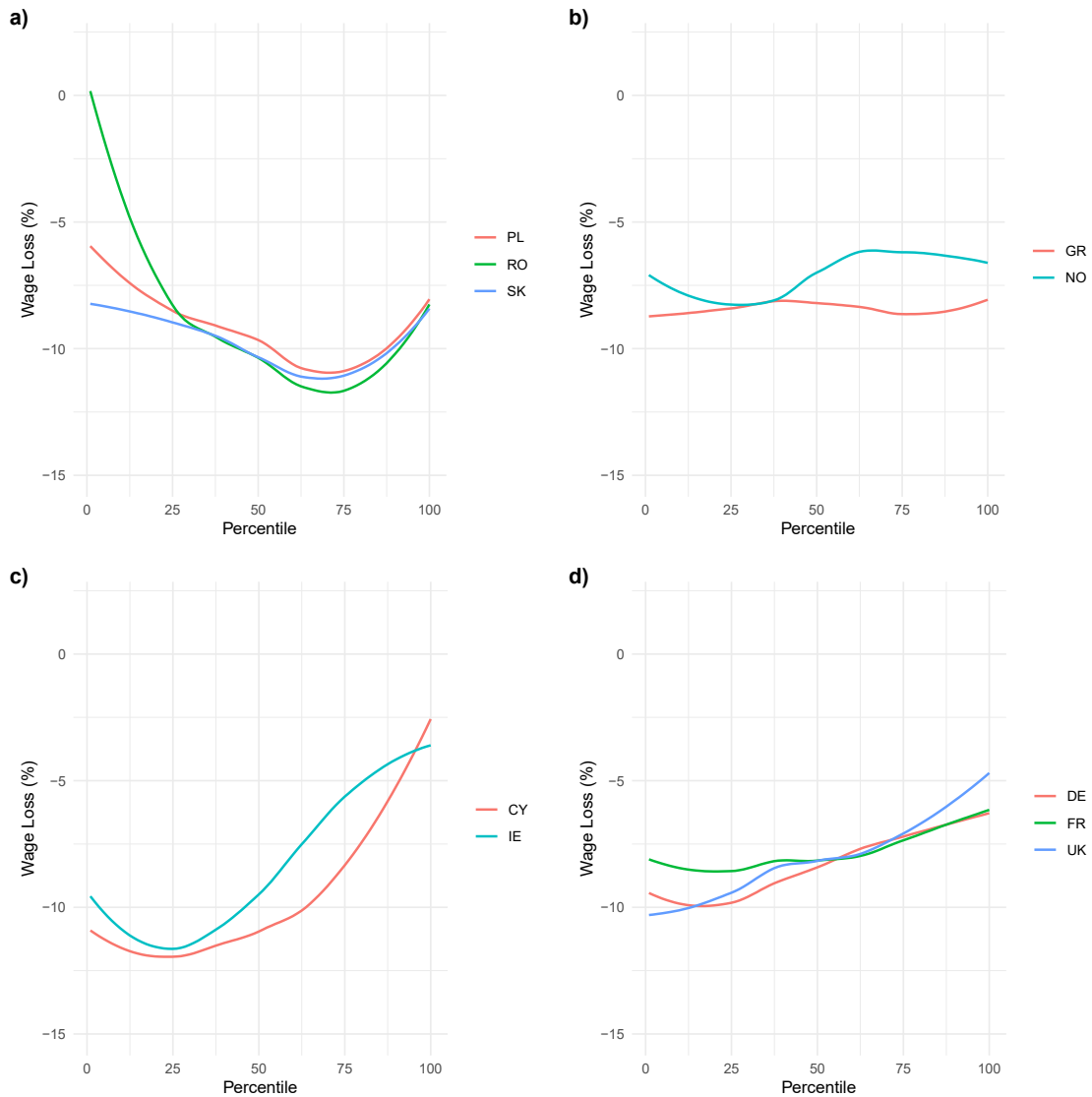
panel d). In this case, wage losses tend to decrease monotonically with the percentile that the worker occupies.

The first relevant thing that we observe in Figure 4 (panels a-d) is that wage losses are sizeable. In fact, in some countries the wage losses at a given percentile can be superior to 10%, see for example, the case of workers at the 75<sup>th</sup> percentile of the wage distribution in Romania, Slovakia and Poland, and of workers at the 25<sup>th</sup> percentile in Cyprus and Ireland. Secondly, in general, wage losses are not equally distributed along the wage distribution since they vary significantly with the centile and the country of the workers. This result can be observed by simply comparing the LICs represented in Figure 4. Third, there is no straightforward relationship between the average wage of a country and its distribution of wage losses caused by the lockdown. For example, we observe that the distribution of wage losses is similar for Norway and Greece, and Ireland and Cyprus, despite that these countries have significantly different average wages. The distribution of wage losses is similar when other scenarios of simulation (not shown here) are considered, and the main difference lies only in the size of the wage drop. As the lockdown period gets longer, and when the partial closure of some activities is considered, wage losses get bigger.

#### 4.1 Changes in poverty due to enforced social distancing

Let us estimate the change in poverty in a formal way by computing the mean loss rate for the poor  $P$ . In Table 2 (columns 2-7) we show this measure for the six simulations under consideration. It is observed that the lockdown is poverty augmenting in all simulated cases for all European countries. For example, under a lockdown of two months, we find a mean loss rate for the poor equal to 10.3% for Europe as a whole. If we also consider a 6-month period of partial functioning of closed activities (scenario  $v$ ), the mean loss rate for the poor in Europe increases up to 22.3%. By countries, the mean loss rates reported in Table 2 are also sizeable and consistent with what the LICs distribution pointed at. Thus, regardless the simulation scenario undertaken, the highest loss for the poor is found in Cyprus (for example, 12.2% for case  $ii$ ), while the smallest one happens in Romania (3.1% for case  $ii$ ). The complete ordering of European countries according to the mean loss rate for the poor under a lockdown of 2 months is shown in Figure 5.

**Figure 4.** Lockdown Incidence Curves in Europe (scenario *ii*).

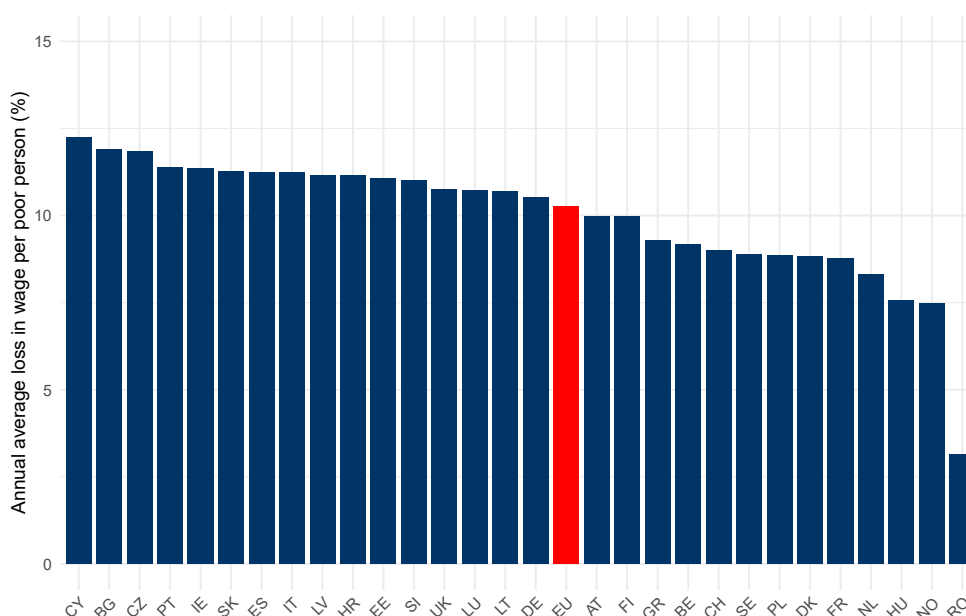


Sources: Authors' analysis from O\*NET, EU-FLS (2018), and EU-SILC (2018).

Despite that the headcount index is not necessarily consistent with the LIC (see Essama-Nssah and Lambert, 2009), we also calculate the absolute change of this index. In Table 2 (columns 8-20) we present the results for the headcount index under the six simulated scenarios. Again, poverty increases for all simulated cases and all European countries. Also, changes in poverty according to the headcount index are important. For example, in Europe as a whole, this measure increases 3 percentage points under two months of lockdown and 10 percentage points if we consider an additional period of six months during which closed activities are partially functioning at 80%. These values imply that—in absence of compensating policies—the percentage of poor people in Europe may

substantially increase even if lockdown does not last long. By countries, we find that the highest increase in poverty according to the headcount index is found in Croatia (cases *i*, *ii*, *iii*, *iv*, *vi*) and Cyprus (cases *v*). On the contrary, the smallest percentage increase in poverty according to the headcount index happens in Romania (case *i*), Switzerland (case *ii*), the Netherlands (case *iii*) and Denmark (cases *iv*, *v* and *vi*).

**Figure 5.** Mean loss rates for the poor in Europe (scenario *ii*).



Sources: Authors' analysis from O\*NET, EU-FLS (2018), and EU-SILC (2018).

#### 4.2 Inequality changes in Europe

Now, we calculate the absolute and relative changes in wage inequality caused by the lockdown, but first we comment on initial wage inequality (baseline) across Europe (Tables 3 and 4). The ordering of European countries according to their initial wage inequality is similar for both the Gini and the MLD indices. Thus, Slovakia is clearly the European country with the lowest pre-lockdown wage inequality. Other countries with low levels of wage inequality before the lockdown are Sweden, Czechia, Belgium and Norway, all of them with a Gini index below 0.30. On the other extreme of the spectrum,

we find the countries with the highest level of pre-lockdown wage inequality: Bulgaria, Ireland, the UK and Spain, all of them with a Gini index above 0.40.

When comparing wage inequality after the lockdown with the baseline, it is observed that changes in inequality are sizeable and increase in all countries with the duration of the lockdown and the partial closure of some activities regardless the inequality index under consideration (Tables 3 and 4). According to the Gini coefficient, increase at scenario *ii* ranges from 2.2% (the Netherlands) to 4.9% (Cyprus). At the more extreme scenario *v* the Gini inequality increases range from 9.5% (Denmark) to 21.2% (Slovakia). Cyprus shows the greatest increase in inequality in cases *i*, *ii* and *iv*, while Slovakia does in cases *iii*, *v* and *vi*. At the other end Norway (scenario *i*), the Netherlands (scenarios *ii* and *iii*), Denmark (scenarios *iv* and *v*) and Germany (scenario *vi*) present the lowest values.

The relative changes can be partly determined by the initial level of inequality (Slovakia has the lowest baseline wage inequality) and a scrutiny of the absolute changes in the Gini coefficient reveals that Cyprus is the European country where inequality increases the most in absolute terms for all simulation cases. For example, at our scenario *ii* Cyprus shows an increase of 1.9 Gini points (in percentage). On the other hand, the smallest absolute change in inequality is found in Norway (scenarios *i* and *ii*), the Netherlands (scenarios *iii* and *vi*) and Denmark (scenarios *iv* and *v*). For scenario *ii*, Norway shows an absolute inequality increase of 0.7 Gini points (in percentage).

The MLD index –as can be expected– is in general more sensitive to the simulated wage losses in our lockdown scenarios, showing higher relative changes in inequality than Gini in all countries. Czechia experiences the highest absolute change in wage inequality for cases *i*, *ii* and *iii*, and Croatia for the other three cases. About relative changes in inequality, Slovakia -which has high absolute changes and the lowest baseline MLD index- shows the largest values for all the simulation scenarios. Finally, Romania has the smallest increase in absolute and relative wage inequality for all cases.

Our findings show an increase in inequality for all European countries but, would inequality changes be different enough to increase inequality between countries? The short answer is yes; the long answer is yes, but much less than the inequality changes occurring within countries. In Table 5 we show the results of the decomposition of wage inequality for all European workers.

**Table 2. Poverty changes in Europe.**

Country	Mean Loss Rate for the Poor (P)						Headcount Index (H)												
	P 1m	P 2m	P 4m	P 1m+CL	P 2m+CL	P 4m+CL	H	H 1m	$\Delta^A H$	H 2m	$\Delta^A H$	H 4m	$\Delta^A H$	H 1m+CL	$\Delta^A H$	H 2m+CL	$\Delta^A H$	H 4m+CL	$\Delta^A H$
Austria	5.0	10.0	20.0	18.8	23.8	33.8	0.250	0.269	0.019	0.290	0.040	0.349	0.098	0.339	0.088	0.360	0.109	0.418	0.168
Belgium	4.6	9.2	18.3	15.2	19.8	29.0	0.177	0.193	0.016	0.216	0.039	0.278	0.101	0.275	0.098	0.305	0.128	0.360	0.183
Bulgaria	5.9	11.9	23.8	18.2	24.1	36.0	0.230	0.250	0.021	0.283	0.053	0.370	0.141	0.342	0.113	0.387	0.157	0.478	0.249
Switzerland	4.5	9.0	18.0	18.1	22.7	31.7	0.254	0.265	0.011	0.279	0.026	0.335	0.082	0.339	0.086	0.364	0.111	0.412	0.158
Cyprus	6.1	12.2	24.5	26.3	32.4	44.7	0.217	0.243	0.026	0.278	0.062	0.370	0.153	0.386	0.170	0.430	0.214	0.505	0.288
Czechia	5.9	11.8	23.7	19.4	25.3	37.2	0.153	0.182	0.029	0.209	0.056	0.309	0.156	0.266	0.112	0.300	0.146	0.388	0.234
Germany	5.3	10.5	21.0	19.4	24.6	35.1	0.271	0.288	0.016	0.309	0.037	0.359	0.088	0.348	0.077	0.375	0.103	0.421	0.150
Denmark	4.4	8.8	17.6	12.1	16.5	25.3	0.155	0.169	0.014	0.184	0.029	0.242	0.087	0.202	0.047	0.227	0.072	0.291	0.135
Estonia	5.5	11.1	22.1	17.9	23.4	34.5	0.237	0.262	0.024	0.288	0.051	0.355	0.118	0.334	0.097	0.366	0.129	0.440	0.203
Spain	5.6	11.2	22.5	21.6	27.2	38.5	0.259	0.280	0.022	0.310	0.051	0.375	0.116	0.378	0.119	0.413	0.154	0.476	0.217
Finland	5.0	10.0	19.9	17.3	22.3	32.3	0.177	0.194	0.017	0.216	0.040	0.292	0.116	0.286	0.109	0.319	0.142	0.382	0.205
France	4.4	8.8	17.5	14.6	19.0	27.7	0.202	0.214	0.013	0.236	0.035	0.311	0.110	0.306	0.104	0.336	0.135	0.398	0.197
Greece	4.6	9.3	18.6	20.2	24.8	34.1	0.228	0.255	0.026	0.279	0.050	0.349	0.121	0.366	0.137	0.408	0.179	0.486	0.258
Croatia	5.6	11.2	22.3	18.9	24.4	35.6	0.153	0.196	0.043	0.238	0.085	0.356	0.203	0.323	0.170	0.365	0.212	0.468	0.315
Hungary	3.8	7.6	15.1	12.4	16.1	23.7	0.155	0.170	0.015	0.195	0.041	0.302	0.147	0.262	0.108	0.304	0.149	0.390	0.235
Ireland	5.7	11.4	22.7	22.8	28.4	39.8	0.268	0.293	0.026	0.316	0.048	0.381	0.114	0.375	0.107	0.401	0.134	0.457	0.190
Italy	5.6	11.2	22.5	22.3	28.0	39.2	0.225	0.244	0.019	0.269	0.044	0.345	0.120	0.341	0.115	0.376	0.151	0.447	0.221
Lithuania	5.4	10.7	21.4	17.4	22.8	33.5	0.229	0.267	0.037	0.302	0.073	0.373	0.144	0.349	0.120	0.387	0.158	0.461	0.231
Luxembourg	5.4	10.7	21.4	19.0	24.3	35.0	0.215	0.243	0.028	0.283	0.068	0.355	0.140	0.317	0.102	0.343	0.128	0.406	0.191
Latvia	5.6	11.2	22.3	18.5	24.1	35.3	0.226	0.256	0.030	0.286	0.060	0.362	0.136	0.332	0.106	0.367	0.142	0.442	0.216
Netherlands	4.2	8.3	16.6	16.5	20.7	29.0	0.242	0.257	0.015	0.276	0.035	0.322	0.080	0.326	0.084	0.348	0.107	0.396	0.155
Norway	3.7	7.5	14.9	11.9	15.6	23.1	0.178	0.195	0.018	0.221	0.044	0.289	0.111	0.290	0.112	0.321	0.143	0.382	0.204
Polonia	4.4	8.9	17.7	14.8	19.2	28.1	0.147	0.180	0.033	0.227	0.080	0.323	0.177	0.275	0.128	0.323	0.177	0.407	0.260
Portugal	5.7	11.4	22.8	19.9	25.6	37.0	0.128	0.147	0.019	0.178	0.049	0.303	0.174	0.267	0.139	0.303	0.174	0.412	0.284
Romania	1.6	3.1	6.3	3.5	5.1	8.2	0.193	0.201	0.008	0.221	0.028	0.346	0.153	0.309	0.115	0.357	0.164	0.472	0.279
Sweden	4.4	8.9	17.8	15.2	19.6	28.5	0.186	0.201	0.015	0.220	0.034	0.283	0.097	0.286	0.100	0.318	0.132	0.381	0.195
Slovenia	5.5	11.0	22.0	16.7	22.2	33.2	0.181	0.201	0.020	0.238	0.057	0.344	0.163	0.297	0.116	0.333	0.152	0.420	0.239
Slovakia	5.6	11.3	22.6	17.7	23.4	34.6	0.117	0.141	0.024	0.180	0.063	0.283	0.166	0.252	0.135	0.307	0.190	0.404	0.287
UK	5.4	10.8	21.5	20.2	25.5	36.3	0.259	0.277	0.018	0.296	0.037	0.352	0.092	0.349	0.090	0.378	0.119	0.432	0.173
Europe	5.1	10.3	20.6	17.2	22.3	32.6	0.321	0.336	0.015	0.352	0.031	0.395	0.073	0.393	0.072	0.419	0.098	0.471	0.150

Note: P is the mean loss rate for the poor and H is the headcount index. CL is partial closure, while 1m, 2m and 3m refer to 1 month, 2 months and 3 months, respectively.  $\Delta^A H$  is the change in the headcount index.

**Table 3.** Wage inequality changes in Europe (Gini).

Country	Baseline	G 1m	$\Delta^A G$	$\Delta^R G$	G 2m	$\Delta^A G$	$\Delta^R G$	G 4m	$\Delta^A G$	$\Delta^R G$	G 1m+CL	$\Delta^A G$	$\Delta^R G$	G 2m+CL	$\Delta^A G$	$\Delta^R G$	G 4m+CL	$\Delta^A G$	$\Delta^R G$
Austria	0.388	0.393	0.005	1.4	0.400	0.012	3.2	0.420	0.032	8.2	0.422	0.033	8.6	0.434	0.046	11.8	0.467	0.079	20.4
Belgium	0.296	0.300	0.004	1.4	0.306	0.010	3.5	0.325	0.029	9.9	0.326	0.030	10.2	0.339	0.043	14.5	0.373	0.078	26.3
Bulgaria	0.442	0.449	0.006	1.4	0.456	0.014	3.2	0.477	0.035	7.8	0.480	0.038	8.6	0.495	0.052	11.9	0.534	0.092	20.7
Switzerland	0.370	0.374	0.004	1.1	0.380	0.010	2.6	0.397	0.027	7.2	0.400	0.030	8.1	0.412	0.042	11.4	0.446	0.075	20.3
Cyprus	0.388	0.397	0.009	2.2	0.407	0.019	4.9	0.434	0.046	11.9	0.447	0.058	15.0	0.466	0.078	20.0	0.516	0.128	32.9
Czechia	0.296	0.302	0.006	2.1	0.310	0.014	4.8	0.333	0.038	12.8	0.329	0.033	11.2	0.343	0.047	16.0	0.383	0.088	29.7
Germany	0.391	0.396	0.004	1.1	0.401	0.010	2.6	0.417	0.026	6.7	0.423	0.032	8.2	0.434	0.043	10.9	0.463	0.071	18.2
Denmark	0.304	0.310	0.005	1.7	0.317	0.012	4.0	0.337	0.033	10.7	0.323	0.019	6.2	0.333	0.029	9.5	0.361	0.056	18.4
Estonia	0.362	0.367	0.005	1.4	0.373	0.011	3.1	0.393	0.031	8.4	0.395	0.033	9.2	0.408	0.046	12.8	0.445	0.083	22.8
Spain	0.405	0.412	0.007	1.6	0.420	0.015	3.7	0.442	0.037	9.1	0.448	0.042	10.5	0.463	0.057	14.1	0.502	0.096	23.8
Finland	0.318	0.323	0.005	1.4	0.329	0.011	3.5	0.349	0.031	9.7	0.350	0.031	9.8	0.363	0.045	14.0	0.400	0.082	25.7
France	0.365	0.368	0.003	1.0	0.373	0.009	2.3	0.390	0.025	6.8	0.389	0.025	6.8	0.401	0.036	9.9	0.433	0.069	18.8
Greece	0.368	0.372	0.004	1.2	0.379	0.011	2.9	0.397	0.029	8.0	0.409	0.041	11.1	0.424	0.056	15.2	0.465	0.097	26.4
Croatia	0.322	0.328	0.007	2.0	0.337	0.015	4.7	0.361	0.039	12.2	0.368	0.046	14.3	0.385	0.063	19.6	0.431	0.109	34.0
Hungary	0.346	0.350	0.004	1.2	0.356	0.010	2.9	0.375	0.029	8.3	0.374	0.028	8.0	0.386	0.040	11.5	0.420	0.074	21.4
Ireland	0.430	0.437	0.007	1.7	0.446	0.016	3.8	0.469	0.039	9.0	0.472	0.042	9.9	0.487	0.057	13.2	0.523	0.094	21.8
Italy	0.377	0.382	0.005	1.5	0.389	0.013	3.4	0.410	0.033	8.9	0.415	0.039	10.2	0.429	0.053	14.0	0.469	0.092	24.5
Lithuania	0.400	0.406	0.006	1.5	0.413	0.013	3.4	0.434	0.034	8.6	0.431	0.032	7.9	0.445	0.046	11.5	0.485	0.085	21.3
Luxembourg	0.390	0.398	0.008	2.0	0.407	0.017	4.3	0.429	0.039	9.9	0.427	0.036	9.3	0.440	0.050	12.8	0.474	0.084	21.5
Latvia	0.383	0.390	0.007	1.8	0.399	0.015	4.0	0.421	0.038	9.9	0.420	0.037	9.6	0.435	0.051	13.4	0.473	0.090	23.4
Netherlands	0.366	0.369	0.003	0.9	0.374	0.008	2.2	0.388	0.022	6.1	0.393	0.028	7.6	0.404	0.038	10.5	0.433	0.067	18.4
Norway	0.300	0.302	0.003	0.8	0.307	0.007	2.3	0.322	0.023	7.6	0.330	0.030	10.0	0.341	0.042	13.9	0.375	0.075	25.1
Polonia	0.333	0.338	0.005	1.5	0.345	0.012	3.6	0.365	0.032	9.5	0.371	0.038	11.5	0.385	0.052	15.6	0.423	0.090	26.9
Portugal	0.395	0.403	0.008	2.0	0.413	0.017	4.4	0.438	0.043	10.8	0.436	0.040	10.2	0.452	0.057	14.4	0.495	0.099	25.1
Romania	0.343	0.347	0.005	1.4	0.354	0.012	3.4	0.374	0.032	9.3	0.372	0.030	8.7	0.387	0.044	12.9	0.428	0.085	25.0
Sweden	0.289	0.294	0.004	1.4	0.300	0.010	3.6	0.320	0.031	10.7	0.322	0.033	11.2	0.336	0.046	15.9	0.373	0.084	29.0
Slovenia	0.328	0.335	0.007	2.1	0.343	0.015	4.7	0.366	0.039	11.8	0.363	0.035	10.8	0.378	0.050	15.3	0.418	0.090	27.5
Slovakia	0.254	0.259	0.005	1.8	0.266	0.012	4.6	0.289	0.035	13.7	0.292	0.038	14.9	0.308	0.054	21.2	0.354	0.100	39.2
UK	0.423	0.428	0.005	1.3	0.435	0.012	2.8	0.453	0.030	7.1	0.456	0.034	7.9	0.469	0.046	10.8	0.501	0.079	18.6
Europe	0.453	0.458	0.004	1.0	0.463	0.010	2.2	0.479	0.026	5.6	0.481	0.028	6.2	0.492	0.039	8.5	0.521	0.068	15.0

Note: G is the Gini index. CL is partial closure, while 1m, 2m and 3m refer to 1 month, 2 months and 3 months, respectively.  $\Delta^A G$  is the absolute change in wage inequality, while  $\Delta^R G$  is the relative change (%) in wage inequality.

**Table 4.** Wage inequality changes in Europe (MLD).

Country	Baseline	T 1m	$\Delta^A T$	$\Delta^R T$	T 2m	$\Delta^A T$	$\Delta^R T$	T 4m	$\Delta^A T$	$\Delta^R T$	T 1m+CL	$\Delta^A T$	$\Delta^R T$	T 2m+CL	$\Delta^A T$	$\Delta^R T$	T 4m+CL	$\Delta^A T$	$\Delta^R T$
Austria	0.327	0.393	0.066	20.3	0.400	0.073	22.4	0.420	0.093	28.3	0.422	0.094	28.9	0.434	0.107	32.6	0.467	0.140	42.8
Belgium	0.185	0.300	0.115	61.9	0.306	0.121	65.1	0.325	0.140	75.4	0.326	0.141	75.8	0.339	0.153	82.7	0.373	0.188	101.5
Bulgaria	0.377	0.449	0.071	19.0	0.456	0.079	21.0	0.477	0.100	26.5	0.480	0.103	27.4	0.495	0.118	31.2	0.534	0.157	41.6
Switzerland	0.306	0.374	0.069	22.4	0.380	0.074	24.3	0.397	0.091	29.8	0.400	0.095	31.0	0.412	0.107	34.9	0.446	0.140	45.7
Cyprus	0.281	0.397	0.116	41.1	0.407	0.126	44.8	0.434	0.153	54.5	0.447	0.165	58.8	0.466	0.185	65.6	0.516	0.235	83.4
Czechia	0.160	0.302	0.141	88.2	0.310	0.149	93.3	0.333	0.173	108.0	0.329	0.168	105.0	0.343	0.183	114.0	0.383	0.223	139.1
Germany	0.329	0.396	0.066	20.1	0.401	0.072	21.9	0.417	0.088	26.7	0.423	0.094	28.5	0.434	0.105	31.7	0.463	0.133	40.5
Denmark	0.221	0.310	0.089	40.2	0.317	0.096	43.3	0.337	0.116	52.7	0.323	0.103	46.4	0.333	0.112	50.9	0.361	0.140	63.2
Estonia	0.269	0.367	0.098	36.6	0.373	0.105	39.0	0.393	0.124	46.2	0.395	0.127	47.1	0.408	0.140	52.0	0.445	0.176	65.6
Spain	0.345	0.412	0.067	19.5	0.420	0.076	21.9	0.442	0.098	28.3	0.448	0.103	29.9	0.463	0.118	34.2	0.502	0.157	45.6
Finland	0.220	0.323	0.103	46.5	0.329	0.109	49.4	0.349	0.129	58.5	0.350	0.129	58.7	0.363	0.143	64.7	0.400	0.180	81.7
France	0.285	0.368	0.084	29.4	0.373	0.089	31.2	0.390	0.105	36.9	0.389	0.105	36.8	0.401	0.116	40.8	0.433	0.149	52.3
Greece	0.288	0.372	0.084	29.2	0.379	0.090	31.3	0.397	0.109	37.8	0.409	0.121	41.8	0.424	0.136	47.0	0.465	0.177	61.4
Croatia	0.192	0.328	0.136	71.1	0.337	0.145	75.5	0.361	0.169	88.1	0.368	0.176	91.6	0.385	0.193	100.5	0.431	0.239	124.6
Hungary	0.264	0.350	0.086	32.6	0.356	0.092	34.8	0.375	0.110	41.8	0.374	0.110	41.5	0.386	0.122	46.0	0.420	0.156	59.0
Ireland	0.358	0.437	0.079	22.0	0.446	0.088	24.5	0.469	0.110	30.8	0.472	0.114	31.8	0.487	0.128	35.8	0.523	0.165	46.0
Italy	0.279	0.382	0.103	37.1	0.389	0.111	39.7	0.410	0.131	47.1	0.415	0.136	48.9	0.429	0.151	54.1	0.469	0.190	68.2
Lithuania	0.308	0.406	0.097	31.6	0.413	0.105	34.1	0.434	0.126	40.9	0.431	0.123	40.0	0.445	0.137	44.6	0.485	0.177	57.3
Luxembourg	0.292	0.398	0.106	36.2	0.407	0.115	39.2	0.429	0.137	46.8	0.427	0.134	46.0	0.440	0.148	50.7	0.474	0.182	62.3
Latvia	0.280	0.390	0.111	39.6	0.399	0.119	42.6	0.421	0.142	50.7	0.420	0.141	50.3	0.435	0.155	55.5	0.473	0.194	69.2
Netherlands	0.272	0.369	0.097	35.7	0.374	0.102	37.5	0.388	0.116	42.7	0.393	0.121	44.7	0.404	0.132	48.6	0.433	0.161	59.2
Norway	0.199	0.302	0.103	51.6	0.307	0.107	53.8	0.322	0.123	61.7	0.330	0.130	65.4	0.341	0.142	71.3	0.375	0.176	88.2
Polonia	0.217	0.338	0.121	55.7	0.345	0.128	58.8	0.365	0.148	67.9	0.371	0.154	70.9	0.385	0.168	77.2	0.423	0.205	94.5
Portugal	0.279	0.403	0.124	44.5	0.413	0.134	48.0	0.438	0.159	57.0	0.436	0.157	56.2	0.452	0.173	62.1	0.495	0.216	77.3
Romania	0.317	0.347	0.031	9.7	0.354	0.037	11.8	0.374	0.058	18.2	0.372	0.056	17.5	0.387	0.070	22.1	0.428	0.111	35.1
Sweden	0.192	0.294	0.101	52.8	0.300	0.108	56.1	0.320	0.128	66.8	0.322	0.130	67.6	0.336	0.143	74.7	0.373	0.181	94.4
Slovenia	0.215	0.335	0.119	55.4	0.343	0.128	59.4	0.366	0.151	70.2	0.363	0.148	68.7	0.378	0.163	75.6	0.418	0.203	94.1
Slovakia	0.123	0.259	0.136	110.9	0.266	0.143	116.7	0.289	0.166	135.6	0.292	0.169	138.0	0.308	0.185	151.0	0.354	0.231	188.3
UK	0.349	0.428	0.079	22.7	0.435	0.086	24.6	0.453	0.104	29.8	0.456	0.108	30.8	0.469	0.120	34.3	0.501	0.153	43.7
Europe	0.421	0.458	0.037	8.7	0.463	0.042	10.1	0.479	0.058	13.8	0.481	0.060	14.3	0.492	0.071	16.9	0.521	0.100	23.8

Note: T is the Mean Logarithmic Deviation. CL is partial closure, while 1m, 2m and 3m refer to 1 month, 2 months and 3 months, respectively.  $\Delta^A T$  is the absolute change in wage inequality, while  $\Delta^R T$  is the relative change (%) in wage inequality.

Our lockdown simulations show, an increase in overall inequality in workers' salary. For example, total inequality in Europe increases 4.27% (0.421 to 0.439) according to the MLD index under a lockdown of two months. For the same scenario, the changes in the between- and within-countries inequality components are 2.44% (from 0.125 to 0.128) and 5.04% (from 0.296 to 0.311), respectively. Thus, both components of overall inequality increase, although their change is not the same, the within-countries inequality component increases significantly more than the between-countries inequality component. That is, cohesion between European countries decreases with the lockdown, although the main change in wage inequality happens within European countries. With the duration of the lockdown and the partial closure of some activities, the value of the changes gets bigger and the double process of wage divergence (between and within) deepens in Europe.

**Table 5.** The between- and within-countries inequality components in Europe.

	Gini	T (MLD)	T <sup>BT</sup>	%	T <sup>WT</sup>	%
<b>BASELINE</b>	0.453	0.421	0.125	29.7	0.296	70.3
<b>Lockdown 1m</b>	0.458	0.429	0.127	29.5	0.302	70.5
$\Delta^A$	0.004	0.008	0.001		0.006	
$\Delta^R$	<b>0.97</b>	<b>1.86</b>	<b>1.17</b>		<b>2.16</b>	
<b>Lockdown 2m</b>	0.463	0.439	0.128	29.2	0.311	70.8
$\Delta^A$	0.010	0.018	0.003		0.015	
$\Delta^R$	<b>2.20</b>	<b>4.27</b>	<b>2.44</b>		<b>5.04</b>	
<b>Lockdown 4m</b>	0.479	0.469	0.132	28.2	0.337	71.8
$\Delta^A$	0.026	0.048	0.007		0.041	
$\Delta^R$	<b>5.65</b>	<b>11.32</b>	<b>5.38</b>		<b>13.83</b>	
<b>Lockdown 1m + Partial Closure 6m</b>	0.481	0.480	0.130	27.1	0.350	72.9
$\Delta^A$	0.028	0.059	0.005		0.054	
$\Delta^R$	<b>6.16</b>	<b>13.96</b>	<b>3.70</b>		<b>18.31</b>	
<b>Lockdown 2m + Partial Closure 6m</b>	0.492	0.504	0.132	26.1	0.373	73.9
$\Delta^A$	0.039	0.083	0.007		0.077	
$\Delta^R$	<b>8.51</b>	<b>19.78</b>	<b>5.24</b>		<b>25.94</b>	
<b>Lockdown 4m + Partial Closure 6m</b>	0.521	0.583	0.136	23.4	0.447	76.6
$\Delta^A$	0.068	0.162	0.011		0.151	
$\Delta^R$	<b>14.96</b>	<b>38.48</b>	<b>8.82</b>		<b>51.03</b>	

Note:  $\Delta^A$  is the absolute change in wage inequality;  $\Delta^R$  is the relative change (%) in wage inequality.

## 5. Conclusions

The emergency measures adopted to contain the spread of Covid-19 all around the world are mainly based on social distancing. Unfortunately, the supply shock due to the paralysis of production imposed by the contention measures implies high economic costs to our economies in terms of GDP contraction. Moreover, given the uneven impact of social enforced distancing on different occupations and industries, these measures could have relevant distributional implications. In this paper, we have explored such effects and evaluated the potential impact of enforced social distancing on poverty and wage inequality for Europe.

Under a lockdown, only workers with essential and non-closed teleworkable occupations can work. Aiming to measure the exposure to wage loss for workers unable to work in this circumstance, we first have computed a teleworking index for all occupations. We observe that average teleworking varies significantly not only across countries (from 0.24 in Romania to 0.48 in Denmark), but also by gender, type of work, type of contract and level of education. Then, considering also the differential status of essential workers and the closure of some activities, we have derived the Lockdown Working Ability index. With this index at hand we have estimated the potential wage losses experienced by European workers under six possible lockdown scenarios corresponding to short- and medium-run.

Poverty increases for the mean loss rate of the poor and the headcount index under all simulations in all countries. And these increases are quite substantial: under a lockdown of two months, the mean loss rate for the poor would be of 10.3% of the wage and the headcount index would increase 3 percentage points on average in Europe. Nonetheless, the poverty changes vary with the European country under consideration. Likewise, wage inequality increases for both the Gini and the MLD indices under all simulations in all countries. Thus, under a lockdown of two months, the changes in the Gini coefficient and the MLD index are 2.2% and 10.1% for Europe as a whole, respectively. Again, changes are sizeable and would increase with the duration of the lockdown and when considering an additional partial closure of some activities in all countries during the de-escalation period. Considering 6 months of partial closure after a two-month lockdown, we estimate a Gini increase of 8.5% in overall Europe, a mean loss rate of 22.3% for the poor workers and a change of 9.8 percentage points in the poverty headcount index. For the decomposition of overall inequality in Europe, both within countries and between

countries inequality increase with the duration of the lockdown and the partial closure of some activities. For example, under a lockdown of two months, within-countries inequality increases 5.0%, while between-countries inequality increases 2.4%. Therefore, in absence of any public policy across Europe, a lockdown will most probably worsen cohesion in Europe, not only between countries but especially within countries.

Our analysis of the potential effects that social distancing can have on workers all around Europe is certainly not complete and leaves out other relevant dimensions. As said in the Introduction, our analysis does not consider the demand-side changes due to individuals' response to the pandemic, nor the subsequent second-order effects in supply. These effects are clearly important but difficult to estimate at this early stage. We also ignore other welfare dimensions that could be certainly affected by the pandemic, like health. While essential workers may be more likely to keep working during the lockdown and not suffer wage losses, many of them –like health and other frontline workers– face a greater exposure to the disease (Barbieri et al., 2020). This could make this group of workers to be the most affected if health inequalities were considered.

Nonetheless, and even without accounting for second round effects that could reinforce this asymmetric impact, our limited analysis already reveals a sizable potential increase in poverty and inequality in European countries. The results of this paper are by no means a call for the early relaxation of containment measures since not properly stopping the pandemic could have devastating effects for the society as a whole. On the contrary, our paper flags up the potential distributional consequences social distancing may have if counteracting public policies are not implemented.

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## Appendix A: Industries and occupations in the EU-LFS and EU-SILC databases.

**Table 1.** ISCO-08 and NACE digit levels by countries in EU-LFS and EU-SILC.

		EU-LFS		EU-SILC		Indexes (EU-SILC)		
	Country	ISCO	NACE	ISCO	NACE	Teleworking	Essential	Closed
AT	Austria	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
BE	Belgium	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
BG	Bulgaria*	2d	1d	1d	1d	ISCO 1d	I(1d) N(1d)	I(1d) N(1d)
CH	Switzerland	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
CY	Cyprus	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
CZ	Czech Republic	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
DE	Germany*	3d	1d	1d	1d	ISCO 2d	I(1d) N(1d)	I(1d) N(1d)
DK	Denmark*	3d	No info	2d	No info	ISCO 2d	I(2d)	I(2d)
EE	Estonia	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
ES	Spain	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
FI	Finland	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
FR	France	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
GR	Greece	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
HR	Croatia	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
HU	Hungary	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
IE	Ireland	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
IT	Italy	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
LT	Lithuania	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
LU	Luxembourg	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
LV	Latvia	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
NL	The Netherlands	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
NO	Norway	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
PL	Poland*	2d	1d	1d	1d	ISCO 1d	I(1d) N(1d)	I(1d) N(1d)
PT	Portugal	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
RO	Romania	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
SE	Sweden	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
SI	Slovenia*	2d	1d	1d	1d	ISCO 1d	I(1d) N(1d)	I(1d) N(1d)
SK	Slovak Republic	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)
UK	United Kingdom	3d	1d	2d	1d	ISCO 2d	I(2d) N(1d)	I(2d) N(1d)

Note: “d” means digit; “I” is for ISCO and “N” is for NACE in columns 8 and 9.

## **Appendix B: The categorization of essential and closed occupations in Europe.**

Our classification of occupations is mainly based on the Royal Decree 463/2020 (Boletín Oficial del Estado, 14<sup>th</sup> March, 2020) approved by the government of Spain on March 14<sup>th</sup> (2020). We have also considered: the Royal Decree 10/2020 (Boletín Oficial del Estado, 29<sup>th</sup> March, 2020) approved by the government of Spain on March 29<sup>th</sup> (2020); the Decree Law 23 (Gazzetta Ufficiale della Repubblica Italiana, 23<sup>rd</sup> February, 2020) and the Decree Law 25 (Gazzetta Ufficiale della Repubblica Italiana, 25<sup>th</sup> March, 2020) approved by the government of Italy on February 23<sup>rd</sup> (2020) and March 25<sup>th</sup> (2020), respectively. We explain now the main criteria followed in our categorization of occupations in Tables B3 and B4.

All occupations in industries A (Agriculture, forestry and fishing) and O (Public administration and defence; Compulsory social security), and occupations 22 (Health professionals) and 32 (Health associate professionals) –for all industries– are classified as entirely essential (1 point) under the lockdown. Most of the occupations in industry Q (Human health and social work activities) are also considered as completely essential. Meanwhile, the majority of occupations in industries B-E (Mining and quarrying; Manufacturing; Electricity, gas, steam and air conditioning supply; Water supply, Sewerage, waste management and remediation activities) receive a value of essentiality equal to 0.1 because some of them (in particular electricity, gas, water supply and sewerage) are fundamental for the correct functioning of the economy during the lockdown.<sup>14</sup> In the same manner, most of the occupations in industry H (Transportation and storage) receive a value of essentiality equal to 0.5 since the Royal Decree 463/2020 have declared 50% of minimum services in transportation. For most occupations in industries J (Information and communication) and K (Financial and insurance activities), the given value of essentiality is 0.25 since the Spanish decree considered that a minimum service of banking and press (part of the communication industry) was deemed essential and this is approximately the percentage of activities in these industries that keep functioning under the lockdown.

With respect to the closed occupations under the lockdown, we have that all occupations –except 22 and 32– in industries G (Wholesale and retail trade; Repair of Motor Vehicles and Motorcycles), I (Accommodation and food service activities) and R-T (Arts, entertainment and recreation; Other service activities; Activities of households as

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<sup>14</sup> From the EU-LFS database, with greater industry disaggregation, we know that the ‘water supply and electricity’ share in industries B-E lies between 5% and 10% in European economies.

employers; Undifferentiated goods and services; Producing activities of households for own use) are classified as completely closed. Likewise, occupations 26 (Legal, social and cultural professionals), 34 (Legal, social, cultural and related associate professionals) and 52 (sales workers) receive a value of closure equal to 0.75 since the Royal Decree 463/2020 have declared that, among all legal activities, only the criminal legal activities should function under the lockdown, and that social and cultural activities and non-online sales are temporary forbidden to prevent people from getting together in large groups. The values shown in Tables B3 and B4 correspond to the essential and closed occupations at the ISCO-08 2-digit level and NACE (Rev.2) 1-digit level. Based on these Tables, we calculate the values at the ISCO-08 1-digit level and NACE (Rev.2) 1-digit level (Tables B5 and B6), and the ISCO-08 2-digit level (Table B7) by averaging occupations and industries.

**Table B1.** Overview of the NACE Rev.2 codes and their description.

<b>NACE code</b>	<b>Description</b>
A	Agriculture, Forestry and Fishing
B	Mining and Quarrying
C	Manufacturing
D	Electricity, Gas, Steam and Air Conditioning Supply
E	Water Supply; Sewerage, Waste Management and Remediation Activities
F	Construction
G	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles
H	Transportation and Storage
I	Accommodation and Food Service Activities
J	Information and Communication
K	Financial and Insurance Activities
L	Real Estate Activities
M	Professional, Scientific and Technical Activities
N	Administrative and Support Service Activities
O	Public Administration and Defence; Compulsory Social Security
P	Education
Q	Human Health and Social Work Activities
R	Arts, Entertainment and Recreation
S	Other Service Activities
T	Activities of Households as Employers; Undifferentiate Goods and Services Producing Activities of Households for Own Use
U	Activities of Extraterritorial Organisations and Bodies

Note: we exclude industry U in our analysis.

**Table B2.** Overview of the ISCO-08 codes and their description.

<b>ISCO code</b>	<b>Description</b>
11	Chief Executives, Senior Officials and Legislators
12	Administrative and Commercial Managers
13	Production and Specialized Services Managers
14	Hospitality, Retail and Other Services Managers
21	Science and Engineering Professionals
22	Health Professionals
23	Teaching Professionals
24	Business and Administration Professionals
25	Information and Communications Technology Professionals
26	Legal, Social and Cultural Professionals
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
41	General and Keyboard Clerks
42	Customer Services Clerks
43	Numerical and Material Recording Clerks
44	Other Clerical Support Workers
51	Personal Services Workers
52	Sales Workers
53	Personal Care Workers
54	Protective Services Workers
61	Market-oriented Skilled Agricultural Workers
62	Market-oriented Skilled Forestry, Fishery and Hunting Workers
63	Subsistence Farmers, Fishers, Hunters and Gatherers
71	Building and Related Trades Workers (excluding Electricians)
72	Metal, Machinery and Related Trades Workers
73	Handicraft and Printing Workers
74	Electrical and Electronic Trades Workers
75	Food Processing, Woodworking, Garment and Other Craft and Related Trades Workers
81	Stationary Plant and Machine Operators
82	Assemblers
83	Drivers and Mobile Plant Operators
91	Cleaners and Helpers
92	Agricultural, Forestry and Fishery Labourers
93	Labourers in Mining, Construction, Manufacturing and Transport
94	Food Preparation Assistants
95	Street and Related Sales and Services Workers
96	Refuse Workers and Other Elementary Workers

Note: we exclude occupation 63 in our analysis.

**Table B3.** Categorization of essential occupations in Europe by Isco (2 digits) and Nace.

Isco\ Nace	A	B-E	F	G	H	I	J	K	L-N	O	P	Q	R-T
11	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
12	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
13	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
14	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
21	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
22	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
24	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
25	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
26	1	0	0	0	0	0	0	0	0	1	0	0	0
31	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
32	1	1	1	1	1	1	1	1	1	1	1	1	1
33	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
34	1	0	0	0	0	0	0	0	0	1	0	1	0
35	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
41	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
42	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
43	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
44	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
51	1	0	0	0	0	0	0	0	0	1	0	0	0
52	1	0	0	0	0	0	0	0	0	1	0	0	0
53	1	0.1	0	1	0	0	0.25	0.25	0	1	0	1	0
54	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
61	1	0.1	0	0	0	0	0.25	0.25	1	1	0	0	1
62	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
71	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
72	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
73	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
74	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
75	1	0.1	0	0	0	0.25	0.25	0.25	0	1	0	0	0
81	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
82	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0	0
83	1	0.1	0	0	0.5	0.25	0.25	0.25	0	1	0	0.5	0
91	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
92	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	0	0
93	1	0.1	0	0	0.25	0	0.25	0.25	0	1	0	0	0
94	1	0.1	0	1	0.25	0.25	0.25	0.25	0	1	0	1	0
95	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
96	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0

Note: see Tables A1 and A2 for the explanation of the entries of this table. The grouping of industries follows the one adopted in EU-SILC.

**Table B4.** Categorization of closed occupations in Europe by Isco (2 digits) and Nace.

Isco\ Nace	A	B-E	F	G	H	I	J	K	L-N	O	P	Q	R-T
11	0	0	0	1	0	1	0	0	0	0	0	0	1
12	0	0	0	1	0	1	0	0	0	0	0	0	1
13	0	0	0	1	0	1	0	0	0	0	0	0	1
14	0	0	0	1	0	1	0	0	0	0	0	0	1
21	0	0	0	1	0	1	0	0	0	0	0	0	1
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	1	0	1	0	0	0	0	0	0	1
24	0	0	0	1	0	1	0	0	0	0	0	0	1
25	0	0	0	1	0	1	0	0	0	0	0	0	1
26	0	0.75	0.75	0.75	0.75	1	0.75	0.75	0.75	0	0.75	0	1
31	0	0	0	1	0	1	0	0	0	0	0	0	1
32	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	1	0	1	0	0	0	0	0	0	1
34	0	0.75	0.75	0.75	0.75	1	0.75	0.75	0.75	0	0.75	0	1
35	0	0	0	1	0	1	0	0	0	0	0	0	1
41	0	0	0	1	0	1	0	0	0	0	0	0	1
42	0	0	0	1	0	1	0	0	0	0	0	0	1
43	0	0	0	1	0	1	0	0	0	0	0	0	1
44	0	0	0	1	0	1	0	0	0	0	0	0	1
51	0	1	1	1	1	1	1	1	1	0	1	0	1
52	0	0.75	0.75	0.75	0.75	0	0	0	1	0	0.75	0	1
53	0	0	0	0	0	1	0	0	0	0	0	0	1
54	0	0	0	1	0	1	0	0	0	0	0	0	1
61	0	0	0	1	0	1	0	0	0	0	0	0	0
62	0	0	0	1	0	1	0	0	0	0	0	0	1
71	0	0	0	1	0	1	0	0	0	0	0	0	1
72	0	0	0	1	0	1	0	0	0	0	0	0	1
73	0	0	0	1	0	1	0	0	0	0	0	0	1
74	0	0	0	1	0	1	0	0	0	0	0	0	1
75	0	0	0	1	0	0	0	0	0	0	1	0	1
81	0	0	0	1	0	1	0	0	0	0	0	0	1
82	0	0	0	1	0	1	0	0	0	0	0	0	1
83	0	0	0	1	0	0	0	0	0	0	0	0	1
91	0	0	0	1	0	1	0	0	0	0	1	0	1
92	0	0	0	1	0	1	0	0	0	0	0	0	1
93	0	0	0	1	0	1	0	0	0	0	0	0	1
94	0	0	0	0	0	0	0	0	0	0	0	0	1
95	0	0	0	1	0	1	0	0	0	0	0	0	1
96	0	0	0	1	0	1	0	0	0	0	0	0	1

Note: see Tables A1 and A2 for the explanation of the entries of this table. The grouping of industries follows the one adopted in EU-SILC.

**Table B5.** Categorization of essential occupations in Europe by Isco (1 digit) and Nace.

Isco\Nace	A	B-E	F	G	H	I	J	K	L-N	O	P	Q	R-T
1	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
2	1	0.1	0	0	0.3	0	0.25	0.25	0	1	0	1	0
3	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	1	0
4	1	0.1	0	0	0.25	0	0.25	0.25	0	1	0	1	0
5	1	0	0	0	0	0	0.25	0.25	0	1	0	1	0
6	1	0.1	0	0	0	0	0.25	0.25	0	1	0	1	0
7	1	0.1	0	0	0	0	0.25	0.25	0	1	0	0.25	0
8	1	0.1	0	0	0.5	0	0.25	0.25	0	1	0	0	0
9	1	0.1	0	0	0.15	0	0.25	0.25	0	1	0	1	0
0	1	0.1	1	0	1	0	1	1	0	1	0	1	0

Note: see Tables A1 and A2 for the explanation of the entries of this table. The grouping of industries follows the one adopted in EU-SILC.

**Table B6.** Categorization of closed occupations in Europe by Isco (1 digit) and Nace.

Isco\Nace	A	B-E	F	G	H	I	J	K	L-N	O	P	Q	R-T
1	0	0	0	1	0	1	0	0	0	0	0	0	1
2	0	0	0	1	0	1	0	0	0	0	0	0	1
3	0	0	0	1	0	1	0	0	0	0	0	0	1
4	0	0	0	1	0	1	0	0	0	0	0	0	1
5	0	0.5	0.5	1	0.5	1	0	0	0	0	0.5	0	1
6	0	0	0	1	0	1	0	0	0	0	0	0	1
7	0	0	0	1	0	1	0	0	0	0	0	0	1
8	0	0	0	1	0	1	0	0	0	0	0	0	1
9	0	0	0	1	0	1	0	0	0	0	0	0	1
0	0	0	0	1	0	1	0	0	0	0	0	0	1

Note: see Tables A1 and A2 for the explanation of the entries of this table. The grouping of industries follows the one adopted in EU-SILC.

**Table B7.** Categorization of essential and closed occupations in Europe by Isco (2 digits).

<b>Isco</b>	<b>Essential</b>	<b>Closed</b>
<b>11</b>	0.5	0
<b>12</b>	0.1	0
<b>13</b>	0.1	0
<b>14</b>	0	0.25
<b>21</b>	0	0
<b>22</b>	1	0
<b>23</b>	0	0
<b>24</b>	0.1	0
<b>25</b>	0.25	0
<b>26</b>	0	0.75
<b>31</b>	0	0
<b>32</b>	1	0
<b>33</b>	0	0
<b>34</b>	0	0.75
<b>35</b>	0.25	0
<b>41</b>	0.1	0
<b>42</b>	0	0
<b>43</b>	0.1	0
<b>44</b>	0.1	0
<b>51</b>	0	0.5
<b>52</b>	0	0.75
<b>53</b>	0.75	0
<b>54</b>	0.25	0
<b>61</b>	1	0
<b>62</b>	1	0
<b>71</b>	0	0
<b>72</b>	0	0
<b>73</b>	0	0
<b>74</b>	0.1	0
<b>75</b>	0.25	0
<b>81</b>	0	0
<b>82</b>	0	0
<b>83</b>	0	0
<b>91</b>	0.25	0
<b>92</b>	1	0
<b>93</b>	0.25	0
<b>94</b>	0.25	0
<b>95</b>	0	0.75
<b>96</b>	0.25	0

Note: see Table A2 for the explanation of the entries of this table.