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Who lost the most? Distributive effects of COVID-19 pandemic

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Abstract

This paper investigates what happened to the wage distribution in Italy during the first wave of the COVID-19 pandemic. It shows which categories of workers and economic sectors have suffered more than others and to what extent both the actual level of smart-working and the ability to Working From-Home can influence the wage distribution. We use a unique dataset relying on the merging of two sample surveys: the Italian Labor Force Survey set up by National Institute of Statistics and the Italian Survey of Professions conducted by the National Institute for Public Policy Analysis. We estimate quantile regression models accounting for selection. First, the findings reveal that the pandemic has affected the wages of the whole workers, but the effect is higher at the bottom of the wage distribution. Second, the actual working from home mitigates the negative distributional consequences of the COVID-19 observed for those at the bottom of the wage distribution. However, the advantage of workers at the bottom tail of the wage distribution seems to lessen in the long term once the health emergency is passed. Third, looking at sectoral heterogeneity, retail and the restaurant are the most hit sectors in terms of wage loss. Fourth, separating by gender, men have been mostly hit by the pandemic, particularly at lowest deciles, though they benefited more from working at home at higher deciles. Finally, women appear as the one that in the long run would benefit more from increasing working from home possibility.

Keywords: Wage inequality; COVID-19; Working from home; Quantile regression

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1. Introduction

The coronavirus emergency has now hit all countries of the world (Karabulut et al. 2021; Milani, 2021; Papageorge et al. 2021; Zimmermann et al., 2020), with a serious impact on the labor market, both in the short (Alon et al., 2020a; Botha et al., 2021) and long term (Baert et al., 2020). Consequently, governments have had to adopt drastic measures to combat the pandemic: on the one hand by closing activities of non-essential services (Ascani et al., 2020; Depalo, 2021; Brodeur et al., 2020a; Brodeur et al. 2020b; Qiu et al., 2020; Caselli et al., 2020), on the other hand by increasing the share of jobs that can be carried out remotely (Dingel and Neiman, 2020; Montenovo et al., 2020, Palomino et al., 2020). Thus, the capacity to Working-From-Home (WFH hereafter) is considered as a key job characteristic in the age of COVID-19 as it allows people to continue their working activity while limiting both the risks for public health and pandemic recessive impacts (Bonacini et al., 2021a).

Among different labor market outcomes affected by the COVID-19 crisis, the wage distribution has been relatively less investigated mainly due to the lack of timely and reliable data (Adams-Prassl et al., 2020; Gallo and Raitano, 2020). In this article we investigate the effect of COVID-19 pandemic on the wage distribution in Italy. Three questions are relevant: What is the actual effect of the pandemic along the wage distribution? To what extent both the actual level of remote working and the capacity to WFH as a possible long-lasting solution can influence the wage distribution? What categories of workers (i.e. women) and economic sectors are suffering more than others?

We choose Italy as an interesting case study because it is one of the countries most affected by the pandemic. As of March 2021, it is the seventh country in the world for cumulative cases with about 3.2 million cases, the sixth for number of deaths with about 103 thousand[i], and the first Western country to adopt severe lockdown measures on March 11, 2020 (Barbieri et al., 2020). Moreover, the consequences on the labor market in Italy have been severe. The employment growth in the first quarter of 2020 is followed by a consistent decline in the second quarter which continued, albeit at a slower pace, also in the third and fourth quarters. An unprecedented fall in employment is observed on an annual average (-456 thousand, -2.0%), associated with a drop in unemployment and the strong growth in the number of inactive. Furthermore, the decrease in employee positions (-1.7%) and in the number of hours worked (-13.6%), as well as the increase in the use of the furlough scheme (*Cassa Integrazione Guadagni, CIG*) (+139.4 hours per thousand worked), are more marked in the service sector compared to that of industry.[ii] Finally, the COVID-19 pandemic has produced significant effects on low wages and on poverty in Italy. According to the preliminary estimates of absolute poverty for the year 2020, released in March 2021 by the Italian National Institute of Statistics (ISTAT hereafter), it has been provided a clear picture of the consequences that the serious economic crisis caused by the pandemic and the health emergency has had on the living conditions of Italian families. These preliminary estimates indicate values of the incidence of absolute poverty growing both in terms of households (from 6.4% in 2019 to 7.7%, + 335 thousand), with over 2 million families, and in terms of individuals (from 7.7% to 9.4%, over 1 million more) which amounted to 5.6 million. In the year of the pandemic, the improvements recorded in 2019 disappeared. After four consecutive years of increase, the

number and share of families (and individuals) in absolute poverty had in fact decreased significantly, while remaining on values much higher than those preceding the crisis that started in 2008, when the incidence of absolute family poverty was less than 4% and that of the individuals was around 3%. Therefore, during pandemic, absolute poverty reaches, in Italy, the highest values since 2005 (i.e., since the time series for this indicator is available).[iii]

To contain infections from COVID-19, it has been recently estimated that at least 3 million employees (i.e. about 13% of the total) started working remotely along with an additional number of workers that did the same even earlier due to the closure of schools and universities on March 5 (Bonacini et al., 2021b). Before the pandemic, Italy was found as the European country with the lowest share of teleworkers (Eurofound and ILO, 2017) but, because of the COVID-19 crisis, it had increased to a larger extent the possibility to work remotely in a very short time, without both clear legislation and satisfactory policies (Bonacini et al., 2021a). Since the country is now gradually improving the share of remote working, it is important to estimate, with the help of real-time data, the distributive impact of the actual WFH. Thus, we build an indicator of remote working to add as a covariate in our estimates, to evaluate its effect along the wage distribution (see Section 3 for details). Despite, some recent empirical papers have examined social and economic consequences of the current pandemic in Italy (Barbieri et al., 2020, Bonacini et al., 2021c, Brunetti et al., 2021, Carbonero and Scicchitano, 2021 Casarico and Lattanzio, 2020), the impacts in terms of inequality and wage distribution have been left largely unexplored. Likewise, all the existing evidence (Bonacini et al., 2021a; Gallo and Raitano, 2020) uses data referring to the pre-pandemic period to simulate the distributional consequences: to our knowledge this is the first paper which estimates real effect of the COVID-19 pandemic on wage distribution in Italy.

As a result, this contribution aims at filling this gap. We use quarterly data in the time span from the first quarter of 2019 to the second quarter of 2020, at the turn of the crisis period, during which the lockdown in Italy occurred, to investigate distributive effects controlling for individual and job characteristics. We use a unique dataset relying on the merging of two sample surveys. The first is the Italian Labor Force Survey set up by ISTAT, which is the official and largest survey conducted in Italy to monitor the dynamics of the labor market. It provides a large amount of information on the socio-economic conditions of Italian men and women of working age, including the actual work performed remotely. The second sample survey is the Italian Survey of Professions (*Indagine Campionaria delle Professioni* - ICP) provided by the *Istituto Nazionale per l'Analisi delle Politiche Pubbliche* (INAPP)) which contains detailed information of the task-content of occupations at the 5-digit ISCO classification level. The ICP is the Italian equivalent of the US O*NET repertoire and allows us building the *Remote Working* attitude. We use this proxy to test whether the potential ability to WFH can be used in the long period as a "new normal" way of working (Bonacini et al., 2021a) once the health emergency situation has passed and the lockdown is over. Indeed, it was predicted that once companies and workers will incur significant fixed costs for WFH due to technologies, changes in production processes and updating of human capital, it is likely that they will no longer want to go back and therefore the remote work should be considered as a long-lasting solution (Brynjolfsson et al., 2020).

Our results show that the pandemic has affected the wages of the whole workers but, the effect is higher at the bottom. The retail and the restaurant are the most affected economic sectors. Notably, the actual WFH variable mitigates the negative distributional consequences of the COVID-19 observed (in general) for those at the bottom of the wage distribution. However, when we consider the WFH capacity index to test the potential long-lasting effects of the opportunity of working remotely, we note that the index underestimates the positive advantage of WFH for workers at the lowest quintiles. The advantage of workers at the bottom tail of the wage distribution, therefore, seem to lessen in the long term. When we separate by gender, we note that women on the long run may benefit more from WFH prospects.

The rest of the article is structured as follows. The next Section presents the literature review on the topic and a brief chronicle of the COVID-19 outbreak in Italy. In Section 3, we describe the datasets, define our variables of interest and provide some descriptive evidence; while Section 4 reports the econometric methodology. Section 5 presents results and robustness checks. Section 6 concludes with some policy implications.

2. Covid-19, labor markets and incomes: the current literature

The economic literature that empirically investigates the effects of the COVID-19 pandemic on the labor market is exploding (see Brodeur et al. (2020) for a recent comprehensive survey). Our paper is related to some strands of this literature. First, some recent studies evaluate the potential and the real distributional effects of the pandemic. Using data from a large Fintech company in the United Kingdom, Hacioglu et al. (2021) show that the smallest spending cuts and the largest earnings drop were observed at the lowest quantiles, but their total incomes were reduced by much less because of the rise in government benefits. Deaton (2021) shows that per capita incomes decrease more in higher-income countries. Wildman (2020) demonstrates a significant positive correlation between income inequality and COVID-19 incidence. Clark et al. (2020) using longitudinal data from France, Germany, Italy, Spain, and Sweden find a reduction in relative inequality between January and September 2020. They argue that a possible explanation is that the policy responses to COVID-19 has been focused on the bottom of the income distribution where the individuals most affected by the pandemic are expected to be found. Kosteas and Renna (2020) use the concentration index to calculate the income-related-inequality in unemployment in the US, and to examine the change in inequality between February and April of 2020. They find that an absolute measure of inequality shows increased inequality during the early months of the pandemic, while a relative measure proves reduced inequality. The authors also find that the potential for remote working helps to explain the increased inequality. Lemieux et al. (2020) investigate the impact of the current pandemic on the Canadian labor market and show that half of job losses are related to workers in the bottom earnings quartile. The impact was higher in industries most affected by shutdowns (accommodation and food services) and for younger workers, paid hourly, and non-union. What this line of research makes clear is that the possibility of investigating this issue is highly dependent on the availability of timely and reliable data since representative

datasets on population incomes and living conditions are normally released long after the interview (Gallo and Raitano, 2020). The UK (Benzeval et al., 2020; Witteveen, 2020) and the US (Berman, 2020; Cortes and Forsythe, 2020) are two exceptions with *ad-hoc* real-time surveys. To solve the question, scholars used real time surveys (e.g., Adams-Prassl et al., 2020; Galasso, 2020) or big data on bank records (Aspachs et al., 2020). However, these kinds of data cannot be taken as representative of the whole population and do not allow to reliably estimate the changes occurring along the income distribution (Gallo and Raitano, 2020). We add to this literature by analyzing what happened to the labor income distribution in Italy during the crisis by using actual data from the official Labor Force Survey (LFS).

In addition, it is clear that the impact of the pandemic and the following containment measures on the economy crucially depends on the workers' ability to WFH. Thus, an exploding strand of economic literature aims at classifying the jobs that can be performed at home, so as to determine what workers might have been less impacted by social distancing measures, mobility restrictions, and risks of contagion (Baker, 2020; Boeri et al., 2020; Dingel and Neiman, 2020; Gottlieb et al., 2020; Hensvik et al., 2020; Holgersen et al., 2020; Mongey et al., 2020; Yasenov, 2020). Further empirical papers explore the potential consequences on the labor income distribution related to a long-lasting increase in WFH feasibility. Palomino et al. (2020), for instance, simulate the capacity of individuals to work under a lockdown based on a Lockdown Working Ability index, which considers their teleworking capacity and whether their occupation is essential or closed among 29 European countries. Under four different scenarios, they estimate an average increase in the headcount poverty index that goes from 4.9 to 9.4 percentage points and a mean loss rate for poor workers between 10% and 16.2%. The average increase in the Gini coefficient ranges from 3.5% to 7.3%. Similarly, Delaporte and Pena (2020) aim to evaluate the distributional outcomes of social distancing because of the pandemic by considering poverty and labor income inequality in Latin American and Caribbean region. They show that both poverty and labor income inequality have gone up, and majority of the income losses can be attributed to sectoral and occupational structure of the economies. Duman (2020) builds the possibility to work remotely index in Turkey: he argues that wage inequality is expected to increase as a result of the supply shocks from confinement policies. Adams-Prassl et al. (2020) investigate the inequality in job and income losses based on the occupation and individual characteristics for the US and the UK. They show that workers unable to work from home have a higher probability of losing their job and that younger and lower educated workers are more likely decrease their income.

In this paper, we build the actual level of remote working and WFH capacity index for Italy and then evaluate its effect at different quantiles of the wage distribution.

Finally, some studies have also investigated the consequences of the COVID-19 pandemic on the labor market in terms of gender inequality, showing that its impact on women may be larger (Alon et al., 2020a; 2020b, Cuesta and Pico, 2020, Del Boca et al., 2020). The potential effects of the pandemics in terms of Gender Wage Gap (GWG), instead, have been largely unexplored. Bonacini et al. (2021b) using data pre-pandemics simulate that the current pandemic may increase the gender pay gap, since this is greater among females working in an occupation with a high level of WFH attitude. In our study, we estimate the GWG

along the whole labor wage distribution during the pandemic, by also showing the role of actual and potential WFH in shaping it.

Regarding Italy, it appears to suffer more than other countries from the effects of the pandemic due to its structural problems (Capano, 2020). Using ICP data for Italy, Barbieri et al. (2020) show that the sectors with the greater share of workers that could work from home are "Energy", "Finance", "Public Administration" and "Professional services", not the sectors affected by the lockdown decrees. Given the share of those who can work from home, there could be up to 3 million persons who worked from home in essential (i.e., open) sectors and not in workplaces during the first wave of the pandemic. Following the methodology proposed by Dingel and Neiman (2020) and applying it to Italy, Cetrulo et al. (2020) catalogue what occupations can perform from home and conclude that only 30% of the Italian workforce is employed in WFH activities. Casarico and Lattanzio (2020) find that, starting from the beginning of March 2020, there was a clear cut in hiring and endings of temporary contracts. They also demonstrate that young, temporary, and low-skill workers are more at risk of unemployment because of COVID-19, while gender is not significant. Regarding the possible impact on incomes in Italy, it is demonstrated that a positive shift in WFH capacity, as a long-lasting result of the pandemic, would be associated with an increase in average labor income, but this potential benefit would be not equally distributed among employees. Specifically, an increase in the opportunity to WFH would favor older, high-educated, and high-paid workers (Bonacini et al., 2021a). Thus, the pandemic and the possible long-lasting increase in the WFH, risk exacerbating pre-existing inequalities in the labor market, especially if it will not be adequately regulated. Consequently, the authors suggest that policies aimed at alleviating inequality, like income support measures (in the short run) and human capital interventions (in the long run), should play a more important compensating role in the future. Gallo and Raitano (2020) simulate what the effects of the pandemic are for the whole 2020 in Italy under three different scenarios. They show that the pandemic has led to a relatively greater decrease in labor incomes for those at the bottom of the income distribution, but they were the same having received the higher benefits from the Government. As a result, market incomes decreased, but social transfers have been found effective in reducing the most serious economic consequences of the pandemic. Carta and De Philippis (2021) use micro data referring to the fourth quarter of 2019 to simulate the impact of pandemics on the distribution of labor income in Italy and find a possible clear increase in income inequality.

To sum up, all the existing evidence on the impact of the pandemic on income in Italy relies on simulations, using data prior to the advent of the pandemic. We investigate what happened during (first wave of) COVID-19 on wage distribution in Italy using data up to the second quarter of 2020, by also showing the actual effect of the WFH as well as of the ability to WFH. The effects in terms of GWG and sectoral heterogeneity along the whole wage distribution are further explored.

3. Data and sample

Our empirical study draws from a unique dataset relying on the merging of two major Italian labor market surveys: the LFS derived from the ISTAT, and the Italian Survey of Professions conducted by INAPP. These

two datasets are combined to obtain data on employment dynamics, individual characteristics, labor market variables, including both the actual and the capacity to WFH.

The empirical analyses exploit cross-sectional quarterly data (2019Q1-2020Q2) derived from the LFS. It is the largest survey conducted in Italy to monitor the quarterly dynamics of the labor market: each year, it collects information on almost 280,000 households in 1,246 Italian municipalities for a total of 700,000 individuals. Because we are interested in estimating the effect of the COVID-19 pandemic on the labor market outcomes, we analyze six quarters, from the first quarter of 2019 to the second quarter of 2020. To isolate the effect of the pandemic, as we will see below, we include in our set of covariates a dummy variable that equals one in the second quarter of 2020, and 0 otherwise.

The sampling design of the survey is composed of two stages, with a stratification of the unit at the first stage; the first stage units are municipalities, whereas the second stage comprises households. Each household member is interviewed. The main difference between the two stages is that although for families a 2-2-2 rotation scheme is applied, the municipalities surveyed do not change over time.

More specifically, a household was interviewed for two consecutive surveys and, after being excluded from the sample for two quarters, was interviewed for another two consecutive quarters. This is defined as a (2-2-2) rotation scheme (for details on the sampling design see, for instance, Mussida and Lucarelli, 2014). This rotation system makes it possible to maintain half of the sample unchanged in two consecutive quarters and in quarters 1 year apart. In other words, the scheme implies a 50 per cent overlapping of the theoretical sample to a quarter of the distance, a 25 per cent overlapping to three quarters, a 50 per cent to four quarters, and a 25 per cent to five quarters.

Our analyses are based on quarterly cross-sectional data for the sample of individuals from the age of 15 to the age of 64. The sample is representative of the overall population as we use the provided population weights. In the first stage, selection, we use the overall sample of individuals, while in the second stage, wage equation, our sample includes only employees. Considering both the non-employed and the employed, 311,654 individual observations are available over the period 2019Q1-2020Q2, while the total number of wage observations is 214,429.

As explained in Section 4, we estimate a quantile regression model with parametric sample selection. The dependent variable for the second and most important stage is the monthly net wage in the respondent's main job, corrected for part-time. The variables used in the two stages of our econometric framework are summarized in Table 1. Explanatory variables may be grouped into supply determinants reflecting individual characteristics (Mincer 1974), which are related to: (1) gender, (2) age, (3) education, (4) geographical area of residence, (5) citizenship, (6) family features/household structure (marital status, household type), (7) characteristics of the job (contract type, occupation, sector of economic activity), (8) actual WFH, (9) WFH capacity index,

As explained above, we included a dummy variable to account for the COVID-19 pandemic. We also consider quarterly dummy variables in our set of covariates.

[TABLE 1 ABOUT HERE]

The relevance of gender is emphasized both in past literature, which analyses aggregate data on the overall labor market (e.g. Baussola, 1988), and in studies using individual labor force data of the Italian labor market for the decade 1993-2003, such as Schindler (2009) and Trivellato et al. (2005). The heterogeneity through the overall age range 15-64 is considered by introducing specific dummy variables for the age brackets [15, 24], [25, 34], [35, 44], [45, 54], and [55, 64]. We consider four educational attainment levels:[iv] no education, lower secondary school, upper secondary school, and graduate. Around half of our sample attained upper secondary education (47.9%), a lower percentage had no education or attained lower secondary education (around 29%) and approximately one fifth achieved a degree (or above).

The geographical differential, which is a structural characteristic of Italian labor market (Bertola and Garibaldi, 2003), is considered by including specific covariates. Four dummy variables for geographical area of residence classified according to the NUTS system were introduced,[v] i.e. North-West, North-East, Centre and South/Islands. More than half of our sample lives in the North (approximately 53%), more than one fifth in the Centre, while the remaining in the South of Italy.

We also control for the citizenship, and around 88% of the sample is Italian. As for family features/household structure, we control for family status (single or married), and the household type, that are single (around 16% of the sample), couple with kids (the strong majority, around 60%), couple without kids, mono-parental mother (8%), and mono-parental father (only 1.6%). As explained in Section 4, the variables for household type are included only in the selection equation for identification purposes.

The Italian LFS allows controlling for a rich set of characteristics of the job, especially relevant for our second stage that is the estimation of the wage equation for employees. We control for temporary work, the type of occupation, and the sector of economic activity. The occupation classification used to build these indicators is the CP2011 and we use three dummies for managerial occupation, white-collar, and blue-collar. For the sector of economic activity, the classification is the ATECO 2 digit, and we have twelve sectors.

Since the ability to WFH has been proved being a key variable lo limit negative consequences from the current pandemics, firstly we want to check for the short-term effect that the *actual* WFH has had in lockdown situation, using a covariate that captures the hours performed remotely during the last month, thus we build a dummy variable "*actual WFH*" equals to 1 if the employees have done their work remotely more than twice a week and 0 otherwise. It is clear that as a result of the containment measures implemented on March 9 2020 the hours carried out remotely are expected to be much greater than in the pre-pandemic situation. From our data, we note that only 1.8% of employees had done their work from home in the second half of 2019, while a year later in full pandemic the same percentage increased up to almost 18%. The actual WFH, indeed, varies between gender and across sectors of economic activities before and during the COVID-19 pandemic. Figures 1 and 2 offer a visual inspection of the changes due to the pandemic to the actual WFH of men and women, and sectors of economic activity, respectively. We note that while before the pandemic the WFH was basically null for both genders (left panel of Figure 1), the attitudes increase

especially for female with the pandemic (right panel of Figure 1). Interestingly, from Figure 2 we see that the pandemic caused a not negligible increase in WFH for the sectors of communication, finance and insurance, education, public administration, and real estate.

[FIGURE 1 ABOUT HERE]

[FIGURE 2 ABOUT HERE]

Finally, we built the *WFH capacity*, as an index useful for measuring the potential ability to do the work from home in the long term: this proxy can be used to test a possible "new normal" way of working, once the emergency situation has passed and the lockdown is over. To do that we use data from the *Indagine Campionaria sulle Professioni* (INAPP-ICP). The ICP is a rather unique source of information on skill, task, and work contents. In fact, the ICP is the only European survey replicating extensively American O*Net.[vi] Both the American O*Net and the Italian ICP focus on occupations (i.e. occupation-level variables are built relying on both survey-based worker-level information as well as on post-survey validation by experts' focus groups). The ICP survey has been realized twice (2007 and 2012) being based on the whole spectrum of the Italian 5-digit occupations (i.e. 811 occupational codes). The interviews cover 16.000 Italian workers ensuring representativeness with respect to sector, occupation, firm size and geographical domain (macro-region).[vii.]

The *WFH* capacity is a composite index (ranging from 0 to 100, from less to more intense) which is a continuous variable measuring the degree to which jobs can be performed remotely. We average the responses to the questions regarding i) the frequency with which respondents use electronic mail, ii) whether the job requires written letters and memos, and iii) how often they have telephone conversations. The indicator follows that used by Montenovo et al. (2020) and Kosteas and Renna (2020) who use the O*NET dataset for the US, while we use the INAPP-ICP dataset which allow us to build a specific indicator for the Italian occupations. The score is calculated for each 5-digit occupation and then aggregated at the 3th digit to realize the ICP-LFS matching. Table A1 in Appendix A presents the specific ICP questions used to build the index, while in Table A2 the occupations with the highest and the lowest ratings for the index are shown. To test the reliability of this proxy, we use the WFH capacity instead of the actual WFH as robustness of our findings for the long term (see Table 6).

4. Econometric strategy

The effect on wages of exogenous variables is likely to differ across individuals. For example, fixed term contracts can have a more negative effects for low-wage workers than for high-wage workers (Brunetti et al. 2018). The standard OLS techniques ignore this heterogeneity and only provide an estimate of the mean

effect of a given variable. The Quantile regression (QR) approach, introduced by Koenker and Basset (1978), allows to estimate the conditional quantiles of a response variable Y (wages in our case) as a function of a set X of covariates on different parts of the wages' distribution. In our paper, following Martins and Pereira (2004) we model the quantile regression as follow:

$$lnw_i = x_i\beta_o + u_{\theta i} \quad \text{with } Q_\theta(lnw_i|x_i) = x_i\beta_o$$

where x_i is the vector of exogenous variables and $Q_\theta(lnw_i|x_i)$ represents the θth conditional quantile of (ln) wages given the vector x_i. The θth regression quantile, $0 < \theta < 1$, is defined as a solution of a minimization problem (Martins and Pereira, 2004). The coefficients estimated in quantile regression for the quantile point quantifies the expected change in the wage's distribution for each quantile as x increases by 1 unit net of other covariates. Therefore, the quantile regression provides snapshots of different points of a conditional distribution. It constitutes a parsimonious way of describing the whole distribution and should bring much value-added if the relationship between the regressors and the independent variable evolves across its conditional distribution. However, the technique relies on a strong assumption: the conditional quantile of an individual remains the same when his/her characteristics change. Since this assumption may well not hold in practice, the results must be interpreted with caution (Koenker, 2005).

The empirical specification of our model is the following. The dependent variable is the natural logarithm of the net monthly wage, the set of exogenous variables in vector X includes: individual characteristics such as the age, gender, level of education, geographic location, and job characteristics (Mincer, 1974). As discussed in the previous section, we include dummy variables to account for the COVID-19 pandemic and for the actual and potential WFH. We provide different specifications of the model: with and without the interaction between COVID-19 indicator and the sectors of activity to understand whether the effect of pandemic is more pronounced in particular sectors, and with and without the interaction between the actual and potential WFH measures and female dummy.

Unfortunately, the estimates could be bias by the sample selection problem. Indeed, differences due to the COVID-19 pandemic and to the use of remote working between workers occur when it comes to labor market participation (Heckman, 1979). Biases due to differences between individuals in the propensity to work may be important in determining whether and how the wage inequality changes along the distribution and failure to account for this bias may result in inaccurate and biased estimation of the wage equations. Hence, due to the potential issues of self-selection, we decide to implement the two-stage estimation strategy, like Heckman (1979), and inspired to Buchinsky (1998). This procedure applies the parametric sample selection model to quantile regression. At the first stage, we estimate as the probability to participate in the labor market:

$$Pr(Y_w|X) = X\beta_w(\theta) + h_\theta(z_w\gamma) \;\; \forall\, \theta \in (0,1)$$

the vector Z regression is a set of observable characteristics that influence the probability that an individual participates in the labor market. These variables are uncorrelated with the (ln) of the wage, and they are

variables for household type (see Section 3 for details). The term $h_\theta(z_w\gamma)$ correct the selection at θth quantile. It represents the inverse Mill's ratio in the Heckman method. At the second stage, we estimate the selectivity-corrected model.

5. Results

In this Section we propose the results of our empirical strategy described in Section 4. The average marginal effects (hereafter AMEs) of the probability of being employed (i.e. first step of our estimates) are shown in Table B1 in the Appendix B. With reference to the selection equation, in line with the literature (see for e.g. ILO 2018), the AME of females highlights that they are less likely to be employed. Accordingly, single with children have lower chances to work with respect to singles or couples without children (i.e., reference category) in particular, the penalty is of about 2 percentage points (hereafter p.p.) for fathers and 4 p.p. for mothers. The employment probability positively increases with age as for each age-group above 25 the AMEs are higher, for example in the age-bracket 25-34 years old the advantage is of about 7 p.p., which goes up to 17 p.p. for the age-interval 55-64 years old. Being Italian citizenship enhances the probability of working of 3.4 p.p. compared to foreigners. In addition, as expected, individuals with higher level of education are more likely to join the labor market, ceteris paribus. Finally, those who live in the most productive areas of the country, namely North-West and North-East of Italy, have larger job opportunities.

Table 2 shows the second step estimates for the sample of employees, which examines the short-term consequences of COVID-19 on wages in Italy. Our dependent variable looks at the wage distribution of employees by analyzing the 10th quantile, the median and the 90thquantile. The post-COVID dummy that captures the first quarter entirely exposed to COVID-19 (2020Q2), suggests that the pandemic has affected the wages of the whole workers but, the effect is higher at the bottom of the wage distribution as the penalty is about 7.5 p.p. versus only 1.1 p.p. of the 90th quantile. The actual WFH coefficient, which is a dummy for whether an individual is WFH more than twice a week, confirms that workers - which benefit from tele-working - receive a wage premium, especially for those belong to the 10th quantile. About gender, it emerges that females experience a wage penalization that decreases across quantiles, in particular this gap goes from 8 p.p. of the 10th quantile to 3.7 p.p. of the 90th quantile.[viii] Regarding age-groups, the wage premium is increasing by age up to the age interval 45-54. Being Italian citizenship positively affects the wage, and this advantage is greater for top earners (4.2 p.p.). The returns to education are larger especially for graduates. Working in a more productive economic area entails a larger wage premium, too. Likewise, fixed-term employment contract provides a lower return, but the penalty is notably relevant for the 10th quantile earners (22 p.p.). About occupation, the wage premium is greater for managers and white-collars compared to blue-collars, but the reward is more consistent for the former, especially those in the highest tail of the distribution (60.9 p.p.).[ix] Finally, considering as the reference category industry, all the other sector dummies have lower wage returns but finance and insurance, irrespective of the wage distribution. In specification II (columns 4-6) of Table 2, to the baseline estimates in specification I (columns 1-3), we add

the interaction terms between sector of economic activity and COVID-19 dummy. Results show that the pandemic, that now refer to the conditions of workers employed only in the industry sector, has a more pronounced effect, in particular the wage penalty is of 11.4 p.p., 3.1 p.p. and 2.9 p.p. for the 10th quantile, median and 90th quantile, respectively. Regarding the interaction terms of sectors with the pandemic dummy, we observe that some of them have been more exposed to the COVID-19, for example in the 2nd quarter of 2020 workers in the restaurant and in the retail sectors face a higher wage penalty. In particular, the wage cut has been more pronounced for 10th quantile and median earners. Considering the lockdown implemented during the pandemic, which mainly affected the industry (i.e. reference category) the retail and the restaurant sectors, these interaction terms show that workers in sectors that have benefited from remote working, substantial employment protection or rise in demand received a positive compensation, regardless the wage distribution. A visible increased in wages mainly occurred to employees in education, real estate, and other services. However, only workers employed in public administration, transportation, and agriculture within the bottom and the median of the distribution have obtained a wage premium, whereas no effects have been observed for the workers in the above tail of the wage distribution. Similarly, only workers in the bottom tail of the wage distribution in communication and finance and insurance have received an increase. Furthermore, including this interaction term, the magnitude of the actual WFH dummy during pandemic decreases, especially for the bottom tail of the wage distribution.

[TABLE 2 ABOUT HERE]

To the baseline estimate of Table 2 we add the interaction term of actual WFH with COVID-19 as well as to the specification reported in column II (see Table 3).

[TABLE 3 ABOUT HERE]

Overall, the magnitude and statistical significance of the estimates remain the same, but by disentangling the effect of actual WFH before and during pandemic, we find that workers at the bottom tail of the wage distribution are the sub-group that benefited most from the introduction of the national pandemic measures, which extended remote working facilities as well as parental leave, given that their wage premium is still statistically significant during COVID-19.

In Tables 4 and 5 we investigate heterogeneous effects of COVID-19 by gender using the same specification of Table 3 (columns I and II). Regarding women (Table 4), the COVID-19 wage reduction of those at 10th quantile and median of the distribution is significant but smaller in magnitude compared to men; indeed the wage penalty is about 5.2 p.p. 1.3 p.p. and 8.7 p.p., 2.6 p.p., respectively for females and males). In addition, for men (Table 5) the wage cut is statistically significant also for the workers belong to the top tail of the distribution, but null for their counterpart. Regardless the gender, the actual WFH reward is significant along the entire wage distribution, although the wage increase is particularly larger for the lowest quantile. Nevertheless, the male sub-group has been the one that mostly benefited from WFH, especially for those with wages above the median. Results suggest that for both sexes, irrespective of the wage distribution, the wage premium is increasing with age and education, but the magnitude is always higher for men. Similarly, working in a well-off geographical area, especially in the North, provides a wage increases across the whole

wage distribution. Regarding the sectors, the worst performance is registered for males and females working in agriculture, real estate, public administration, education, and other service sectors compared to employees in industry. In contrast, they both receive a wage premium in finance and insurance sector. Gender differences, instead, are observed in the restaurant sector as women are not penalized only when their wage is in the 90th quantile, and in the communication sector for wage above the median, while men are always penalized. In contrast, men in the transportation get reward when their wage is above the median, conversely women are always penalized. Once we add the interaction term between sectors and pandemic (Tables 4 and 5 – column II), employees in the industry sector during COVID-19 have been equally affected regardless the gender. Regardless the gender, workers in the public administration and education sectors have obtained a wage premium that is similarly in magnitude within the same quantile. For those working in the restaurant the wage decrease has affected only men in the lowest tail of the distribution during pandemic, while women have been unaffected. The wage inequalities have been particularly biting for those in the retail sector up to the median wage distribution, especially men, though women in the 90th quantile received a premium of 6.6 p.p. Males in the agriculture sector benefited from the pandemic across the entire wage distribution, conversely women received the larger wage premium only in the 10th quantile (18.1 p.p.). About transportation both males and females received a wage increase during COVID-19 up to the median, but the advantage is always larger in magnitude for the latter. Also, real estate workers registered a wage increase, mainly males in the 10th quantile, but at the top of the distribution the benefit is solely for women (11.1 p.p.). A positive wage is obtained by workers in the bottom tail of the distribution of Finance and Insurance, with men additionally benefited when belong to the median distribution. Women have received wage reward during pandemic over the whole distribution in the other services sector, instead men strictly in the bottom tail. Finally, communication sector provided a wage premium merely for men in the 10th quantile of the wage distribution (7.2 p.p.).

[TABLE 4 ABOUT HERE]

[TABLE 5 ABOUT HERE]

Finally, as robustness checks, we run the same specifications reported in Tables 2, 4 and 5 (Table 6 panel A, B and C, respectively), replacing actual WFH with WFH capacity index to test potential long-lasting effect of the possibility of doing remote working. As shown in Table 6, on average, findings underline that, irrespective of the working sample, this index underestimates the positive advantage of WFH for the 10th quantile of the distribution, because during the emergency this category of workers was the one that mostly took advantage from teleworking. On the other hand, with reference to the female sub-sample (Panel B), it is noticeable that women on the long-run may benefit more of the opportunity to do their work from home as the wage premium for those belong to the median and 90th quantile is almost double with respect to the one observed for the actual WFH (see Table 4). This result seems to confirm that in Italy most of additional

housework and childcare associated with the health emergency situation has fallen on women (Del Boca et al., 2020). All in all, the evidence suggests that, when the COVID-19 emergency has passed, WFH attitude can provide, especially for women, a solution to reconcile family and working life, without being penalized.

[TABLE 6 ABOUT HERE]

6. Conclusions

Measuring the actual distributive effects of the pandemics is a less examined topic, mainly because of the lack of timely and reliable data. In this paper we have investigated the effects of the COVID-19 pandemic on the whole labor income distribution in Italy, by using a unique dataset obtained by merging real data from the official LFS and from the Italian Survey of Professions. Moreover, WFH has become the key variable for the coexistence with the coronavirus without interrupting economic activities: recent estimates for the U.S. show that the share of people working from home have quadrupled to 50% of U.S. workforce (Brynjolfsson et al., 2020). In addition, due to uncertainty about the duration of the pandemic and the route of production and distribution of vaccines, it is shown that the WFH might become an ordinary, rather than unconventional, way of working in the labor markets (Bonacini et al. 2021a). Thus, we have estimated the effect on the labor income distribution of both the actual level of WFH in the emergency and the potential capacity to work remotely once the health emergency is over.

Our results show that the negative distributional consequences of the COVID-19 pandemic are more pronounced at the lowest quantiles of the labor income distribution. Looking at the sectoral composition, workers in retail and restaurant face the highest wage penalty. However, the possibility of WFH mitigates the negative effect observed (in general) for those at the bottom of the wage distribution. Indeed, on average workers that benefit from WFH receive a wage premium, and this is especially true for those at the bottom of the distribution. Notably, this relative advantage is confirmed by disentangling the effect of actual WFH before and during the pandemic. Our findings suggest that while the benefit associated with WFH disappears for median and top earner, it persists after the pandemic for workers at the bottom tail of the distribution. When we estimate our models separately by gender, we see that COVID-19 consequences were negative over the whole wage distribution for workers employed in the industry sector, regardless of sex, while for those in the retail, only at the 10^{th} quantile and median. Conversely, the penalization is observed only for male workers in the lowest tail of the distribution in the restaurant sector. Notably, when we consider the WFH capacity index to test the potential long-lasting effects of the opportunity of doing remote working, we note that the index underestimates the positive advantage of WFH for workers at the bottom of the wage distribution. The advantage of workers at the lowest quantiles, therefore, seems to reduce in the long term, likely because they were in the group that during the emergency immediately and mostly benefited from WFH. Interestingly, we see that women on the long run may benefit more from WFH opportunities, as this might be a way to reconcile family and working duties.

In conclusion, our findings suggest that the current crisis risks exacerbating some of the pre-existing inequalities in the labor market especially if it is not effectively regulated. In this respect, during a health emergency, ex-post policies aimed at reducing inequality in the short run, like short-time work schemes appear crucial (Giupponi and Landais, 2018; 2020). Indeed, it was shown that workers in countries with a well-established short-time work scheme, are significantly less likely to be affected by the crisis (Adams-Prassl et al., 2020).

The current crisis has forced many companies to an extensive use of WFH and, for many of them, to think about a "new normal" way of working (https://www.upwork.com/resources/how-to-adjust-to-the-new-normal-of-remotework). For instance, Facebook and some other companies, in the Information Technology economic sector have already established they will allow many employees to WFH permanently.[x] Thus, long-term policies able to solve potential knowledge gaps seem to be necessary. First, childcare facilities and financial support to households with children, are crucial to reconcile family and work for mothers (Del Boca and Vuri, 2007) and to allow the adoption of remote working, especially for women with young children (Pouliakas, 2020). Second, education policies aimed at increasing the school enrolment rate are decisive in reducing unequal distribution of benefits related to an increase of remote working opportunities by rising human capital and facilitating its complementarities with technological change (Acemoglu, 1997, Scicchitano, 2010).

A massive contribution to finance policies to support the categories most affected by the crisis and to improve the labor market may come from the Next Generation European Union funds. Italy, which pushed hard for more EU support at the height of the crisis, is set to receive the largest share: 209 billion euros, or 28 percent of the entire rescue fund. The Italian Recovery and Resilience Plan (RRP), currently under construction, translates this opportunity into action. It mobilizes over 300 billion euros, by adding the funds allocated with the 2021-2026 budget planning to the financial resources coming from EU Next Generation program. The RRP defines "actions and interventions to overcome the economic and social impact of the pandemic, acting on the country's structural nodes": our paper helps informing policy-makers and building an evidence-based policy, by providing fresh evidence from real time data.

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Tables

Table 1 Descriptive statistics

Variable	Mean	Std. Dev.
Female	0.452	0.498
Age		
15-24	0.053	0.225
25-34	0.187	0.390
45-54	0.309	0.462
55-64	0.191	0.393
Education		
None	0.024	0.152
Lower secondary school	0.271	0.445
Upper secondary school	0.479	0.500
Graduate	0.226	0.418
Geographical area of residence		
North-West	0.305	0.461
North-East	0.227	0.419
Center	0.212	0.409
South	0.255	0.436
Italian citizenship	0.881	0.323
Married	0.554	0.497
Household type		
Single	0.161	0.368
Couple with child	0.599	0.490
Couple without child	0.145	0.352
Single father	0.016	0.124
Single mother	0.080	0.271
Characteristics of the job		
Fixed-term contract	0.164	0.370
Managerial occupation	0.087	0.282
White-collar	0.435	0.496
Blue-collar	0.477	0.499
Sector of economic activity		
Agriculture	0.026	0.160
Industry	0.238	0.426
Construction	0.047	0.211
Retail	0.117	0.322
Restaurant	0.057	0.232
Transportation	0.056	0.230
Communication	0.028	0.165
Finance and Insurance	0.030	0.169
Real estate	0.087	0.282
Public administration	0.068	0.252
Education	0.172	0.378
Other services	0.073	0.261
actual WFH	0.044	0.205
Observations	311,654	

Source: Authors' calculations from 2019Q1-2020Q2 ISTAT ICP data

Table 2 – Estimates of the effects of COVID-19 on the wage distribution of Italian workers

	(I)			(II)		
	Quantile					
	10th	median	90th	10th	Median	90th
COVID-19	-0.075***	-0.021***	-0.011**	-0.114***	-0.031***	-0.029***
	(0.004)	(0.002)	(0.005)	(0.010)	(0.003)	(0.005)
WFH	0.077***	0.040***	0.045***	0.052***	0.034***	0.044***
	(0.005)	(0.003)	(0.007)	(0.007)	(0.004)	(0.010)
Female	-0.080***	-0.072***	-0.037***	-0.079***	-0.072***	-0.035***
	(0.005)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)
Age 25-34	0.038***	0.037***	0.027**	0.032***	0.037***	0.025***
	(0.012)	(0.004)	(0.011)	(0.010)	(0.005)	(0.009)
Age 35-44	0.067***	0.072***	0.066***	0.063***	0.072***	0.062***
	(0.017)	(0.006)	(0.016)	(0.013)	(0.007)	(0.016)
Age 45-54	0.075***	0.086***	0.069***	0.070***	0.086***	0.064***
	(0.019)	(0.006)	(0.019)	(0.014)	(0.007)	(0.018)
Age 55-64	0.066***	0.068***	0.043**	0.060***	0.068***	0.038*
	(0.022)	(0.008)	(0.022)	(0.016)	(0.008)	(0.021)
Italian citizenship	0.014*	0.037***	0.042***	0.013***	0.037***	0.042***
	(0.008)	(0.002)	(0.005)	(0.005)	(0.003)	(0.007)
Lower secondary school	0.017**	0.018***	-0.001	0.017	0.019***	-0.002
	(0.008)	(0.003)	(0.010)	(0.012)	(0.005)	(0.012)
Upper secondary school	0.013	0.020***	-0.011	0.012	0.021***	-0.013
	(0.011)	(0.005)	(0.011)	(0.014)	(0.005)	(0.016)
Graduate	0.043***	0.058***	0.023*	0.041**	0.058***	0.019
	(0.015)	(0.006)	(0.013)	(0.018)	(0.006)	(0.020)
North-West	0.041***	0.032***	0.015*	0.039***	0.032***	0.013
	(0.011)	(0.004)	(0.008)	(0.008)	(0.003)	(0.010)
North-East	0.045***	0.041***	0.028**	0.040***	0.041***	0.025**
	(0.014)	(0.005)	(0.012)	(0.008)	(0.004)	(0.013)
Center	0.020**	0.005	-0.019***	0.017***	0.005	-0.020***
	(0.008)	(0.004)	(0.007)	(0.006)	(0.003)	(0.006)
Managerial Occupations	0.310***	0.367***	0.609***	0.314***	0.369***	0.610***
	(0.004)	(0.003)	(0.008)	(0.004)	(0.003)	(0.007)
White-collar	0.128***	0.125***	0.132***	0.129***	0.125***	0.132***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)
Fixed-term contract	-0.220***	-0.091***	-0.019***	-0.223***	-0.090***	-0.020***
	(0.005)	(0.002)	(0.004)	(0.008)	(0.002)	(0.005)
Agriculture	-0.222***	-0.147***	-0.136***	-0.230***	-0.150***	-0.139***
	(0.009)	(0.005)	(0.006)	(0.009)	(0.005)	(0.006)
Construction	-0.029***	-0.015***	0.006	-0.024***	-0.012***	0.007
	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)
Retail	-0.098***	-0.061***	-0.035***	-0.097***	-0.063***	-0.038***
	(0.005)	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)
Restaurant	-0.200***	-0.069***	0.005	-0.174***	-0.063***	0.004
	(0.011)	(0.004)	(0.006)	(0.008)	(0.003)	(0.008)
Transportation	-0.031***	0.003	0.070***	-0.039***	-0.000	0.068***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.004)

Communication	-0.034***	-0.008*	-0.002	-0.037***	-0.009***	-0.001
	(0.008)	(0.004)	(0.006)	(0.007)	(0.003)	(0.007)
Finance and Insurance	0.055***	0.092***	0.081***	0.044***	0.090***	0.081***
	(0.007)	(0.004)	(0.004)	(0.006)	(0.003)	(0.006)
Real estate	-0.158***	-0.092***	-0.045***	-0.166***	-0.097***	-0.052***
	(0.005)	(0.002)	(0.005)	(0.006)	(0.003)	(0.005)
Public administration	-0.034***	-0.042***	-0.055***	-0.047***	-0.046***	-0.057***
	(0.003)	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)
Education	-0.075***	-0.068***	-0.065***	-0.087***	-0.072***	-0.069***
	(0.002)	(0.002)	(0.005)	(0.003)	(0.002)	(0.004)
Other services	-0.311***	-0.166***	-0.047***	-0.321***	-0.169***	-0.055***
	(0.007)	(0.002)	(0.005)	(0.005)	(0.003)	(0.005)
COVID19*Agriculture				0.104***	0.023**	0.022
				(0.035)	(0.011)	(0.014)
COVID19*Construction				-0.012	0.010*	0.020**
				(0.012)	(0.006)	(0.010)
COVID19*Retail				-0.229***	-0.066***	0.011
				(0.033)	(0.010)	(0.019)
COVID19*Restaurant				-0.085***	-0.016**	-0.004
				(0.022)	(0.008)	(0.014)
COVID19*Transportation				0.071***	0.023***	0.017
				(0.012)	(0.005)	(0.012)
COVID19*Communication				0.060***	0.006	0.001
				(0.023)	(0.006)	(0.020)
COVID19*Finance and Insurance				0.091***	0.014	0.004
				(0.017)	(0.011)	(0.014)
COVID19*Real estate				0.081***	0.030***	0.053***
				(0.020)	(0.006)	(0.015)
COVID19*Public administration				0.111***	0.021***	0.019
				(0.011)	(0.007)	(0.011)
COVID19*Education				0.102***	0.029***	0.033***
				(0.010)	(0.005)	(0.010)
COVID19*Other services				0.103***	0.026***	0.047**
				(0.016)	(0.007)	(0.023)
Constant	6.507***	6.982***	7.329***	6.509***	6.982***	7.333***
	(0.019)	(0.007)	(0.015)	(0.015)	(0.007)	(0.019)
N. observations	214.148					

Notes: Reference category: 15-24 years old; no education; South and Islands; Industry; Blue-collar. Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. (I) is the specification without interaction terms; (II) is the specification with the interaction terms between sectors dummies and COVID-19 dummy
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT-ICP data.

Table 3 Estimates of the effects of COVID-19 on the wage distribution of Italian workers with the interaction WFH and COVID-19

	(I)			(II)		
	Quantile					
	10th	median	90th	10th	median	90th
COVID-19	-0.084***	-0.021***	-0.009*	-0.116***	-0.031***	-0.026***
	(0.004)	(0.002)	(0.005)	(0.008)	(0.004)	(0.008)
WFH	0.038***	0.044***	0.069***	0.038***	0.045***	0.070***
	(0.009)	(0.004)	(0.012)	(0.007)	(0.005)	(0.010)
COVID-19*WFH	0.071***	-0.006	-0.039**	0.023**	-0.019***	-0.044***
	(0.011)	(0.006)	(0.016)	(0.009)	(0.006)	(0.014)
Female	-0.080***	-0.072***	-0.036***	-0.080***	-0.072***	-0.035***
	(0.005)	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)
Age 25-34	0.038***	0.037***	0.027***	0.033***	0.037***	0.025***
	(0.015)	(0.006)	(0.009)	(0.012)	(0.005)	(0.007)
Age 35-44	0.068***	0.072***	0.065***	0.065***	0.072***	0.062***
	(0.019)	(0.008)	(0.014)	(0.018)	(0.006)	(0.011)
Age 45-54	0.075***	0.086***	0.067***	0.073***	0.086***	0.064***
	(0.021)	(0.009)	(0.017)	(0.021)	(0.007)	(0.012)
Age 55-64	0.066***	0.068***	0.042**	0.064***	0.068***	0.037**
	(0.023)	(0.011)	(0.019)	(0.022)	(0.008)	(0.015)
Italian citizenship	0.014**	0.037***	0.043***	0.014**	0.037***	0.042***
	(0.006)	(0.003)	(0.005)	(0.006)	(0.003)	(0.005)
Lower secondary school	0.018	0.018***	-0.001	0.018*	0.019***	-0.002
	(0.013)	(0.005)	(0.009)	(0.011)	(0.005)	(0.008)
Upper secondary school	0.014	0.020***	-0.011	0.013	0.021***	-0.013
	(0.016)	(0.006)	(0.013)	(0.012)	(0.005)	(0.012)
Graduate	0.044**	0.057***	0.022	0.043***	0.057***	0.020
	(0.020)	(0.008)	(0.017)	(0.014)	(0.006)	(0.015)
North-West	0.041***	0.032***	0.014*	0.040***	0.032***	0.013
	(0.011)	(0.006)	(0.008)	(0.008)	(0.003)	(0.009)
North-East	0.045***	0.041***	0.027***	0.043***	0.040***	0.026**
	(0.013)	(0.007)	(0.009)	(0.010)	(0.004)	(0.010)
Center	0.020***	0.005	-0.019***	0.018***	0.004	-0.020***
	(0.008)	(0.004)	(0.006)	(0.007)	(0.003)	(0.006)
Managerial Occupations	0.311***	0.367***	0.609***	0.314***	0.369***	0.609***
	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.007)
White-collar	0.128***	0.125***	0.132***	0.129***	0.125***	0.132***
	(0.002)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
Fixed-term contract	-0.220***	-0.090***	-0.020***	-0.223***	-0.090***	-0.021***
	(0.005)	(0.002)	(0.004)	(0.005)	(0.002)	(0.005)
Agriculture	-0.221***	-0.147***	-0.136***	-0.230***	-0.150***	-0.139***
	(0.010)	(0.005)	(0.005)	(0.013)	(0.006)	(0.009)
Construction	-0.029***	-0.015***	0.006	-0.024***	-0.012***	0.007
	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)
Retail	-0.099***	-0.061***	-0.036***	-0.097***	-0.063***	-0.038***
	(0.005)	(0.002)	(0.003)	(0.005)	(0.002)	(0.004)
Restaurant	-0.200***	-0.069***	0.005	-0.173***	-0.064***	0.004
	(0.008)	(0.004)	(0.007)	(0.008)	(0.004)	(0.005)
Transportation	-0.032***	0.003	0.070***	-0.039***	-0.000	0.068***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
Communication	-0.033***	-0.009**	-0.001	-0.036***	-0.010***	-0.002
	(0.006)	(0.004)	(0.008)	(0.006)	(0.004)	(0.008)
Finance and Insurance	0.054***	0.093***	0.081***	0.044***	0.090***	0.081***

	(0.005)	(0.004)	(0.006)	(0.006)	(0.003)	(0.007)
Real estate	-0.159***	-0.092***	-0.045***	-0.167***	-0.097***	-0.053***
	(0.005)	(0.002)	(0.006)	(0.005)	(0.002)	(0.005)
Public administration	-0.036***	-0.042***	-0.055***	-0.048***	-0.047***	-0.057***
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)
Education	-0.076***	-0.068***	-0.066***	-0.087***	-0.072***	-0.069***
	(0.003)	(0.001)	(0.003)	(0.003)	(0.002)	(0.005)
Other services	-0.312***	-0.165***	-0.048***	-0.321***	-0.169***	-0.054***
	(0.009)	(0.003)	(0.008)	(0.008)	(0.003)	(0.008)
COVID19*Agriculture				0.105***	0.023*	0.021
				(0.029)	(0.012)	(0.020)
COVID19*Construction				-0.011	0.009	0.020*
				(0.014)	(0.006)	(0.011)
COVID19*Retail				-0.228***	-0.066***	0.009
				(0.043)	(0.017)	(0.030)
COVID19*Restaurant				-0.084***	-0.017*	-0.006
				(0.020)	(0.009)	(0.016)
COVID19*Transportation				0.072***	0.022***	0.015
				(0.014)	(0.008)	(0.012)
COVID19*Communication				0.059***	0.011	0.003
				(0.021)	(0.010)	(0.024)
COVID19*Finance and Insurance				0.088***	0.017*	0.010
				(0.021)	(0.010)	(0.015)
COVID19*Real estate				0.083***	0.032***	0.052***
				(0.019)	(0.006)	(0.011)
COVID19*Public administration				0.109***	0.024***	0.019**
				(0.009)	(0.006)	(0.009)
COVID19*Education				0.097***	0.031***	0.034***
				(0.007)	(0.005)	(0.009)
COVID19*Other services				0.100***	0.026***	0.045**
				(0.013)	(0.010)	(0.019)
Constant	6.510***	6.982***	7.327***	6.508***	6.982***	7.332***
	(0.013)	(0.006)	(0.013)	(0.017)	(0.006)	(0.014)
N. observations				214.148		

Notes: Reference category: 15-24 years old; no education; South and Islands; Industry; Blue-collar. Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1(I) is the specification without interaction terms; (II) is the specification with the interaction terms between sectors dummies and COVID-19 dummy.
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT-ICP data.

Table 4 Estimates of the effects of COVID-19 on the wage distribution of Italian workers: Female sub-sample

	(I)			(II)		
	Quantile					
	10th	median	90th	10th	median	90th
COVID-19	-0.052***	-0.013***	0.002	-0.111***	-0.031***	-0.023**
	(0.006)	(0.003)	(0.007)	(0.015)	(0.006)	(0.011)
WFH	0.073***	0.029***	0.030***	0.055***	0.024***	0.035***
	(0.006)	(0.004)	(0.009)	(0.006)	(0.004)	(0.012)
Age 25-34	0.103***	0.063***	0.096***	0.096***	0.063***	0.096***
	(0.022)	(0.008)	(0.014)	(0.015)	(0.011)	(0.012)
Age 35-44	0.168***	0.117***	0.158***	0.161***	0.116***	0.156***
	(0.026)	(0.010)	(0.019)	(0.019)	(0.014)	(0.016)
Age 45-54	0.196***	0.141***	0.166***	0.188***	0.140***	0.165***
	(0.028)	(0.011)	(0.023)	(0.020)	(0.014)	(0.016)
Age 55-64	0.209***	0.141***	0.141***	0.198***	0.139***	0.139***
	(0.030)	(0.013)	(0.026)	(0.023)	(0.016)	(0.021)
Italian citizenship	0.023***	0.065***	0.085***	0.021*	0.066***	0.087***
	(0.008)	(0.005)	(0.009)	(0.011)	(0.005)	(0.009)
Lower secondary school	0.056***	0.036***	-0.007	0.047**	0.033***	-0.013
	(0.014)	(0.007)	(0.025)	(0.019)	(0.009)	(0.027)
Upper secondary school	0.087***	0.066***	0.012	0.075***	0.064***	0.006
	(0.020)	(0.008)	(0.026)	(0.019)	(0.010)	(0.027)
Graduate	0.145***	0.125***	0.066**	0.134***	0.122***	0.060*
	(0.027)	(0.010)	(0.029)	(0.021)	(0.012)	(0.032)
North-West	0.095***	0.072***	0.066***	0.090***	0.071***	0.062***
	(0.017)	(0.006)	(0.011)	(0.011)	(0.007)	(0.011)
North-East	0.109***	0.091***	0.097***	0.104***	0.090***	0.094***
	(0.020)	(0.007)	(0.015)	(0.015)	(0.007)	(0.014)
Center	0.064***	0.038***	0.023***	0.060***	0.037***	0.021**
	(0.013)	(0.006)	(0.008)	(0.011)	(0.005)	(0.008)
Managerial Occupations	0.305***	0.309***	0.535***	0.308***	0.309***	0.535***
	(0.008)	(0.003)	(0.010)	(0.006)	(0.005)	(0.011)
White-collar	0.153***	0.125***	0.105***	0.154***	0.124***	0.106***
	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)	(0.006)
Fixed-term contract	-0.208***	-0.075***	0.025***	-0.211***	-0.075***	0.026***
	(0.010)	(0.003)	(0.009)	(0.009)	(0.003)	(0.007)
Agriculture	-0.265***	-0.148***	-0.122***	-0.284***	-0.145***	-0.116***
	(0.020)	(0.012)	(0.014)	(0.030)	(0.009)	(0.012)
Construction	-0.084***	-0.021**	0.068***	-0.087***	-0.018	0.065***
	(0.015)	(0.010)	(0.023)	(0.014)	(0.016)	(0.023)
Retail	-0.077***	-0.030***	0.011	-0.079***	-0.033***	0.011**
	(0.008)	(0.004)	(0.007)	(0.007)	(0.003)	(0.006)
Restaurant	-0.174***	-0.040***	0.032***	-0.151***	-0.037***	0.027***
	(0.013)	(0.005)	(0.008)	(0.015)	(0.004)	(0.009)
Transportation	-0.042***	-0.042***	-0.001	-0.056***	-0.047***	-0.003
	(0.008)	(0.005)	(0.007)	(0.008)	(0.005)	(0.010)
Communication	-0.003	0.030***	0.075***	-0.013	0.029***	0.070***
	(0.012)	(0.007)	(0.016)	(0.012)	(0.009)	(0.018)

Finance and Insurance	0.061***	0.136***	0.158***	0.050***	0.133***	0.166***
	(0.010)	(0.007)	(0.009)	(0.009)	(0.007)	(0.011)
Real estate	-0.138***	-0.069***	-0.002	-0.147***	-0.074***	-0.014
	(0.009)	(0.004)	(0.010)	(0.008)	(0.004)	(0.009)
Public administration	-0.019***	-0.024***	-0.019**	-0.034***	-0.028***	-0.023**
	(0.005)	(0.004)	(0.009)	(0.008)	(0.004)	(0.010)
Education	-0.046***	-0.038***	-0.022***	-0.058***	-0.042***	-0.027***
	(0.006)	(0.003)	(0.006)	(0.006)	(0.003)	(0.006)
Other services	-0.286***	-0.150***	-0.012	-0.300***	-0.155***	-0.018*
	(0.011)	(0.005)	(0.011)	(0.010)	(0.005)	(0.010)
COVID19*Agriculture				0.181**	-0.011	-0.063
				(0.075)	(0.028)	(0.042)
COVID19*Construction				-0.008	0.012	0.007
				(0.031)	(0.011)	(0.021)
COVID19*Retail				-0.221***	-0.057***	0.066**
				(0.041)	(0.018)	(0.029)
COVID19*Restaurant				-0.130	0.002	0.034
				(0.098)	(0.033)	(0.059)
COVID19*Transportation				0.104***	0.026**	0.021
				(0.023)	(0.011)	(0.029)
COVID19*Communication				0.046	0.004	0.030
				(0.049)	(0.018)	(0.046)
COVID19*Finance and Insurance				0.080***	0.011	-0.027
				(0.027)	(0.011)	(0.021)
COVID19*Real estate				0.065**	0.034***	0.111***
				(0.026)	(0.010)	(0.027)
COVID19*Public administration				0.105***	0.026***	0.018
				(0.015)	(0.010)	(0.020)
COVID19*Education				0.094***	0.029***	0.031*
				(0.018)	(0.009)	(0.018)
COVID19*Other services				0.091***	0.029***	0.050**
				(0.033)	(0.009)	(0.023)
Constant	6.297***	6.831***	7.216***	6.314***	6.833***	7.224***
	(0.027)	(0.014)	(0.032)	(0.035)	(0.015)	(0.049)
N. observations				99.117		

Notes: Reference category: 15-24 years old; no education; South and Islands; Industry; Blue-collar. Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1(I) is the specification without interaction terms; (II) is the specification with the interaction terms between sectors dummies and COVID-19 dummy.
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT-ICP data.

Table 5 - Estimates of the effects of COVID-19 on the wage distribution of Italian workers: Male sub-sample

	(I)			(II)		
	Quantile					
	10th	median	90th	10th	median	90th
COVID-19	-0.087***	-0.026***	-0.019***	-0.120***	-0.034***	-0.027***
	(0.006)	(0.003)	(0.004)	(0.009)	(0.003)	(0.010)
WFH	0.071***	0.041***	0.055***	0.042***	0.037***	0.058***
	(0.008)	(0.006)	(0.010)	(0.005)	(0.006)	(0.010)
Age 25-34	0.142***	0.081***	0.050***	0.142***	0.081***	0.050***
	(0.011)	(0.005)	(0.008)	(0.009)	(0.004)	(0.007)
Age 35-44	0.225***	0.156***	0.130***	0.227***	0.155***	0.131***
	(0.011)	(0.005)	(0.008)	(0.009)	(0.003)	(0.008)
Age 45-54	0.254***	0.191***	0.162***	0.257***	0.190***	0.163***
	(0.010)	(0.005)	(0.008)	(0.008)	(0.003)	(0.008)
Age 55-64	0.261***	0.191***	0.178***	0.262***	0.190***	0.180***
	(0.011)	(0.005)	(0.008)	(0.009)	(0.003)	(0.007)
Italian citizenship	0.062***	0.051***	0.053***	0.063***	0.051***	0.052***
	(0.005)	(0.003)	(0.005)	(0.006)	(0.002)	(0.005)
Lower secondary school	0.074***	0.050***	0.034***	0.077***	0.052***	0.034***
	(0.010)	(0.004)	(0.009)	(0.011)	(0.006)	(0.009)
Upper secondary school	0.109***	0.080***	0.061***	0.113***	0.082***	0.061***
	(0.009)	(0.004)	(0.009)	(0.012)	(0.006)	(0.008)
Graduate	0.160***	0.146***	0.143***	0.164***	0.147***	0.143***
	(0.010)	(0.005)	(0.011)	(0.012)	(0.006)	(0.010)
North-West	0.128***	0.091***	0.087***	0.127***	0.090***	0.087***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.005)
North-East	0.141***	0.109***	0.107***	0.138***	0.108***	0.107***
	(0.004)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)
Center	0.084***	0.040***	0.026***	0.081***	0.040***	0.027***
	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.004)
Managerial Occupations	0.331***	0.420***	0.666***	0.333***	0.420***	0.666***
	(0.007)	(0.004)	(0.008)	(0.005)	(0.004)	(0.006)
White-collar	0.118***	0.123***	0.157***	0.119***	0.123***	0.157***
	(0.005)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)
Fixed-term contract	-0.226***	-0.105***	-0.053***	-0.226***	-0.106***	-0.053***
	(0.010)	(0.003)	(0.005)	(0.006)	(0.002)	(0.005)
Agriculture	-0.217***	-0.146***	-0.132***	-0.224***	-0.150***	-0.140***
	(0.017)	(0.005)	(0.008)	(0.016)	(0.005)	(0.007)
Construction	-0.032***	-0.019***	0.004	-0.029***	-0.017***	0.004
	(0.005)	(0.003)	(0.006)	(0.005)	(0.003)	(0.005)
Retail	-0.110***	-0.078***	-0.063***	-0.109***	-0.080***	-0.065***
	(0.006)	(0.003)	(0.004)	(0.006)	(0.003)	(0.004)
Restaurant	-0.221***	-0.094***	-0.013	-0.194***	-0.082***	-0.009
	(0.010)	(0.005)	(0.008)	(0.010)	(0.005)	(0.010)
Transportation	-0.033***	0.014***	0.080***	-0.037***	0.011***	0.078***
	(0.006)	(0.003)	(0.004)	(0.005)	(0.003)	(0.005)
Communication	-0.038***	-0.026***	-0.036***	-0.048***	-0.027***	-0.033***
	(0.007)	(0.005)	(0.006)	(0.008)	(0.005)	(0.008)

Finance and Insurance	0.048***	0.059***	0.022***	0.041***	0.056***	0.021***
	(0.011)	(0.005)	(0.005)	(0.010)	(0.004)	(0.005)
Real estate	-0.163***	-0.108***	-0.066***	-0.173***	-0.112***	-0.065***
	(0.008)	(0.004)	(0.006)	(0.007)	(0.003)	(0.006)
Public administration	-0.046***	-0.050***	-0.076***	-0.058***	-0.054***	-0.078***
	(0.004)	(0.003)	(0.005)	(0.005)	(0.003)	(0.006)
Education	-0.113***	-0.105***	-0.099***	-0.123***	-0.110***	-0.104***
	(0.006)	(0.002)	(0.008)	(0.007)	(0.003)	(0.007)
Other services	-0.319***	-0.152***	-0.074***	-0.331***	-0.156***	-0.076***
	(0.012)	(0.005)	(0.008)	(0.009)	(0.006)	(0.009)
COVID19*Agriculture				0.086*	0.033**	0.052*
				(0.049)	(0.014)	(0.027)
COVID19*Construction				-0.014	0.013*	0.018*
				(0.029)	(0.007)	(0.010)
COVID19*Retail				-0.249***	-0.075***	-0.042
				(0.066)	(0.013)	(0.032)
COVID19*Restaurant				-0.089**	-0.018	-0.008
				(0.037)	(0.012)	(0.018)
COVID19*Transportation				0.055***	0.019**	0.019
				(0.015)	(0.008)	(0.016)
COVID19*Communication				0.072***	0.009	-0.011
				(0.015)	(0.013)	(0.017)
COVID19*Finance and Insurance				0.099***	0.023*	0.007
				(0.034)	(0.012)	(0.017)
COVID19*Real estate				0.092***	0.031***	0.001
				(0.024)	(0.012)	(0.017)
COVID19*Public administration				0.115***	0.028***	0.016
				(0.010)	(0.011)	(0.013)
COVID19*Education				0.102***	0.024***	0.031*
				(0.018)	(0.006)	(0.019)
COVID19*Other services				0.090***	0.022	0.011
				(0.030)	(0.019)	(0.029)
Constant	6.593***	6.944***	7.224***	6.594***	6.946***	7.226***
	(0.012)	(0.006)	(0.014)	(0.011)	(0.007)	(0.010)
N. observations				115.031		

Notes: Reference category: 15-24 years old; no education; South and Islands; Industry; Blue-collar. Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1(I) is the specification without interaction terms; (II) is the specification with the interaction terms between sectors dummies and COVID-19 dummy.
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT-ICP data.

Table 6 - Robustness check of the effects of COVID-19 on the wage distribution of Italian workers using WFH capacity index

	(I)			(II)		
	Quantile					
	10th	median	90th	10th	median	90th
	Panel A - All					
WFH capacity index	0.042***	0.044***	0.048***	0.041***	0.044***	0.048***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
	Panel B - Females					
WFH capacity index	0.048***	0.055***	0.062***	0.045***	0.055***	0.062***
	(0.005)	(0.002)	(0.004)	(0.004)	(0.003)	(0.004)
	Panel C – Males					
WFH capacity index	0.042***	0.039***	0.043***	0.041***	0.039***	0.043***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.004)

Notes: Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT-ICP data.

Appendix A

Table A1 ICP index related questions.

Code	Title	Sub-title
	Remote Work	
H.3	Using Telephone	How often do you have telephone conversations in this job?
H.4	Using mail	How often do you use electronic mail in this job?
H.5	Using letters and memos	How often does the job require written letters and memos?

Table A2 Occupations with the highest and the lowest ratings of WFH index

Code	Description	WFH score
	Top Five	
11210	Ambassadors, plenipotentiary ministers and other leaders of the diplomatic career	99
11231	Directors of territorial and equivalent school offices	99
11242	Rectors of universities, directors of higher education institutions and research institutes	99
12390	Other directors and department managers	99
22151	Chemical and petroleum engineers	99
	Bottom five	
72320	Drivers of machinery for the manufacture of other rubber articles	13
81410	Unqualified cleaning staff in accommodation services and ships	12
54870	Lifeguards and similar professions	9
74240	Drivers of animal-drawn vehicles	6
81420	Unqualified personnel in catering services	5

Appendix B

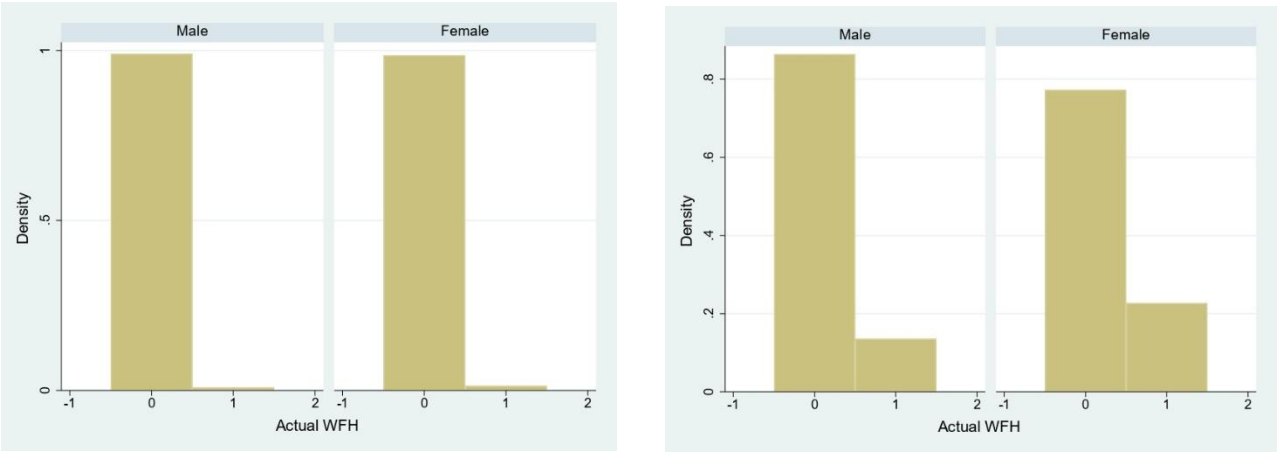
Table B1 - First stage estimates

	Prob. Employment
Couple with child	0.003***
	(0.001)
Single father with child	-0.020***
	(0.003)
Single mother with child	-0.039***
	(0.002)
Female	-0.030***
	(0.001)
Age 25-34	0.069***
	(0.002)
Age 35-44	0.118***
	(0.002)
Age 45-54	0.144***
	(0.002)
Age 55-64	0.169***
	(0.002)
Italian citizenship	0.033***
	(0.002)
Lower secondary school	0.041***
	(0.003)
Upper secondary school	0.084***
	(0.003)
Graduate	0.119***
	(0.003)
North-West	0.083***
	(0.001)
North-East	0.098***
	(0.001)
Center	0.059***
	(0.001)
N. observations	311.654

Notes: Reference category: 15-24 years old; no education; South and Islands.
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations from 2019Q1-2020Q2 ISTAT data.

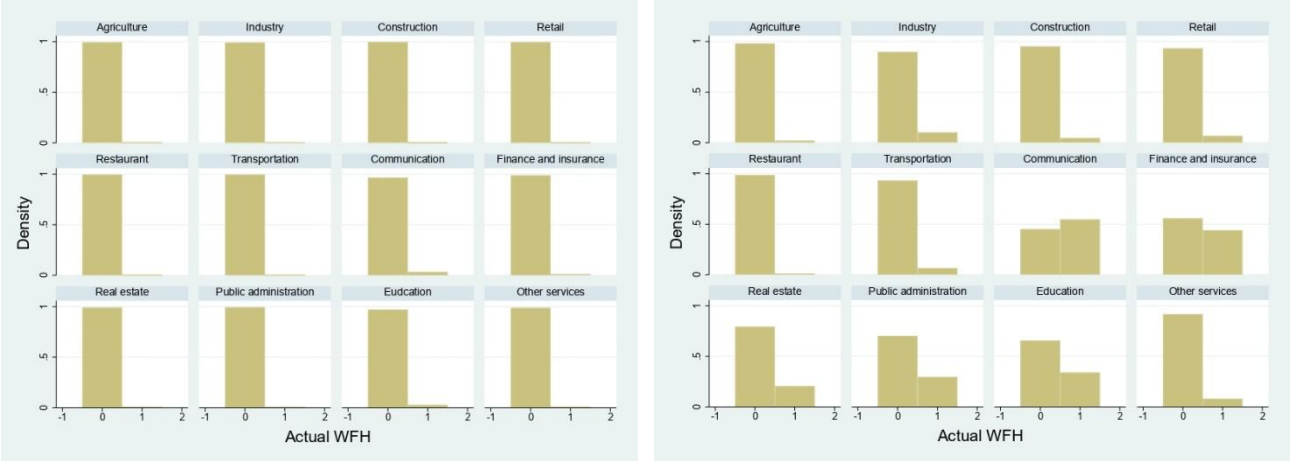
Figure 1 Actual WFH of men and women before (panel a) and during the pandemic (panel b)

(a) **(b)**



Source: Authors' calculations from 2019Q1-2020Q2 ISTAT data

Figure 2 Actual WFH by sector of economic activity before (panel a) and during the pandemic (panel b) **(a)** **(b)**



Source: Authors' calculations from 2019Q1-2020Q2 ISTAT data

Endnotes

[i] See https://coronavirus.jhu.edu/map.html

[ii] See https://www.istat.it/it/files//2021/03/Mercato_lavoro_IV_trim_2020.pdf

[iii] More details are available at: https://www.istat.it/it/files//2021/03/STAT_TODAY_stime-preliminari-2020-pov-assoluta_spese.pdf

[iv] Educational dummy indicators refer to the highest and successfully completed educational attainment of the individual. The educational classification used to build these indicators is the ISCED 97. We have four categories: no education (none or elementary educational level), primary education (lower secondary educational level), secondary education (upper secondary attainment level), and tertiary education (post-secondary, tertiary or higher educational level).

[v] NUTS is the acronym of "*Nomenclatura delle unità territoriali statistiche*". Specifically, we refer to the first level of disaggregation, NUTS1, corresponding to the macro-region. According to this classification, there are four NUTS1 for Italy, North-West, North-East, Centre, and South.

[vi] The US O*Net database is based on the Dictionary of Occupational Titles which since 1939 provided information on occupations with a specific focus on the skills required in the public employment service. The O*Net is based on the Standard Occupational Classification (SOC) providing for each elementary occupation variables on knowledge, skills, abilities and tasks. The key dimensions included in the O*Net are the following: *worker characteristics* – permanent characteristics affecting workers performance as well as their propensity to acquire knowledge and skills; *worker requirements* – workers characteristics matured by means of experience and education; *experience* - characteristics mostly related to past work experience; *occupation* – a large set of variables referring to requirements and specific features of the various occupations.

[vii] On average, 20 workers per each Italian occupation are interviewed providing representative information at the 5th digit. The survey includes more than 400 variables on skill, work contents, attitudes, tasks and many other subjective and objective information on occupations. More in particular, the ICP offers a massive amount of information concerning work contents and attitudes, skills and tasks, technological and organizational characteristics of productive processes, degree of standardization and control of workers operations, importance and nature of social interactions. A fundamental aspect of our data is that our task and skill variables are specific to the Italian economy. Thus, the ICP may be used to define the structure of the labour market, the level of technology and the industrial relations, which characterize the Italian economy. More specifically, the use of ICP variables avoid potential methodological problems which may arise when information related to the American occupational structure (i.e. contained in the US O*Net repertoire) is matched with labour market data referring to different economies as the European ones. As the ICP is based on Italian occupations, and not those of the U.S., it is more reliable in defining characteristics of the Italian production structure, technology and industrial relations. Thus, we avoid potential biases arising when information referring to the U.S. occupational structure (those contained in the U.S. O*Net repertoire) are matched to labour market data referring to different economies such as the European ones.

[viii] Such a result confirms that GWG phenomenon is traditionally an important issue in Italy (Biagetti and Scicchitano 2011; 2014; Mussida and Picchio; 2014a: 2014b, Picchio and Mussida, 2011).

[ix] It is consistent with what Biagetti et al. (2020) found with respect to Italy.

[x] More in particular, Mr. Zuckerberg declared: "*It's clear that Covid has changed a lot about our lives, and that certainly includes the way that most of us work. Coming out of this period, I expect that remote work is going to be a growing trend as well.*" (See: https://www.nytimes.com/2020/05/21/technology/facebook-remote-work-coronavirus.html).