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Giovanni Gallo, , Silvia Granato, Michele Raitano

Dipartimento di Economia Marco Biagi
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Heterogeneous effects of the Covid-19 crisis on Italian workers' incomes: the role played by jobs routinization and teleworkability

Giovanni Gallo[a], Silvia Granato[b], Michele Raitano[c]

[a] University of Modena and Reggio Emilia, Modena (Italy)

[b] European Commission, Joint Research Centre (JRC), Ispra (Italy)

[c] Sapienza University of Rome, Rome (Italy)

Abstract

The Covid-19 pandemic appears to have engendered heterogeneous effects on individuals' labour market prospects. This paper focuses on two possible sources of a heterogeneous exposition to labour market risks associated with the pandemic outbreak: the routine task content of the job and the teleworkability. To evaluate whether these dimensions played a crucial role in amplifying employment and wage gaps among workers, we focus on the case of Italy, the first EU country hit by the Covid-19 first wave. We use a static microsimulation model based on data from the Statistics on Income and Living Condition survey (IT-SILC) enriched with administrative data and aligned to monthly observed labour market dynamics by industry and regions. We simulate changes in the wage distribution in 2020 and investigate whether income drops risks – before and after income support measures to capture the effect of public redistribution – differed among workers whose jobs are characterised by a different degree of routinization (as proxied by the routine task intensity - RTI index) and teleworkability (as proxied by the TWA index). We find that RTI and TWA are negatively and positively associated with wages, respectively, and they are correlated with higher (respectively lower) risks of a large labour income drop due to the pandemic. However, differences in income drop risks for workers who differ by RTI and TWA largely reduce when income support measures are considered.

Keywords: Covid-19, earnings distribution, inequality, income support measures, task routinization, teleworkability, Italy, nowcasting

JEL codes: D31, H24, I38, J31, C15

1. Introduction

Since the occurrence of the Covid-19 outbreak, many studies have started investigating the effect of the pandemic on the income distribution. Given the absence of timely population microdata – which are usually made available with a three year lag—most of the existing studies have relied on real-time data – which, however, fail to be representative of the whole population and to provide a thorough picture of all income sources (e.g., Adams-Prassl et al., 2020; Galasso, 2020; Menta, 2021; Clark et al., 2021; Aspachs et al. 2020, Del Boca et al. 2022) – or on microsimulation exercises (e.g., Almeida et al., 2021; Cantò et al., 2021; Christl et al., 2021; Brewer and Tasseva, 2021; Gallo and Raitano, 2022).

The latter studies rely on existing microdata on the income distribution – collected before the onset of the pandemic and representative of the national population – to simulate counterfactual scenarios about the changes in the various income sources engendered by the spread of Covid-19, aligning past microdata to aggregate information on changes in labour market outcomes since the onset of the pandemic. Because of the unavailability of timely information on the evolution of income distribution for a long time span, microsimulations of distributional changes in a given population observed in past years are usually considered as the best strategy available for researchers to inquire about the effects of the COVID-19 pandemic on the income distribution in a timely manner (Christl et al., 2021; Cantó et al., 2021).

The existing microsimulation studies have mostly investigated the effect of the pandemic on major aggregate distributional indicators – including the Gini index of market and disposable equivalised income, the at risk of poverty (AROP) rate before and after income support benefits, or some indicators of the individuals' wage distribution. Nevertheless, in addition to providing an aggregate picture of main distributive changes, microsimulation models may be used to analyse in more detail the heterogeneous effects exerted by the pandemic on specific population subgroups. This is the approach adopted in the present study, which focuses on two possible sources of an individual's heterogeneous exposition to labour market risks associated with the pandemic outbreak: the routine task content of the job and the teleworkability.

On the one hand, a growing literature has demonstrated that the workers' ability to work remotely – especially in the first phase of the pandemic, characterised by the spread of social distancing measures – may become a further driver of inequality in employment and wages (Bonacini et al., 2021). On the other hand, the pandemic outbreak might exacerbate differences among workers who perform jobs with different characteristics in terms of routine task content and personal interactions (Autor and Reynolds, 2020).

A negative relationship between the digitalization of labour processes and the level of routineness of labour tasks and employment dynamics hand was predicted by the Routine-Biased-Technological Change (RBTC) hypothesis, put forward by Autor et al. (2003).[1] Such hypothesis states that the unfolding of ICT is biased towards the replacement of routine (i.e. repetitive and encodable) tasks. Hence, the larger the share of routinary tasks comprising a certain occupation, the greater the potential for a machine-driven substitution of human work associated to such occupation. This RBTC

[1] For an extensive discussion of the RBTC hypothesis, see Acemoglu and Autor (2011). Among the empirical papers which tested this hypothesis see, e.g., Autor et al. (2006), Goos et al. (2014), Goos and Manning (2007), Cirillo et al. (2021).

hypothesis may explain the polarization of the labour market in terms of both jobs and wages, since the demand for middle-skill jobs – usually requiring routine manual and cognitive skills – declines relatively to the rising demand in well-paid skilled jobs typically requiring non-routine cognitive skills and in low-paid less-skilled jobs requiring non-routine manual skills.

From a theoretical perspective, how the pandemic may have affected jobs with a different degree of routineness is undetermined. As a matter of fact, the routine-task content of a job is not merely overlapping to its teleworkability and, relatedly, risks coming from the digitalisation and automation process cannot be overlapped to pandemic-related labour market risks. On the one hand, non-routine manual jobs requiring personal interactions (e.g., carers, waiters) cannot be performed remotely, while some routinary tasks may be performed at home. Thus, workers who are at higher risk of being replaced by automation technologies are potentially relatively more protected from the negative economic consequences of the pandemic. In addition, as pointed out by Autor and Reynolds (2020), remote work and changing consumers' behaviours may reduce the demand for non-routinary low-paid jobs in sectors as travel and tourism. Hence, there is a risk that – as a medium-term consequence of the pandemic – the demand for less routinary non-cognitive jobs requiring personal interactions will drop, contributing to worsening employment and wage prospects of those low-paid workers that were shielded from the RBTC. On the other hand, some routinary-non-cognitive tasks involve physical contact and cannot be performed from home, making these workers more vulnerable to the effects of the pandemic crisis. Furthermore, the pandemic may have accelerated the automation of jobs, being firms incentivised to adapt the production process by automatizing tasks previously carried out by workers, also in order to reduce health risks.

Therefore, the effects of the pandemic on workers characterised by a different routineness of her jobs have to be investigated empirically. Likewise, empirical analyses are needed to quantitatively measure the differential risk exposition of those performing or not teleworkable jobs. This paper contributes to the flourishing strand of the literature investigating the distributive effects of the Covid-19 by providing, to the best of our knowledge, the first study which measures, through a sound microsimulation model, the short-term effects (i.e. in 2020) of the pandemic on the income of workers who differ according to their job's routine-task content and teleworkability.

To evaluate whether the job's routineness and the teleworkability differently exposed individuals to income drops risks after the pandemic occurrence, thus representing new engines of wage inequality (Franzini and Pianta, 2015), we focus on the case of Italy, the first EU country hit by the Covid-19 first wave and adopting tight social distancing measures. Italy is also a country that ranks among the countries with the highest levels of income poverty and inequality in the EU (Raitano, 2019) and characterised by a steep rise in wage inequality in the last decades also due to the rising share of individuals employed through non-standard arrangements (Franzini and Raitano, 2019). Despite differences in data, methods and assumptions on individual labour market transitions, microsimulation studies about Italy focusing on the effects of the pandemic on the Italian wage distribution in 2020 (Christl et al., 2021; Carta and De Philippis, 2021; Gallo and Raitano, 2022) achieve substantially similar findings. Indeed, they find that the pandemic largely increased wage inequality and low-pay risks, but the redistributive emergency measures were rather effective in cushioning the worsening of the income distribution.

Following Gallo and Raitano (2022), in this paper we use a static microsimulation model based on the Italian component of the European Union Statistics of Income and Living Conditions (EU-SILC, the Italian component is named IT-SILC) enriched with administrative data provided by the National Social Security Institute (INPS) and aligned to monthly labour market dynamics by industry and regions observed in 2020. We thus simulate changes in the wage distribution in 2020 and investigate whether income drops risks – before and after income support measures to capture the effect of public redistribution – differed among workers whose job tasks are characterised by a different degree of routinization (as proxied by the routine task intensity (RTI) index) and teleworkability (as proxied by the TWA index). In our analysis we greatly benefit from the availability of the Italian Survey on Occupations – the only European survey replicating the structure of the American O*Net – which allows us to characterise the occupations recorded in IT-SILC along the dimension of telework feasibility and their level of routineness. Specifically, we rank the occupations relying on the technical teleworkability index built by Sostero et al (2020) and on the routine task index developed by Cirillo et al (2020).

In detail, we pursue three main goals: i) compare wages of workers characterized by a different degree of RTI and TWA; ii) inquire whether workers with different RTI and TWA were differentially exposed to labour income drop risks since the occurrence of the Covid-19 pandemic; iii) investigate whether such heterogeneity of labour income drop risks was mitigated or magnified once income support measures implemented by the Italian Government to cope with the effects of the pandemic (henceforth 'emergency benefits') are taken into account.[2]

Our main results document that, on the one hand, RTI and TWA are negatively and positively associated with wages, respectively, and, on the other hand, they are associated with higher (respectively lower) risks of a large labour income drop due to the pandemic. However, the redistributive effort exerted by the Italian Government in 2020 to cope with the effect of the pandemic on labour incomes was rather effective in protecting workers differently exposed to the risks engendered by the Covid-19 outbreak. Indeed, differences in income drop risks for workers who differ by RTI and TWA almost disappear when income support measures are considered.

The paper is organised as follows. Section 2 briefly discusses the channels through which the pandemic may differentially penalise workers performing jobs differing by RTI and TWA. Section 3 presents the data, the characteristics and main assumptions of our microsimulation model, and explains the RTI and TWA indices. Section 4 shows preliminary evidence on the distribution of employment and wages by RTI and TWA in the pre-pandemic world. Section 5 presents the main findings of our microsimulation exercise on income drops risks – before and after the emergency benefits – characterising individuals performing jobs with different degrees of teleworkability and routine task content. Section 6 concludes.

[2] In what follows, we use the term 'emergency benefits' in a broad sense, i.e., also including the already existing income support measures that acted as an automatic stabiliser after the pandemic occurrence.

2. Routine-task content of jobs, teleworkability and possible divides due to the Covid-19 pandemic

The economic literature on the impact of the Covid-19 pandemic on the labour market is growing rapidly. Using real-time survey data, several studies analysed the labour market responses in the first months of the pandemic in various countries, documenting unequal consequences, as more fragile individuals – e.g. younger, females, foreign citizens, lower educated and lower wage workers – were more severely hit, mostly because of a pre-pandemic sorting in occupations requiring more interpersonal contact, that cannot be performed remotely (e.g., Galasso, 2020; Adams-Prassl et al., 2020; Clark et al., 2020; Cajner et al., 2020; Montenovo et al., 2022; Cortes et al., 2020; Beland et al. 2020; Crossley et al. 2020). These studies usually focus on the short-term employment dynamics after the Covid-19 outbreak, while impacts on the wage distribution according to the workers' and jobs' characteristics have been less investigated, mainly due to the lack of reliable data.

As concerns Italy, the context of this study, Aina et al. (2021) compare data from the 2019 and 2020 waves of the Italian Labour Force Survey and document that the pandemic had a more severe negative effect on the earnings of workers at the bottom of the wage distribution, but this negative effect is mitigated by the possibility of actual working from home. However, the emergency measures implemented by the various governments to deal with the crisis might have cushioned the unequal effects engendered by the pandemic-related recession. Gallo and Raitano (2022) find, through a microsimulation exercise, that monetary poverty, income inequality and the share of low-paid workers in Italy highly increased in 2020, but such increase largely reduces when the emergency benefits are added to labour incomes. Similar findings are also found by Carta and De Philippis (2021) who simulate changes in household labour incomes. Casarico and Lattanzio (2021) analyse the evolution of hirings and separations for different categories of workers in the first and second quarters of 2020 and find that more disadvantaged workers experienced a higher drop in separation probability, indicating that the implemented public policies (mostly the stoppage of layoffs; see Section 3.1) were able to protect these groups of vulnerable workers.

Overall, the literature indicates that the job characteristics are the main mediator of the huge disparities in the magnitude of employment losses across demographic and socio-economic groups. At least in the first phase of the pandemic, characterized by social distancing as a key response to the spread of the virus, the main role was clearly played by workers' ability to work remotely.

Accordingly, a large literature has used data on tasks performed in each occupation to assess jobs' working-from-home feasibility and estimate the share of teleworkable jobs (e.g., Dingel and Neiman, 2020; Holgersen et al., 2020; Boeri et al., 2020; Cetrulo et al., 2020a; Sostero et al., 2020). All studies report a strong heterogeneity of teleworkability across industries ad occupations, finding that remote work applies primarily to the top quartile of higher-skilled workers. Findings for US document that workers in occupations with low working from home and high physical proximity, that are most likely to be affected by the pandemic, are predominantly characterized by more economically vulnerable traits (e.g., lower education, younger age, foreign citizenship; Yasenov, 2020; Mongey et al., 2021). Similarly, using pre-pandemic data for Italy, Cetrulo et al. (2021) show that those individuals who are not able to perform their work remotely are also more exposed to transition into unemployment and to earning low wages. Consistently, Bonacini et al (2021) show that a moderate shift in working-from-home feasibility would be associated with a rise of labour income inequality among employees, because it would tend to benefit male, older, graduated, and high-paid employees to a greater extent. Overall, this literature suggest that the feasibility of working-from-home is a 'privilege' of a minority of advantaged workers.

Social distancing and remote work have also implications related to digital technologies and automation. On the one hand, technology can facilitate remote work but not to the same degree for all occupations. As discussed above, remote work applies primarily to the top quartile of higher-skilled workers, those that also face the fewest risks from automation and artificial intelligence, while routinary-non-cognitive tasks often involve physical contact and cannot be performed from home. Thus, low wage manual and routine workers are potentially disproportionally affected by the Covid-19 crisis. Moreover, as suggested by Autor and Reynolds (2020), if remote work displaces office time and reduces the need for business travel and personal interaction, demand for many non-college-educated low-paid low-skill workers is likely to drop.

Consequently, while in the past decades we have assisted to a technological change leading to polarization of low and high-skilled jobs and hollowing out of middle-skilled jobs characterized by a high level of tasks routineness, remote work is likely to shape the post-covid crisis trajectory in the direction of complementing the impact of technology in removing middle-skill routine jobs and extending this trend to the low-wage end of the bar. Furthermore, Covid-19 may accelerate the automation of jobs since firms are incentivised to invest in technology and adapt the production process by automatizing tasks previously carried out by workers, also in order to reduce health risks from a pandemic (Caselli et al., 2020).

Thus, the pandemic might contribute, on the one hand, to speed up the implementation of automation displacing routine-jobs, widening the employment and wage gap between workers in routinary and non-routinary tasks. At the same time, partially contrasting the expectations from the RBTC hypothesis, the pandemic may also enlarge the gap between cognitive and non-cognitive workers penalising those performing manual non-routinary activities because of the increased need for social distance and changing consumers' behaviours.

Overall, since some of the characteristics that protected jobs during the early months of the Covid-19 crisis – i.e., the ability to work from home and the non-routine cognitive task content – are also more frequently associated with higher income and job security in normal times, the pandemic may have ended up in exacerbating pre-existing wage inequalities.

3. Data and model assumptions

This section first describes the main measures implemented in Italy to sustain workers' incomes, which were reduced as a consequence of the social distancing measures and the pandemic-related economic recession (Section 3.1). We then present the characteristics of the dataset used and of the microsimulation model (Section 3.2), the model's assumptions and the simulated scenarios (Section 3.3) and the indices we use to measure the teleworkability and the routine-intensity of a job (Section 3.4).

3.1 The emergency benefits to deal with the pandemic in Italy

In this paper we focus on the distribution of labour incomes among workers. Our unit of analysis is, then, the individual, whereas we are not interested is investigating the evolution of the income

distribution at the household level.[3] Thus, in our simulations we only consider the income support measures devoted to workers (independently of the household conditions), while benefits devoted to sustaining the income of disadvantaged households (i.e., minimum income schemes) are not simulated.[4]

From the beginning of March 2020, the Italian Government introduced a set of measures to protect workers against the negative effects of the pandemic on the business cycle and to compensate for income drops related to the shutdown of many work activities (see, for details, Jessoula et al., 2021). The most important measures were introduced in the Decree no. 18/2020 issued on March 17, called '*Decreto Cura*'.

The main measure established by this Decree, renewed by subsequent provisions, concerns the extension to all employees – independently from firm size and sector of activity – of the short-time work allowance, *Cassa Integrazione Guadagni* (henceforth CIG), which is the wage-compensation scheme for working-time reduction. The replacement rate of CIG is 80% with ceilings that largely reduce the replacement rate for medium- and high-paid workers.[5] The '*Decreto Cura*' established four additional emergency policies worthy of attention. First, layoffs were stopped, and, from February 23 2020, employers were prevented from firing employees. This measure was then renewed, with some exceptions, up to June 2021. Second, the duration of the unemployment benefits (henceforth UB)[6] was extended up to 4 months in favour of those recipients whose benefit duration expired in the period between March and June 2020. Third, a lump sum 100 euro flat-rate transfer (henceforth 'Bonus-100') was paid in March 2020 to employees who continued working on company premises during the lockdown because their job could not be performed remotely. Fourth, the government introduced a lump sum flat-rate transfer (henceforth 'Bonus-600') targeted at different categories of atypical and self-employed workers. The duration and the amount of the benefit (initially 600 euros per month, then increased to 1000 euros per month for specific categories) varied according to the workers' category (Jessoula et al., 2021). Details about the simulated benefits are reported in Table A1 in the online Appendix.

3.2 Model characteristics and data

We adopt a static tax-benefit microsimulation model drawing on Gallo and Raitano (2022). As typical in this class of models (Beirne et al., 2020; Bronka et al., 2020; Figari and Fiorio, 2020), we simulate the pandemic effects on the income distribution assuming, on the one hand, no individuals' behavioural changes and, on the other hand, no structural changes in the labour demand and in the wage structure.

[3] About the effects of the pandemic on the household income distribution in Italy, see Gallo and Raitano (2022).

[4] Also note that we do not simulate the effects of the measures introduced to sustain firms' production, since they cannot be considered in an individual-level microsimulation model.

[5] The monthly benefit was indeed capped in 2020 at €940 and €1,130 when the monthly wage is below or no lower than €2,160, respectively.

[6] The unemployment benefits considered in our model are NASPI (`*Nuova Assicurazione Sociale per l'Impiego')* for former employees and DIS-COLL (*Disoccupazione Collaboratori*) for those previously employed in parasubordinate collaborations (i.e. individuals legally self-employed but often "economically dependent" on a single client).

The model relies on the 2017 wave of the Italian component of the IT-SILC survey, enriched by the monthly information on workers' activity sector, wage, and contractual arrangements recorded in the administrative archives managed by INPS. The resulting dataset is called AD-SILC 2017. Income variables in AD-SILC 2017, which refer to the year 2016, have been inflation-adjusted to 2020 using consumer price indexes provided by the Italian National Institute of Statistics (ISTAT). Noteworthy, the version of IT-SILC 2017 used for our study includes a very fine-grained information about the occupation of each worker, that is coded through the 4-digit ISCO classification. As will be explained in Section 3.4, we exploit the granularity of the occupational variable available in IT-SILC to measure the job's routine-task content and the teleworkability for each worker in our sample.

In order to simulate the effects of the COVID-19 pandemic on the income distribution, the information on the activity sector available in our dataset and collected in administrative archives is crucial. Indeed, this information is recorded according to the 6-digit ATECO classification, the same used by the Italian government to establish essential and non-essential sectors.[7] Thus, differently from other analyses about Italy (Figari and Fiorio, 2020; Brunori et al., 2021; MEF, 2020; Carta and De Philippis, 2021) which had information on the workers' sector of activity at most at the 2-digit ATECO level and had to randomly select 'essential' and 'non-essential' workers, our dataset allows us to exactly identify workers at risk of firm shutdown because of the social distancing measures.

The microsimulation model includes all taxes and benefits which existed before the pandemic and simulates entitlement conditions to the layoffs stoppage and to the emergency benefits described in Section 3.1. By means of nowcasting techniques, microsimulations are aligned to aggregate data about labour market outcomes in 2020 delivered by national institutions or computed using the Italian Labour Force Survey (ILFS). In particular, we aligned our model to the spread of the CIG allowance among the employees distinguished by NUTS-2 region, month, sector of activity, and broad occupation (see Section 3.3). In addition, information available in the INPS archives allows us to exactly distinguish the various categories of atypical and self-employed workers entitled to the 'Bonus-600' and to the UB.

To assess changes due to the occurrence of the pandemic, we refer to the inflation-adjusted income distribution observed in 2016 as the "No-Covid scenario". Hence, we use information on individuals' incomes and monthly occupational statuses recorded in INPS administrative data (or declared in the IT-SILC interview if missing in INPS records) to simulate what would have occurred in 2020 if the pandemic had not happened. In other words, as standard in microsimulation exercises, we assume that, in absence of the pandemic, individuals' labour market outcomes in 2020 would have been the same of 2016.

Our analyses assess the effect of the pandemic on workers' gross incomes, both from labour and from the income support measures described in Section 3.1. We consider both employees and self-employed workers. More in detail, the analysis is based on a subsample of 17,133 individuals aged 15-65 who had positive labour incomes and were not retired in 2016 (76.8% and 23.2% of sampled

[7] From the beginning of March 2020 the Italian Government established the shutdown of all commercial and retail business activities, except for those considered basic necessities. Sectors identified as 'non-essential' were identified by a Prime Minister Decree according to the 6-digit ATECO sector. Most of these shutdown measures were interrupted or alleviated in May and June. For the full list of 'essential sectors', see https://www.gazzettaufficiale.it/eli/id/2020/03/26/20A01877/sg.

individuals are employees and self-employed workers, respectively). We thus compare the 2016 distribution (henceforth, the No-Covid scenario) with the distribution in a simulated pandemic scenario of gross annual labour incomes (i.e. incomes from employment and self-employment) and workers' gross total income (i.e., labour income plus emergency benefits, gross of taxes). Therefore, by comparing the effects on labour and total income, it is possible to quantify the cushioning effect of the emergency benefits on workers' income losses due to the pandemic.

3.3 Assumptions and simulated scenarios

We simulate the effects of the pandemic on workers' incomes during the whole 2020. For this purpose, we adopt assumptions based on the occupational status of individuals. Specifically, we distinguish six categories of workers: i) open-ended employees in essential sectors; ii) open-ended employees in non-essential sectors; iii) temporary employees in essential sectors; iv) temporary employees in non-essential sectors; v) self-employed in essential sectors; vi) self-employed in non-essential sectors.

Although the stoppage of layoffs introduced by the national government was not limited to a specific typology of employment contract, we assume that this policy was effective for open-ended employees only, since employers could merely not renew temporary contracts. To simulate the effect of the stoppage of layoffs, we use the information on the monthly employment in 2016 and, for those who were employed in February, we replace – for the whole duration of the layoff stoppage (i.e., March-December 2020) – the unemployment periods recorded in the following months (thus receiving zero incomes or UB/CIG) with the mean monthly wage (computed according to actual earnings in worked months).[8] However, despite the stoppage of layoffs, aggregate statistics on transitions in and out of the labour market provided by INPS show that 1 million open-ended contracts ceased from March to December 2020, but they were 27% less than those reported in the same period in 2019. We then implement the same trend in our model, randomly stopping the layoff in 27% of cases.

Since employers could not fire their employees, all firms were allowed to take advantage of the CIG. To simulate the CIG receipt (available to both open-ended and temporary employees), we rely on a high number of cells by worker characteristics based on aggregate statistics provided by INPS on the distribution of the CIG for each NUTS-2 region and month in essential and non-essential sectors[9] and by ILFS on the distribution of the CIG by broad occupation.[10] We thus identify the number of

[8] Consistently, we do not consider in the post-Covid scenarios UB and CIG received by open-ended employees in the No-Covid scenario during the months of application of the layoffs' stoppage.

[9] The spread of the CIG allowance in non-essential sectors was below 100% during the lockdown period since some firms asked for derogation from the mandatory shutdown of their activity. Moreover, individuals who were able to work from home had the opportunity to continue their activity if their firm was not shut down. Likewise, CIG was also asked by firms in essential sectors that suffered from a reduction in their activity due to the pandemic. Note that temporary employees may also receive the CIG until their contract does not expire.

[10] We distinguish three broad occupational groups: high (the first two levels of the 1-digit ISCO-08 classification), medium (ISCO-08 third and fourth level), and low (from ISCO-08 fifth level onwards). Note that we did not identify the risk of receiving the CIG allowance by distinguishing workers according to their teleworkability since – as specific questions about this issue in the ILFS were absent – this index is based on the ISCO classification that we already used to create cells of risk exposure to CIG.

workers who were suspended from their job and received this allowance in a certain month instead of their wage through a monthly random selection, where we assume that selected individuals had zero working hours in that month.

Regarding fixed-term employees, our dataset does not provide information about the expected duration of the contract, preventing us from exactly considering the lack of contract renewal. Consequently, for each month from March 2020, we simulate an unemployment spell instead of the employment reported in the corresponding period in 2016 for temporary workers who changed firms or experienced a non-working spell the month before. We simulate hiring as a temporary employee according to the aggregate statistics provided by INPS on monthly hiring through such an arrangement.[11]

Regarding individuals who were unemployed in February 2020 but working in the No-COVID scenario in the following months, we randomly simulate 32% fewer new hirings, consistent with the 2019–2020 trend observed in aggregate statistics provided by INPS. We also assume that months spent in unemployment from March 2020 by those formerly working as an open-ended or a temporary employee are covered by UB.

Regarding the self-employed, to take into account changes in social distance measures during 2020, we make different assumptions on their income loss with respect to the No-Covid income, by month and according to their sector of activity (essential or non-essential), their teleworkability (measured by the index proposed by Sostero et al., 2020; see Section 3.4), and the seriousness of the spread of the pandemic in their region of residence (see Table A2 in the online Appendix for details).

Self-employed are entitled to receive the monthly lump sum Bonus-600 for the March-May 2020 period. For the sake of simplicity, we adopt a 100% take-up rate for Bonus-600 among self-employed with an annual labour income lower than €50,000, while the take-up rate becomes 0 for those with an income level higher than €50,000. On the basis of the outputs of our model, about 4.6 million of individuals received this benefit, consistently with aggregated data provided by INPS. Regarding the Bonus-100, given the lack of information on the physical presence of employees in their workplace during the spring lockdown, we assign the benefit to all employees with a gross annual wage lower than 40,000 euros, with a non-teleworkable occupation and without CIG benefits in March 2020 (approximately 22% of total employees).

3.4 How to measure jobs' routine-task content and teleworkability

To measure to what degree a job is teleworkable or routinary we rely on the Italian Survey on Occupations (*Indagine Campionaria Professioni*; henceforth ICP), that is the only European survey replicating the structure of the American O*Net.[12] This survey represents a unique source of

[11] Hirings through temporary contracts did not stop in 2020 but decreased significantly with respect to 2019. In March, May, and December 2020, for instance, hirings through temporary contracts have been approximately 50% lower than the values in the corresponding month in 2019.

[12] The ICP is carried out jointly by INAPP (*Istituto Nazionale per l'Analisi delle Politiche Pubbliche*) and the Italian Statistical Office (ISTAT), and its last wave was released in 2013. This survey collects information on the content of work through a rich questionnaire composed of seven sections, including: knowledge, skills, attitudes, generalized work

information on skills, tasks and content of approximately 800 occupations (5-digit CP2011 classification, the Italian equivalent of the ISCO-08 classification). Crucial for our aims, the ICP survey has been used by Sostero et al (2020) to develop a 'technical teleworkability index' (henceforth TWA) and by Cirillo et al. (2020) to build a routine task intensity index (henceforth RTI). In what follows we thus adopt these two indices to capture the workers' heterogeneity with respect to their job's routine task content and teleworkability.

The RTI index proposed by Cirillo et al. (2020) is based -– following Acemoglu and Autor (2011) - on the difference between the routine and non-routine dimensions of occupations. First, various sub-indicators are computed: the routine cognitive (RC) indicator, which captures the degree of repetitiveness and standardization of tasks; the routine manual (RM) indicator, capturing the degree of repetitiveness of manual operations; the non-routine manual (NRM) indicator, measuring the degree of manual dexterity needed to perform operations; the non-routine cognitive analytical (NRCA) indicator, which captures the relevance of tasks that imply to think creatively; and the non-routine cognitive interpersonal (NRCI) indicator, measuring the importance of interaction and social relationships. Then, the RTI is calculated as the difference between the routine and non-routine dimensions of occupations according to the following formula:

$$(1) \qquad RTI = (RC + RM) - (NRM) - (NRCA+NRCI)$$

The resulting measure is a continuous index assuming values from 0 to 100 for each 5-digit occupation.[13]) We computed the RTI for the 4-digit occupations available in our dataset by aggregating the 5-digit occupations values borrowed from Cirillo et al. (2020), using weights based on the relative share of employment in each 5-digit occupation among the 4-digit group obtained from the ILFS.

As concerns the measure of teleworkability, Sostero et al. (2020) exploit the task information from the ICP survey to construct for each 5-digit occupation a binary index which defines as non-teleworkable an occupation with at least one physical task reported as sufficiently important.[14] As for the RTI index, we derive the TWA by aggregating the 5-digit values from the ICP to our 4-digit occupations using population-weighted averages obtained from the ILFS. Following Sostero et al. (2020), each 4-digit occupation is defined as teleworkable when the obtained continuous TWA is above the threshold of 0.4.

activities, values, work styles, and working conditions. In total, 16,000 Italian workers were interviewed, on average 20 workers per each 5-digit occupation. For details about the ICP structure, see Cetrulo et al. (2020b).

[13] Examples of occupations with high values of the index are plant and machine operators and assemblers, while on the other extreme of the distribution we find, among others, university professors and researchers.

[14] In detail, six indicators of physical tasks were identified by Sostero et al. (2020) from the analysis of the task contents: manual dexterity, finger dexterity, performing general physical activities, handling and moving objects, inspecting equipment/structures/material, operating vehicles/mechanized devices/equipment. For each of these variables, ICP data report the level of importance on a scale from 0 to 100. Each 5-digit occupation is classified as non-teleworkable if at least one of the physical task variable has a value above a threshold of 40, where the threshold is chosen based on the distribution of the importance of the scores across occupations. Examples of fully technical teleworkable occupations are legal professions, sales and marketing managers and professionals, ICT managers and software developers, secretaries, numerical clerks. On the other spectrum of the distribution (fully non-teleworkable occupations) we have personal service workers, health and blue-collar workers.

We then match the RTI and TWA indices values to each worker surveyed in AD-SILC 2017 according to the recorded ISCO-08 4-digit occupation. In our analyses, we take the TWA index as a binary variable and distinguish workers in three uniform groups – Low, Mid and High RTI – according to the terciles of the RTI distribution.[15] Table A3 in the online Appendix shows the five most frequently performed occupations included in the terciles of RTI and in the two categories of the TWA index. For instance, among non-teleworkable jobs there are medical equipment producers, shopkeepers and shop sales assistants, which are classified as low-, mid- and high-RTI jobs, respectively. Likewise, among jobs that can be performed remotely we find occupations as financial brokers, programmers and bank clerks which are identified by the RTI index as low-, mid- and high-RTI jobs, respectively.

4. Jobs and earnings by RTI and TWA in the pre-pandemic world

Table 1 presents the distribution of workers in our sample across terciles of RTI and TWA.[16] The share of workers performing a teleworkable job is 58.1%. Moreover, routineness and teleworkability are negatively correlated: the highest share of teleworkable jobs (70.4%) is observed in the lowest RTI tercile. Nevertheless, the correlation between RTI and TWA indices is far from being perfect, as confirmed by the evidence that a relatively high share of low-routine jobs is not teleworkable (29.6%), while the opposite emerges within high routinary jobs (42.9%). Therefore, as mentioned, the two dimensions cannot be merely overlapped and need to be jointly assessed to inquire the heterogenous exposition of workers to risks of labour income drop because of the pandemic occurrence.

Table 1. Sample composition by RTI tercile and TWA

RTI tercile	Teleworkable		Total
	No	Yes	
1	2,058 *9.9%* (29.6%)	4,905 *23.5%* (70.4%)	6,962 *33.4%*
2	2,795 *13.4%* (39.4%)	4,306 *20.6%* (60.6%)	7,101 *34.0%*
3	3,885 *18.6%* (57.1%)	2,923 *14.0%* (42.9%)	6,807 *32.6%*
Total	8,737 *41.9%*	12,134 *58.1%*	20,871 *100.0%*

Notes: Percentage values in italics; row percentages in parenthesis. Source: Elaborations on AD-SILC 2017.

[15] Results available upon request show that our main findings about the effects of the pandemic on workers performing a job with a different routine task content do not change if we take the RTI as a continuous variable.

[16] Note that the number of individuals belonging to the second and the third RTI tercile is not perfectly equal in our sample because of a mass of the RTI distribution at the second tercile value.

It has to be noted that, as shown in Table A4 in the online Appendix, the share of self-employed workers (23.2% in our sample) largely differs among those who belong to the first two terciles of the RTI distribution (26.9% and 28.9% among those in low- and mid-RTI jobs) and those performing high routinary jobs (the share of self-employed workers among those identified as performing high-RTI jobs is 14.8%).

Workers performing a TWA job lie, on average, on an upper part of the earnings distribution with respect to those whose job cannot be performed remotely. Looking at the distribution by deciles of gross annual labour incomes in the No-Covid world (i.e. in 2016; Table 2), it emerges, indeed, that 56.3% of those with a TWA occupation lie above the median of the distribution, whereas the corresponding share among those performing a non-TWA job is 41.3%. The share of low-paid TWA workers (and, vice versa, high-paid non-TWA workers) is, though, not negligible. Likewise, as expected, workers in low-RTI jobs are more likely to lie in the upper half of the distribution (61.6%) with respect to those performing mid- and high-RTI jobs (46.5% and 41.9%, respectively). Nonetheless, as already pointed out for TWA, the juxtaposition between RTI and earnings level is not straightforward. In other terms, a high wage dispersion also emerges among groups of workers homogenous with respect to the RTI and TWA levels of their jobs.

Table 2. Distribution of workers by decile of annual gross labour income, RTI tercile and TWA (column percentages)

Decile of the No-Covid gross labour income distribution	RTI tercile			Teleworkable	
	1	2	3	No	Yes
1	8.6%	10.3%	11.1%	12.6%	8.2%
2	7.3%	11.2%	11.7%	12.4%	8.4%
3	7.8%	11.4%	10.7%	10.9%	9.3%
4	7.5%	9.8%	12.8%	11.4%	9.0%
5	7.4%	10.8%	11.9%	11.6%	8.9%
6	8.9%	9.7%	11.4%	10.3%	9.8%
7	10.8%	9.0%	10.2%	9.6%	10.3%
8	13.2%	8.9%	8.0%	9.6%	10.3%
9	13.0%	9.2%	7.8%	6.9%	12.2%
10	15.7%	9.7%	4.5%	4.9%	13.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Elaborations on AD-SILC 2017.

Nevertheless, it is interesting to inquire the empirical mean association between these job's characteristics and earnings. Table 3 shows the OLS estimates obtained regressing log annual earnings in the No-Covid scenario on a set of worker's and job's characteristics. For our purposes, it is worth noting that, even when controlling for age, education, contractual arrangements, and other relevant covariates, TWA and RTI are significantly associated with wages. In detail, when not controlling for industries (captured by 2-digit NACE) and broad occupational groups (i.e. managers, white- and blue-collars), specification M1 in Table 3 shows that wages are significantly and negatively associated with the routine-task intensity and the impossibility of working remotely. Furthermore, the negative and statistically significant association between high-RTI, non-TWA and labour incomes persists when industry and broad occupational fixed effects are added to the set of controls (specification M2 in Table 3).

Table 3. OLS estimates of the association between log annual gross labour income, RTI and TWA in the No-Covid scenario

	M1	M2	M3	M4
Female	-0.305***	-0.263***	-0.304***	-0.262***
Non-Italian citizen	-0.339***	-0.268***	-0.345***	-0.268***
Age	0.053***	0.048***	0.053***	0.048***
Age squared	-0.000***	-0.000***	-0.000***	-0.000***
Upper sec. education	0.192***	0.149***	0.194***	0.150***
Tertiary education	0.390***	0.246***	0.389***	0.246***
Private, fixed-term employee	-0.344***	-0.222***	-0.345***	-0.223***
Public, open-ended employee	0.070***	0.155***	0.074***	0.158***
Public, fixed-term employee	-0.255***	-0.170**	-0.251***	-0.167**
Self-employed	-0.429***	-0.388***	-0.428***	-0.388***
Part-time contract	-0.529***	-0.486***	-0.529***	-0.487***
Medium RTI	-0.073***	-0.011		
High RTI	-0.087***	-0.037**		
No TWA	-0.132***	-0.038*		
TWA/Mid RTI			-0.075***	-0.031*
TWA/High RTI			-0.118***	-0.051**
Non-TWA/Low RTI			-0.161***	-0.075**
Non-TWA/Mid RTI			-0.222***	-0.040*
Non-TWA/High RTI			-0.208***	-0.079***
Industry and occupation FE	No	Yes	No	Yes
Observations	17,133	17,133	17,133	17,133
R-squared	0.292	0.327	0.293	0.327

Notes: Additional covariates included in all specifications: household composition dummies; geographical macro-area of work (North, Centre, South); population density of the area of residence (high, mid and low populated areas). Private, open-ended employee is the reference category for occupational status. Standard errors clustered by NUTS-3 region level; individual sample weights included. *** p<0.01, ** p<0.05, * p<0.10. Source: Elaborations on AD-SILC 2017.

In addition, we investigate possible non-linear relationships between RTI and TWA by interacting the three RTI deciles with the binary TWA index (specifications M3 and M4 in Table 3). Those performing a TWA and low-RTI job (the excluded category in the regression specification) are always characterised by a significantly higher wage with respect to all the other workers' subgroups. Furthermore, when industry and occupational fixed effects are not included, a wage gap within workers performing a non-TWA job arises: indeed, those performing a mid- and a high-RTI non teleworkable job earn significantly less than those still in a non-TWA occupation but performing a low-RTI job.

These preliminary findings confirm that job characteristics as the routine-task content and the teleworkability are major drivers of earnings gaps. By relying on the counterfactual post-Covid distribution obtained from our microsimulation exercise, we move to investigate whether these two characteristics have also been major drivers of differential labour income drops after the Covid-19 occurrence.

5. Pandemic effects on workers' incomes by RTI and TWA

This section shows the main findings of our microsimulation application. In detail, we present indicators of the distribution of the income loss experienced by workers in 2020 with respect to the 'No-Covid scenario' and of the incidence of workers receiving a low wage, which are identified as those earning less than 60% of the national median wage. Both indicators are shown with reference to gross labour income and to 'total individual income', which is obtained as labour incomes augmented by the 'emergency benefits' presented in Section 3.1 (i.e., UB, CIG allowances, and special bonuses for workers).

We present descriptive results instead of relying on multivariate regressions on simulated incomes. This choice follows from the fact that our dependent variables (i.e. income loss and low-pay risk) represent the final outcomes of a microsimulation model, of which the results are driven by the assumptions made in the model (e.g., about the spread of CIG receipt, fall of self-employment incomes). Regressions would allow controlling for the association between the dependent variable and a set of relevant covariates (e.g. industries and occupations in our case) that are potentially confounding the link between the dependent variable and our core independent variables (RTI and TWA). However, it would not be methodologically correct to estimate a regression model using a specification that includes as controls the same variables – e.g., industry, occupational status and contractual arrangement – which were used to make assumptions about the frequency of a certain labour market risk after the occurrence of the pandemic. Therefore, when observing our findings, it has to be kept in mind that descriptive results about a certain risk for those performing jobs with a different degree of RTI or TWA may be driven by labour market risks related to a relative concentration of jobs with different routine task content or teleworkability in the various industries (and especially, in the 'non-essential' industries whose activities were often shut-down during Spring 2020).

As concerns income drop risks – where a drop is defined as 'large' when it amounts to more than 10% of the No-Covid income and 'moderate' when the loss amounts to at most 10% – we find that workers performing a non-TWA job have been, as expected, more exposed to the risk of experiencing a large drop in their 2020 gross labour income with respect to the No-Covid scenario (upper panel of Table 4). The share of workers experiencing a large income drop grows, indeed, from 33.8% to 51.5% when we distinguish those performing TWA and non-TWA jobs, respectively. Similarly, the share of workers reporting a gross labour income drop is much higher among those in Mid-RTI (44.9%) and High-RTI (48.2%) jobs than among those in Low-RTI occupations (30.6%). Thus, a high income drop risks characterises those workers in Mid-RTI jobs as well. This group also contains major non-routinary jobs which cannot be held remotely, as the shopkeeper (see Table A3 in the online Appendix). Thus, a crucial divide – discussed below – might be related to the interaction between RTI and TWA.

Table 4. Loss from pandemic – before and after emergency benefits – by RTI tercile and TWA (column percentages)

Gross labour income						
Loss from pandemic	Low RTI	Mid RTI	High RTI	Non-TWA	TWA	Total
No loss	46.5%	30.5%	27.9%	26.5%	41.1%	35.0%
Moderate loss	23.0%	24.6%	23.9%	22.0%	25.1%	23.8%
Great loss	30.6%	44.9%	48.2%	51.5%	33.8%	41.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Gross individual total income						
Loss from pandemic	Low RTI	Mid RTI	High RTI	Non-TWA	TWA	Total
No loss	51.9%	36.7%	31.5%	32.8%	45.3%	40.1%
Moderate loss	25.4%	34.9%	44.7%	39.2%	31.9%	34.9%
Great loss	22.6%	28.4%	23.8%	28.0%	22.8%	25.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes: The income loss is 'great' if the relative decrease is more than 10%, it is 'moderate' otherwise. 'No loss' means that the income level remains unchanged or even increases after the pandemic. Source: elaborations on AD-SILC 2017.

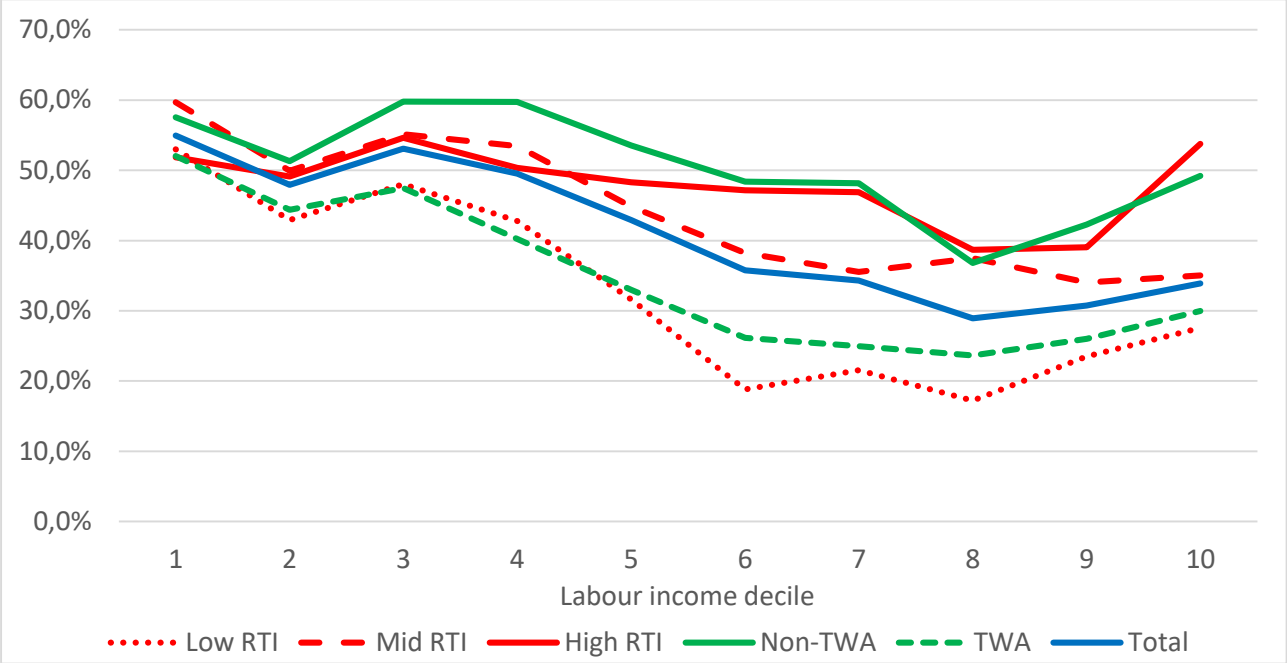
Interestingly, differences in large income drop risks by job's characteristics largely reduce when we focus on total incomes (bottom panel of Table 4), confirming the redistributive effect played by post-Covid emergency measures implemented in Italy (Gallo and Raitano, 2022).[17] The gap in the large income drop risk between workers performing non-TWA and TWA jobs reduces from 17.7 percentage points (p.p.) to 5.2 p.p., and, similarly, differences between workers characterised by a different routine-task content of their job almost disappear. Moreover, when emergency benefits are considered, the share of large income drops is higher among Mid-RTI workers than among High-RTI workers. This evidence might be due to the higher relative share of self-employed workers in the second tercile of the RTI distribution (see Table A4 in the online Appendix), since the income protection for the self-employed, especially in the final months of 2020, was relatively less generous than the one provided to employees thanks to the extended coverage of the CIG allowance.

The progressivity of the emergency benefits implemented in Italy in 2020, already pointed out by Carta and De Philippis (2021) and Gallo and Raitano (2022) for the mass of workers, is clearly confirmed when we compare the share of workers – distinguished by TWA and RTI terciles – experiencing labour income loss and total income loss (Figures 1 and 2). As a matter of fact, the shape of the distribution of the losses by deciles of the No-Covid labour income distribution reverses when emergency benefits are considered. Nevertheless, it has to be noticed that the highest share of workers with a great loss of total income emerges among those performing high-paid, non-teleworkable and highly routinary jobs (see the upper tail of the curves in Figure 2). In addition,

[17] Gallo and Raitano (2022) point out that the progressive effect of the emergency benefits mostly depends depends on the effect of the ceiling on the CIG amount, which relatively penalises middle- and high-paid workers, and on the flat-rate amount of the Bonus-600. Notably, in the poorest decile, the benefits increase largely exceeds the income loss since the Bonus 600 was received by poorer workers independently of both the extent of income loss and the previous labour income.

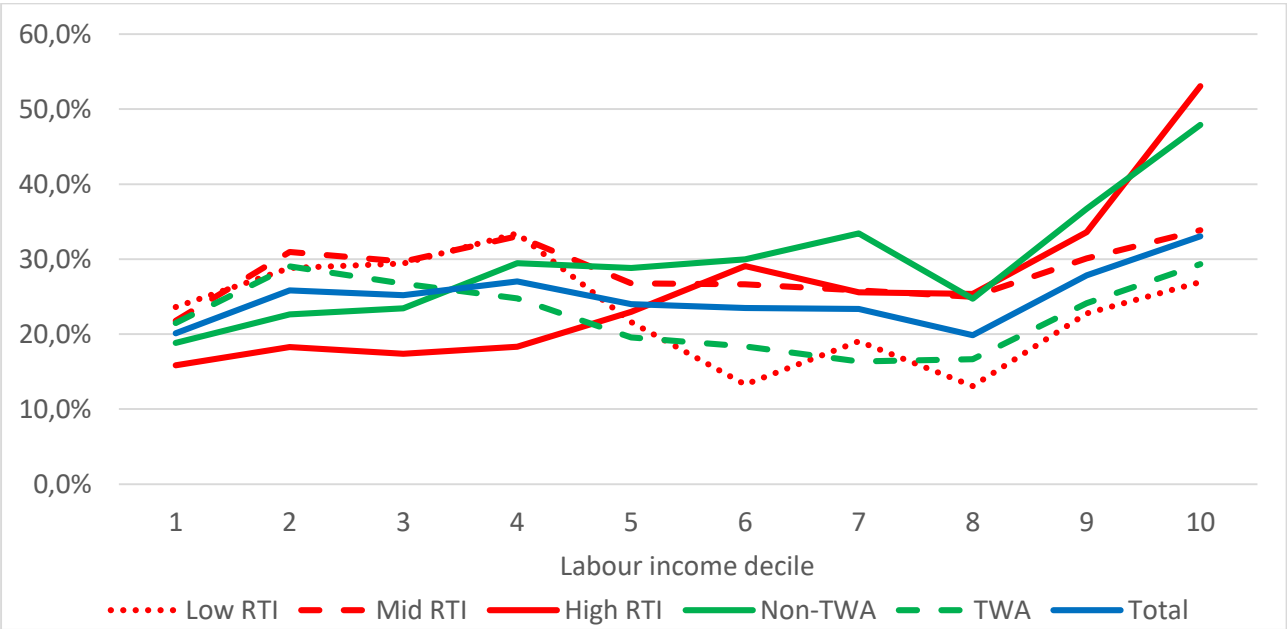
Figure 1 also highlights that labour market risks were higher for those lying in the bottom part of the income distribution, especially for those performing non-TWA job.

Figure 1. Share of workers experiencing a great loss in annual gross income by RTI tercile, TWA and decile of labour income in the No-COVID distribution



Notes: A great loss refers to an income drop higher than 10% from the No-Covid to the Post-Covid scenario. Source: Elaborations on AD-SILC 2017.

Figure 2. Share of workers experiencing a great loss in annual total individual income by RTI tercile, TWA and decile of labour income in the No-COVID distribution



Notes: A great loss refers to an income drop higher than 10% from the No-Covid to the Post-Covid scenario. Source: Elaborations on AD-SILC 2017.

The teleworkability of a job emerges as the main shield against Covid-19 related labour market risks. Therefore, observing income risks of workers performing jobs with a different content of routineness, without considering the teleworkability of that job, might be short-sighted. We then repeated the computation of labour and total income losses by dividing workers in 6 groups according to the interaction between the TWA binary variable and the RTI terciles.

Confirming the evidence that labour market risks in the first months after the pandemic occurrence were mostly driven by the job teleworkability, Table 5 shows that the share of workers experiencing a large labour income drop does not dramatically differ across the RTI terciles when we focus on those performing a TWA activity. Conversely, when the focus is on those in non-TWA jobs, the share of workers experiencing a large labour income drops is more than 25 p.p. higher among Mid- and High-RTI workers than among those in Low-RTI occupations. Interestingly, the share of large income losers is almost the same between Low-RTI workers performing TWA or non-TWA activities. Also note that, when focusing on total income (bottom panel of Table 5), the groups of workers reporting the lowest share of 'great losers' are High-RTI but TWA workers (17.2%) and Low-RTI and non TWA workers (18.9%).[18]

The evidence shown so far suggests that labour market risks related to the pandemic – and the associated new types of earnings inequality – are shaped by various factors (as TWA, RTI and, of course, the industry and the contractual arrangement) instead than by a single dimension.

Table 5. Loss from pandemic – before and after emergency benefits – interacting TWA and RTI terciles (column percentages)

Gross labour income						
Loss from pandemic	TWA			Non-TWA		
	Low RTI	Mid RTI	High RTI	Low RTI	Mid RTI	High RTI
No loss	46.2%	37.0%	38.6%	47.2%	20.5%	19.8%
Moderate loss	23.4%	26.2%	26.5%	21.9%	22.1%	22.0%
Great loss	30.5%	36.8%	34.9%	30.9%	57.4%	58.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Gross individual total income						
Loss from pandemic	TWA			Non-TWA		
	Low RTI	Mid RTI	High RTI	Low RTI	Mid RTI	High RTI
No loss	50.8%	41.5%	41.8%	54.6%	29.4%	23.8%
Moderate loss	25.0%	33.5%	41.1%	26.5%	37.0%	47.5%
Great loss	24.2%	25.0%	17.2%	18.9%	33.7%	28.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes: The income loss is 'great' if the relative decrease is more than 10%, it is 'moderate' otherwise. 'No loss' means that the income level remains unchanged or even increases after the pandemic. Source: elaborations on AD-SILC 2017.

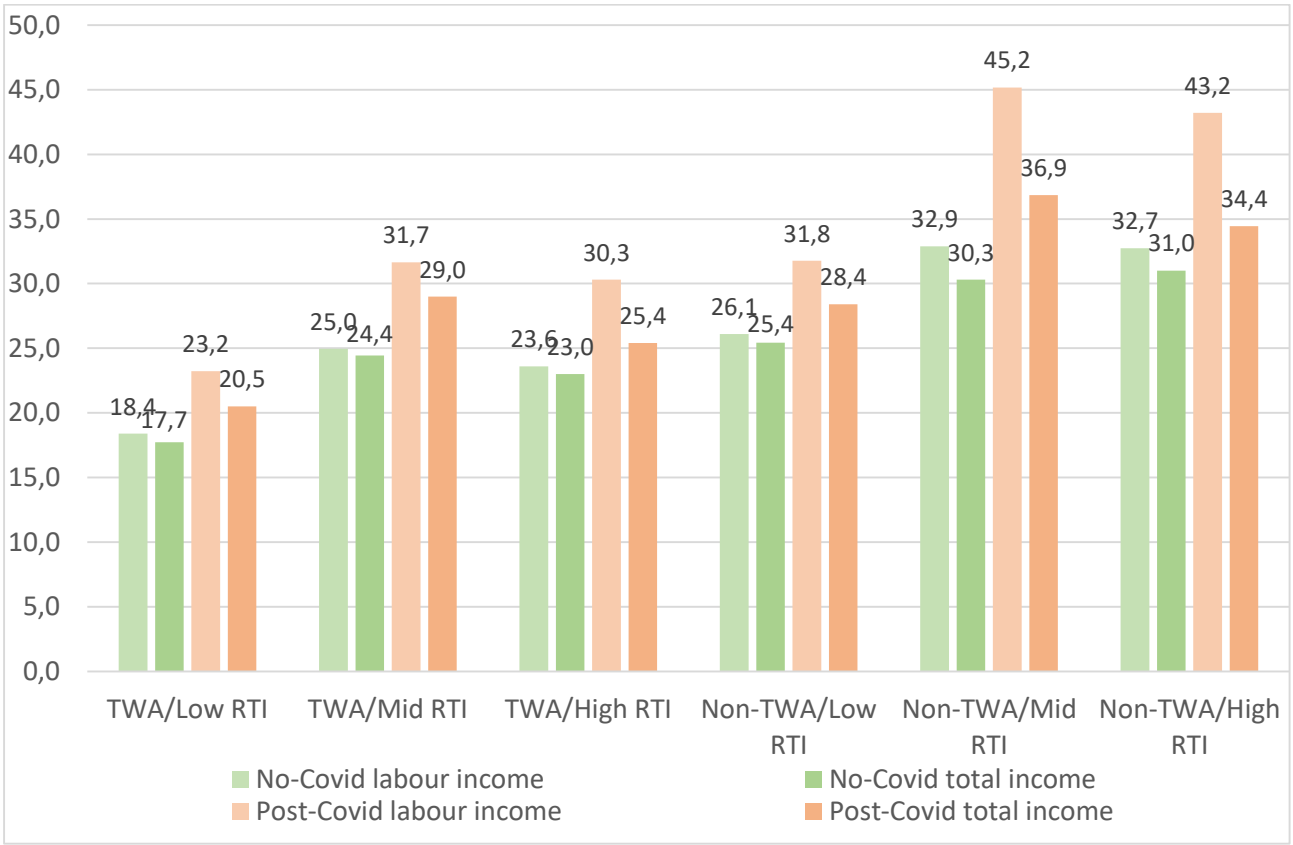
The picture about relative risks of different groups of workers and the redistributive impact of the emergency benefits is confirmed when we look at the share of low-income workers, i.e. those

[18] As mentioned, the influence of emergency benefits in changing the labour income distribution depends on both the access to these benefits and the degree of progressivity of the benefit formula. For instance, flat-rate benefit (e.g., the bonus-600 for self-employed and atypical workers) highly advantage low-paid workers who receive a benefit amount independent of the size of the income loss, while the computation formula of the CIG allowance relatively penalises high-wage workers because of the existence of a relatively low cap to the benefit amount (see Section 3.1).

earning less than the 60% of the median of the distribution of labour income or total income. Specifically, we distinguish six groups of workers according to the crossing between RTI and TWA (Figure 3), while the low-income risks of workers are observed by RTI and TWA separately in Figure A5 in the online Appendix.

The highest increase in the incidence of low-pay emerges within those performing a non TWA and Mid- or High-RTI job (+12.3 and +10.5 p.p., respectively), while the lowest increase in the low-pay incidence characterises workers in Low-RTI and TWA as well as workers in Low-RTI and non-TWA jobs (+4.8 and +5.7 p.p., respectively). However, the rise in the low-pay incidence largely reduces when the emergency benefits are added to labour income. Similarly to what emerged relative to the great income loss risk, the highest increase in the share of low-pay workers from the No-Covid to the Post-Covid total income characterises Mid-RTI workers, independently of the teleworkability of their job (among Mid-RTI workers, the incidence of low-pay workers rises by 4.6 and 6.3 p.p. for TWA and non-TWA workers, respectively, when comparing Pre- and Post-Covid total incomes; see Figure 3). As already mentioned, the relative disadvantage for Mid-RTI workers when the focus is on total income might be due to the lower amount of emergency benefits received by self-employed workers whose share is much lower among the High-RTI workers than among those performing a Mid-RTI job.

Figure 3. Effects of the pandemic on the incidence of low income risk interacting TWA and RTI tercile



Notes: The low income threshold is defined as 60% of the median of the distribution of labour or total income in the No-Covid scenario. Source: Elaborations on AD-SILC 2017 data.

6. Conclusions

By relying on microsimulations based on nowcasting techniques and focusing on the case of Italy, this paper aims at assessing whether the job's routineness and teleworkability differently exposed individuals to income drops risks after the pandemic occurrence. Because of the unavailability of timely information on the evolution of income distribution for a long time span, simulations of distributional changes in a given population observed in past years are the best strategy available for researchers to inquire about the effects of the COVID-19 pandemic on poverty and inequality in a timely manner (Christl et al., 2021; Cantò et al., 2021).

Among the possible drivers of earnings inequality among workers, we focused on teleworkability - since it has emerged from many studies as a new crucial factor dividing more and less advantaged workers- and on the task routineness -since workers performing different types of jobs may have been differently exposed to pandemic-related labour market risks also independently of the possibility of performing that job remotely.

To this purpose, we first compared wages of workers characterized by a different degree of RTI and TWA in the pre-pandemic world and then investigated whether workers with different RTI and TWA levels were differentially exposed to labour income drop risks since the occurrence of the Covid-19 pandemic, also considering the cushioning effect exerted by the emergency income support measures implemented by the Italian Government to cope with the effects of the pandemic.

We first found that RTI and TWA are negatively and positively associated with wages, respectively, thus suggesting that these two jobs characteristics may represent further factors driving wage inequalities over those already pointed out by the economic literature (Franzini and Pianta, 2015; Raitano, 2019). Furthermore, microsimulations on the counterfactual Post-Covid individual income distribution show that RTI and TWA are associated with higher (respectively lower) risks of a large labour income drop due to the pandemic. However, differences in income drop risks for workers who differ by RTI and TWA largely lessen when income support measures are considered, thus suggesting that the redistributive effect of the emergency measures implemented by the Italian Government was rather effective. Moreover, we also find that TWA and RTI cannot be considered separately as risk factors, since different patterns arise when we distinguish workers with a same degree of RTI and performing TWA or non-TWA jobs (or vice versa). Hence, the evidence from our microsimulations suggests that labour market risks related to the pandemic – and the associated new types of earnings inequality that may derive – are shaped by various factors (as TWA, RTI and, of course, the industry and the contractual arrangement) instead than by a single dimension.

The technological changes accelerated by the pandemic spread together with possible changes in the consumers' choices might then differentially affect labour demand and labour supply of certain jobs, thus creating room for new dimensions of wage inequality. This is possibly contrasting some interpretations of previous inequality trends, as the RBTC hypothesis, which predicted a relative advantage for manual-non routine workers with respect to middle class routinary workers (Autor et al., 2003; Acemoglu and Autor, 2011). Indeed, the need for social distancing might particularly dampen those workers – as carers or waiters – whose tasks require personal interactions.

As a matter of fact- as argued by Autor and Reynolds (2020)- telework, together with the three other major post-covid transformations, i.e. urban re-densification, employment concentration in large firms and further automation pushed by the social distancing requirements, is likely to shape the post-Covid crisis trajectory in the direction of complementing the impact of technology in removing

middle-skill routine jobs, on the one hand, and also extending this trend to the low-wage end of the bar, on the other hand. Likewise, low-pay workers in some sectors – as travelling, tourisms, restaurants – might be further dampened by changing consumers' habits even when the pandemic spread will end. As a consequence, a further increase in inequality and earnings gaps between a minority of safe and well-paid workers and a large majority of precarious and low-pay workers might emerge.

These trends, especially those related to changes in investment in innovation by firms and in behaviours and tastes by consumers, require time to occur. In this paper, we are only able to observe the very short-term period effect of the Covid crisis, that was mostly driven by the shutdown of certain activities due to the social distancing measures implemented during the first two waves of the pandemic. Nevertheless, observing these short-term trends might provide useful insights that help identifying possible underlying trends, in order to timely start depicting sound redistributive and predistributive measures to cushion a further increase of wage inequality along the faults we focused on in this paper.

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Online Appendix

Table A1. Simulated policies introduced during 2020 and their duration in 2020

Measure	Content	Duration
Extension of the CIG allowance	Short-time work compensation scheme for employees in all firms and economic sectors, independent of the extent of the working time reduction (i.e., it also protects workers whose working time is reduced to zero).	From March to the end of 2020
Extension of ordinary unemployment benefits	Duration extended up to 4 months in favour of recipients whose benefits had expired.	From March to June 2020
Flat-rate allowance for atypical and self-employed workers ('Bonus-600')	Para-subordinate collaborators and professionals received a 600-euro monthly benefit in March and April and a 1,000 euro monthly benefit in May. Self-employed enrolled in INPS (i.e., craftsmen, dealers and farmers) received a 600-euro monthly benefit in March and April. Professionals enrolled in a private social insurance fund managed by their professional associations and with an income below specific thresholds received a 600-euro monthly benefit from March to May. Intermittent and seasonal workers received a 600 euro monthly benefit from March to May and three additional monthly instalments from September 2020 (the amount was increased to 1000 euros for seasonal workers in tourism from May 2020).	The duration of the allowance depends on the specific worker's category
Lump sum transfer for employees ('Bonus-100')	100 euro lump sum benefit paid to employees working on company premises.	March 2020
Stoppage of layoffs	Ban on the layoff of employees, with some exceptions.	From 23 February up to the end of 2020

Source: Jessoula et al. (2021).

Table A2. Assumptions about monthly self-employment income loss in 2020 (% with respect to the No-COVID scenario)

Month	Non-essential		Essential	
	Non Teleworkable	Teleworkable	Non Teleworkable	Teleworkable
Jan	100%	100%	100%	100%
Feb	100%	100%	100%	100%
Mar	0%	33%	50%	75%
Apr	0%	33%	50%	75%
May	75%	75%	75%	75%
Jun	75%	75%	75%	100%
Jul	75%	75%	75%	100%
Aug	75%	75%	75%	100%
Sep	75%	75%	75%	100%
Oct	75%	75%	75%	100%
Nov	0%/25%/50%	33%/50%/67%	50%/67%/75%	75%/90%/100%
Dec	0%/25%/50%	33%/50%/67%	50%/67%/75%	75%/90%/100%

Note: In November and December the self-employment income loss changes according to the 'colour' of the zone (yellow, orange and red zones, respectively), i.e. according to the seriousness of the pandemic spread.

Table A3. Representative jobs belonging to the RTI terciles and to the TWA categories in the AD-SILC 2017 sample

RTI tercile	Teleworkable	
	No	Yes
1	Medical and Therapeutic Equipment	Stenographers and Typists
	Electronics Mechanics and Servicers	Sociologists, Anthropologists and Related Professionals
	Protective Services Workers	Authors and Related Writers
	Journalists	Securities and Finance Dealers and Brokers
2	Locomotive Engine Drivers	Word-Processor and Related Operators
	Shop Supervisors	Transport Conductors
	Shopkeepers	Applications Programmers
	Mixed Crop and Animal Producers	Statistical, Finance and Insurance Clerks
	Market-Oriented Skilled Forestry, Fishery and Hunting Workers	Database Designers and Administrators
3	Assemblers	Cooks
	Livestock and Dairy Producers	Credit and Loans Officers
	Shop Sales Assistants	Stock Clerks
	Electronics and Telecommunications Installers and Repairers	Bank Tellers and Related Clerks
	Chemical and Photographic Products Plant and Machine Operators	Production Managers in Agriculture, Forestry and Fisheries

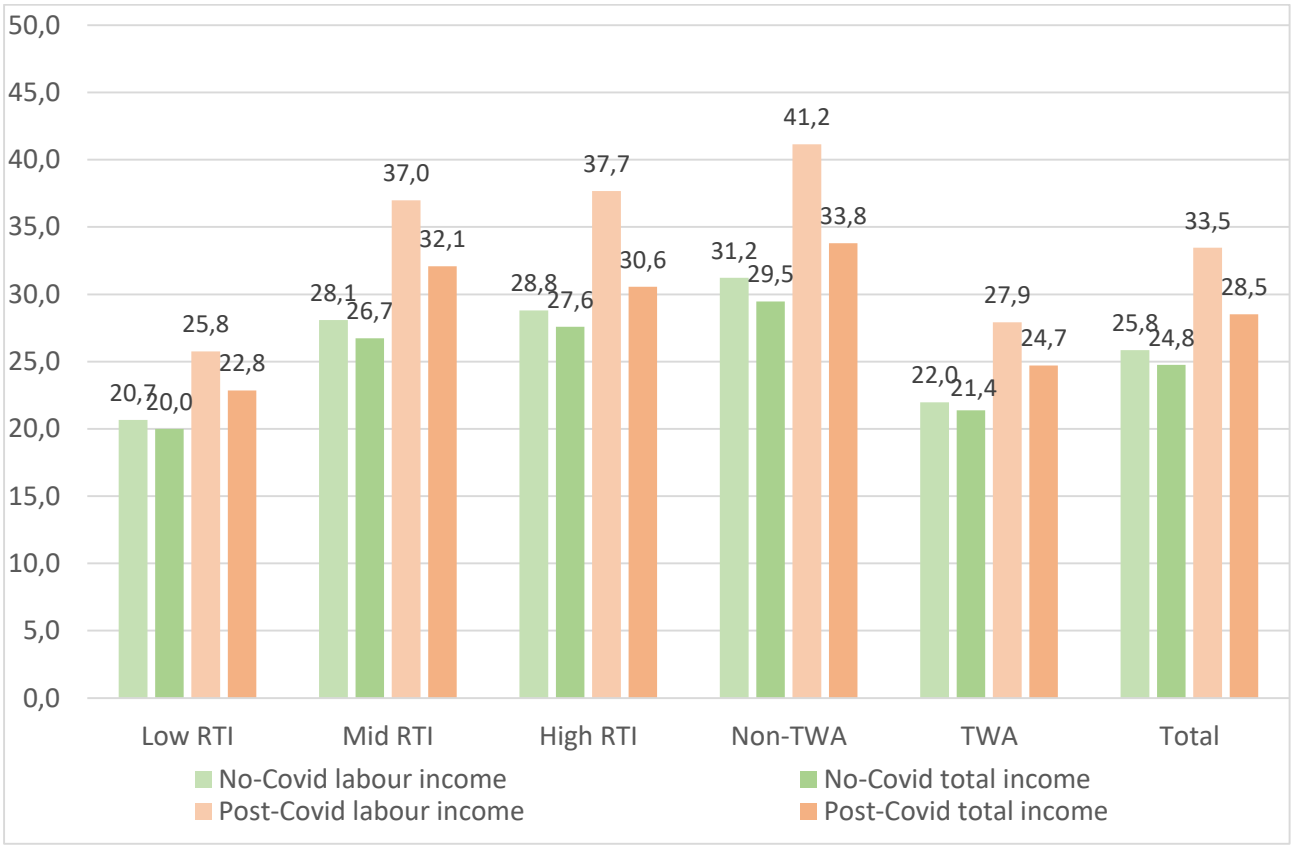
Source: Elaborations on AD-SILC 2017.

Table A4. Share of self-employed workers by RTI terciles and TWA

RTI tercile	Teleworkable		Total
	No	Yes	
1	73.1%	73.2%	73.2%
2	71.1%	73.0%	72.2%
3	84.3%	86.3%	85.2%
Total	77.4%	76.3%	76.8%

Source: Elaborations on AD-SILC 2017.

Figure A5. Effects of the pandemic on the incidence of low income risk by RTI tercile and TWA



Notes: The low income threshold is defined as 60% of the median of the distribution of labour or total income in the No-Covid scenario. Source: Elaborations on AD-SILC 2017 data.