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WORKING PAPER SERIES

Working from home and the explosion of enduring divides: income, employment and safety risks

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Working from home and the explosion of enduring divides: income, employment and safety risks*

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Abstract

Why are there so many non-teleworkable occupations? Is teleworking only a matter of ICT usage or does it also reflect the division of labour and the underlying hierarchical layers inside organizations? What does it happen to those workers not able to telework in terms of socio-economic risks, and how does the gender dimension interact with risk stratification? Hereby, we intend to shed light on these questions using a detailed integrated dataset at individual and occupational level (Indagine Campionaria delle Professioni, Indagine delle Forze di Lavoro and Inail archive) which provides information on different nature of risks (income, employment and safety). Our results entail that, first, class attributes strongly influence the chance of working from home, second, those individuals who are not able to perform their work remotely are more exposed to transition to unemployment, to earn low wages, and to safety and health risks, third, being woman and employed with a temporary contract significantly amplify risk stratification.

JEL classification: J2, D2, D63, I14, C38.

Keywords: Occupational structure, teleworking, COVID-19, social divides.

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1 Introduction

With the outburst of the pandemic, societies are facing a major transformation of the established organization of productive activities, in particular the way in which work is physically performed at workplaces. Related, another deep challenge concerns the exploding socio-economic divides which are associated with the pandemic. Indeed, not all segments of the population have been equally hit by the economic damages arising from the impossibility of performing their own job. For some segments direct and indirect pandemic risks have been stratifying and conflating. This is the case of Black, Coloured and Latino communities in the US which have been facing rising health and poverty risks (Selden and Berdahl, 2020; Gonzalez et al., 2020; Montenovolo et al., 2020). These workers however were suffering profound injustices in terms of access to medical assistance, income insecurity and occupational segregation well before the pandemic (Millett et al., 2020). Similarly, indigenous and suburb communities in Latin America did have far less chance to stay at home during lock-downs forced to choose between income security and health protection (Dueñas et al., 2020).

From the other side of the Atlantic, the Eurozone established for the first time a common plan to finance unemployment subsidies, the SURE, because of the enormous job losses. However, European responses to tackle the labour-market impacts of the COVID-19 crisis have been heterogeneous, ranging from extensions of sick-leaves, furlough schemes, redundancy pay systems, extraordinary income transfers, suspensions of layoffs. The only common denominator across all countries has been the switch to telework. Clearly, the higher the presence of social protection schemes and of labour market institutions operating in a given country, the lower the possibility that job losses will result into individual socio-economic risks. On the contrary, the higher the level of informality and the weakness of labour market institutions, the higher the associated individual risks.

In this paper we focus on a country presenting a combination of formal and informal labour markets, Italy, the first European economy hit by the pandemic and immediately adopting measures of social distancing since the mid of March 2020. As a consequence of lock-down measures, productive activities have been overwhelmed by the imposition of teleworking. Firms and public bodies have faced the pressure to reshape their organizational set-up introducing for the first time forms of remote-working. In Italy, however, working-from-home appears to be more a privilege for a few occupations rather than a generalized possibility. In fact, we recently documented that only thirty percent of Italian workers may work remotely (Cetrulo et al., 2020b). Those workers tend to belong to the upper echelon of the occupational distribution, are better remunerated and employed with permanent contracts. This figure has been confirmed by survey data reporting between 6,5 and 8 million workers abruptly shifted to remotely-work against approximately 500.000 workers in 2018 (FondazioneDiVittorio, 2020). It is also in line with the US experience wherein, according to a web-survey carried out between April and June 2020 by Brynjolfsson et al. (2020), only one-third of the US workforce shifted to telework, confirming the previous estimate by Dingel and Neiman (2020). Other studies on advanced economies confirm this ratio, generally ranging from 30% to 50% of the workforce.

Why are there so many non-teleworkable occupations? Is teleworking only a matter of ICT usage or does it also reflect the division of labour and the underlying hierarchical layers inside organizations? What does it happen to those workers not able to telework in terms of socio-economic risks, and how does the gender dimension interact with risk stratification? Hereby, we intend to shed light on these questions using a detailed integrated dataset at individual and occupational level (Indagine Campionaria delle Professioni, Indagine delle Forze di Lavoro and Inail archive) which provides information on different nature of risks (income, employment and safety). Our results entail that, first, class attributes strongly influence the chance of working from home, second, those individuals who are not able to perform their work remotely are more exposed to transition to unemployment, to earn low wages, and to safety and health risks, third, being woman and employed with a temporary contract significantly amplify risk stratification.

More in detail, to address the first question, after having distinguished among the two populations of working and not-working from home, we dissect which are the attributes of teleworkability. We resort to the *anatomy* of the Italian occupations developed in [Cetrulo et al. \(2020a\)](#) assigning scores to attributes of power, knowledge and learning, ICT skills, creativity and team-working, per each 4-digit occupation. Then, we ask what happens to those segments not able to work remotely. In this respect, we study the probabilities of transition to unemployment (occupational risk), of getting low-income (income risk) and of job related injuries and diseases (health risk). We therefore identify those occupations which face stratifying risks, namely characterized by the co-occurrence of these three events. We finally estimate a probit model at individual and occupation level, accounting for a large set of covariates, and focusing on the role played by teleworkability, contractual, and gender determinants.

The first result of our study is that class attributes strongly affect the chance of working from home. Although the use of ICT devices and related knowledge are dramatically important to remotely-work, the degree of power and autonomy exercised in decision-making processes, and therefore the positioning along internal hierarchies, significantly differs between teleworkable and non teleworkable occupations. Women look to be endowed by a lower degree of power and autonomy compared to men in teleworkable occupations, and in general to be largely concentrated in the bottom part of the ISCO classification in non-teleworkable occupations, with gender and class divides intersecting. Moving to stratification of socio-economic risks, according to our second result, those individuals who are not able to perform their work remotely are more exposed to the risk of becoming unemployed, earning a lower wage and facing significant safety and health risks. The occupations facing the highest risks include food preparation-cooking-and-distribution personnel, waiters and similar professions, unqualified staff in charge of cleaning services in offices and shops, these latter being all professions with a predominant female share. Indeed, the third result entails that being woman and being employed with a temporary contract significantly amplify risk stratification.

Our empirical investigation looks at the structural determinants of occupations and it is not intended to produce now-casting ([Adams-Prassl et al., 2020b](#)), but rather to understand who are those segments experiencing risk stratification, with the aim of informing targeted policy interventions. It is by no coincidence that what before was an unequal system of organizing societies it is now getting a socially unjust one ([Dosi et al., 2020](#)) marked by exploding enduring divides.

The paper is organised as follows: in Section 2 we discuss the streams of literature relevant to inform the empirical analysis, while in Section 3 we detail data, methodology and descriptive evidence. Results are shown in Section 4 and further discussed in Section 5 which concludes the paper.

2 Background literature

In this section we discuss first the evidence on the diffusion and impacts of teleworking as organizational choice in usual times, while we next devote attention to teleworkability as a must in pandemic times.

2.1 Teleworking as a choice in usual times

The notion of “telecommuting” has been coined by [Nilles \(1975\)](#) with reference to the remotely execution of work tasks (including communications) at home or in other places different from the office. Early studies focusing on the diffusion of telework and related impacts on firms’ and workers’ performance have been stimulated by the fast diffusion of computers ([Nilles, 1975](#)) as well as by the effect of the 1970s’ energy crisis on mass transport ([Harkness, 1977](#)). However, contrary to the expectation of a progressive disappearance of offices and the spreading of nomad workers operating from their “electronic cottages” ([Toffler and Alvin, 1980](#); [Makimoto and Manners, 1997](#)), telework has been only slowly diffusing, with the highest rates recorded in the Northern European countries, Japan and the US ([Messenger, 2017](#)). Indeed, since 1980 the proportion of employees who primarily work from home has more than tripled

and the range of ‘teleworkable activities’ has also increased including a wide spectrum of service jobs, ranging from sales assistants and realtors to managers and software engineers (Bloom et al., 2015).

Sectoral, occupational and firm characteristics are crucial to understand the extent to which a given task is “teleworkable”. Indeed, “teleworkability” depends on the executed functions, availability of computers and digital infrastructures allowing to perform tasks remotely, firm managerial and organizational capabilities, worker ICT skills (Bailey and Kurland, 2002). In terms of hierarchical layers inside organizations (Huws, 1991; Huws et al., 1999; Bailey and Kurland, 2002; Corso et al., 2006; Neirotti et al., 2011), clerks, managers and professionals are seen as the most apt recipients of telework because of the more frequent use of computer, lower physical requirements and higher level of discretion and autonomy in defining the work pace characterizing those segments (Olson, 1983).¹ More recent evidence confirms the importance of adopting an occupational-based perspective to understand the patterns of telework diffusion, as the largest share of those working remotely are concentrated in specific occupational categories such as managers, professionals and, to a lower extent, clerical workers (Messenger, 2019).

From micro-level occupational differences to country-level ones, telework diffusion ranges from 30% adoption rates in Sweden and Finland, to much lower rates recorded in Italy, namely 3.6% in 2018.² Those differences are mainly due to heterogeneity in ICT infrastructures and in active policies aimed at promoting the diffusion of ICT skills and internal workplace flexibility (i.e. flexible working hours) (Huws et al., 1999; Messenger, 2019). Clearly, the industrial composition matters as well, with countries having larger shares of manufacturing, like Germany, less apt to teleworkability. Additionally, firm size matters being dimensionality a carrier of both technological and organizational capabilities. At the European level, Vazquez and Winkler (2017) report that the share of teleworking labourers has increased more than 15% in ICT intensive industries during the last decade, while according to the 2015 European Working Condition Survey (EWCS), around 13.5% of European workers had experience of telework, with only 5.2% of them usually working from home (Eurofound, 2020).³

Teleworking is supposed to reduce spared time (log-in), eventual unproductive working phases (breaks) and sick leaves. This seems to be confirmed by Bloom et al. (2015) which find that being assigned to telework raises individual productivity. Dutcher (2012), via a quasi-experimental setting, shows that working from home can have positive implications on productivity in the case of creative tasks, while a negative relationship is detected in the case of repetitive and low-skilled tasks.

In terms of workers satisfaction, Arntz et al. (2019), relying on the German Socio-economic panel (GSP) between 1997 and 2014, highlight the importance of workers’ socio-demographic characteristics: while childless employees even working an unpaid extra-hour per week report higher satisfaction due to telework, the latter penalizes women compared to men in terms of monthly wages, therefore increasing the gender-pay gap, with women accepting wage reduction against available free time to reconcile home caring schedules (Mas and Pallais, 2017). Increasing overtime is also reported in Lott and Chung (2016).

Overall, if teleworking remains an attribute characterizing only few countries and occupations, having been generically configured as a complementary rather than a unique organizational choice, it is crucial to understand and detect which are the underlying characteristics making teleworking possible, and to estimate the socio-economic risks for those who cannot telework. This is of paramount importance nowadays since teleworking has shifted from being an organizational option (based on workers’ voluntary choice) for those few innovative firms and countries of adoption, to a must necessary to keep operating productive activities under pandemic times.

¹Regarding managerial activities, Bailey and Kurland (1999) introduced the concept of “remote managing” referring to the possibility of controlling workers remotely and alternating face to face interactions with virtual management of subordinates.

²<https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200206-1>

³The authors adopt an extended definition of telework including both working from home and other forms of ICT enabled remote working. About half does telework only occasionally while one-quarter performs remotely almost all tasks. Across the EU, the fraction ranges from 38% in the Northern-Eastern countries (Germany being the only exception at 13%) to 16% in Spain and 7% in Italy.

2.2 Teleworking as a must in pandemic times

Teleworkability significantly depends on technical attributes of occupations and on the internal division of labour and knowledge inside organizations. Jobs requiring in-person interactions, or alternatively, transforming external objects/environment and/or deploying complex and voluminous machines can hardly be performed from home. The opposite holds for jobs characterized by the use of ICT devices and software which do not require social exchanges. Therefore, the actual performed tasks, rather than the sheer sector of activity, represent the appropriate level of information to detect teleworkability.⁴

Indeed, the explosion of the pandemic has seen the emergence of a growing literature based on occupation-level data to produce some quantitative assessment of the share of teleworkable jobs. The first study has been [Dingel and Neiman \(2020\)](#) which, relying on the US O*NET dataset, gave a figure of 37% of the US workforce having the *technical feasibility* to work from home. According to this study, occupations able to work from home include those in STEM, education, training, and library services, legal and financial activities and managerial ones. At the opposite are those manual workers in building and grounds cleaning and maintenance, food preparation and serving, construction and extraction, and installation, maintenance, and repairing. Corroborating evidence is in [Hensvik et al. \(2020\)](#) which rely on the American Time Use Survey. Among the top-5 most teleworkable occupations at 4-digit, the authors report medical transcriptionists, computer scientists, economists, farmers and artists. Relying on the BIBB/BAuA Employment Survey for German jobs, [Alipour et al. \(2020\)](#) document that 56% of the workforce can potentially shift to telework. The estimate for Italy stands at 30% according to [Cetrulo et al. \(2020b\)](#). All studies report strong heterogeneity across sectors and occupations.

But the question is what happens to the rest of non-teleworkable occupations. Confirming the evidence in [Cetrulo et al. \(2020b\)](#), [Brussevich et al. \(2020\)](#), covering 35 OECD countries, find that workers less likely to work remotely are largely concentrated in sectors more hit by the pandemic, such as accommodation and food services, transportation, and retail and wholesale sectors. According to their estimates, about 15% of the workforce employed is at high risk of layoffs mostly involving vulnerable occupations, sectors and informal labour markets. [Montenovo et al. \(2020\)](#) report heterogeneous economic impacts of the pandemic across US subgroups. They identify as pivotal the role played by occupational characteristics (degree of teleworkability and social interaction) and industry in explaining job losses.

More comprehensive risk analyses are however scant. The exposure to health and employment risks of occupations distinguished by degree of teleworkability is analysed in [Beland et al. \(2020\)](#). Relying on the Current Population Survey (CPS) to study the impact of stay-at-home orders on employment and wages in the US, they find higher job security for remote occupations. Consistently, [Adams-Prassl et al. \(2020a\)](#) report that the higher the fraction of tasks executable from home, the lower the risk for workers of being furloughed under the UK Job Retention Scheme. For Italy [Barbieri et al. \(2020\)](#) and [Boeri et al. \(2020\)](#) have looked at those sectors of activity more exposed to contagion via physical proximity, with the highest exposure registered in the health sector.

In the following, we aim at contributing to the extant literature by focusing on the underlying characteristics of teleworkability, clarifying, first, which attributes of the working activities allow to telework and, second, quantifying, from a multi-level perspective, the socio-economic risks that those who cannot telework are facing.

3 Data, methodology and descriptive evidence

In this section we first present the integrated dataset used to conduct the empirical investigation (Subsection 3.1), and we then move to describe our classification to distinguish those occupations which

⁴Occupation-level analyses are also extremely informative for what concerns individuals' location within the class structure of a society ([Wright, 1980, 1997](#)).

can and cannot perform their activity from home (Subsection 3.2). Health risks deriving from working activity are presented in Subsection 3.3, while gender divides in terms of teleworkable occupations are discussed in Subsection 3.4.

3.1 Integrated datasets description

Our empirical analysis draws on the matching of three different databases, namely the RLFC-ISTAT (Rilevazioni Forza Lavoro) which allows to recover information on the Italian labour force at individual level, the Bancadati delle Professioni-INAIL which provides occupation-based information on labour conditions, namely accidents at work and job diseases, and finally the ICP-INAPP (Indagine Campionaria delle Professioni) providing information on tasks and activities performed at workplaces. From the matching, we exploit a huge informative set, part of the so called Italian Informative System of Occupations (see Table 1 for more details).⁵

The RLFC collects detailed information on workers employment status, income, socio-demographic characteristics (i.e. education, age, gender, region), type of employment contract, 4-digit occupation, and sector of activity. The survey, an annually repeated cross-section, is conducted by the ISTAT three times per year with a quarterly frequency, interviewing around 250 thousand families resident in Italy, corresponding to a total of about 600 thousand individuals, across 1.400 Italian municipalities. Each individual is interviewed four times in two subsequent quarters, at year t , and in the corresponding quarters at year $t + 1$.⁶ Our time span of analysis employs the most recent wave, 2016-2017, while the remaining available annual waves up to 2011 are used as robustness checks in the Appendix (see Table 10 and Table 11).

As already illustrated in [Cetrulo et al. \(2020a\)](#), the ICP represents the only European source comparable with the American O*NET database, the latter being the most comprehensive data-base reporting qualitative and quantitative information on tasks, skills, work contexts and organisational characteristics at the 5-digit level of observation. The construction of the dataset entails a complex, multi-layer strategy of data collection and information processing allowing for both detailed occupational descriptions and inter-occupational comparability. Currently, two waves of the ICP database are available (2007 and 2012) with a spectrum covering 797 occupational codes, excluding armed forces. We rely on the 2012 wave. The interviews were administered to 16,000 Italian workers to ensure statistical representativeness with respect to sectoral, occupational, dimensional and geographical heterogeneity. Both O*NET and ICP questions are organised in six main sections, expressions of a content model that simultaneously provides information from both a job-oriented and a worker-oriented perspective. The descriptors are: worker characteristics (enduring abilities), worker requirements (skills and education), occupational requirements (organisational and work context), experience requirements (training, cross functional skills), workforce characteristics (labour market information) and occupation-specific information (generalised activities and work context). Therefore, descriptors are formulated by making it possible to distinguish, for instance, inner individual abilities from competences acquired on the job. For each question, two rating scales are generally provided: level and importance.

The Banca dati delle Professioni released by the INAIL (National Institute for Occupational Accident Insurance) contains information on work accidents' and occupational diseases' incidence at 5-digit occupational level from 2017 to 2018. The public release of this dataset is part of an integrated project aimed at progressively matching different sources of information on occupations. To our knowledge, this is the first time the INAIL dataset is used in combination with other two sources of information on occupations. To get time-consistent estimation, we use the cross-sectional 2017 wave.

⁵For other studies employing the RLFC-ICP matched dataset see [Cirillo et al. \(2020\)](#); [Cassandra et al. \(2020\)](#).

⁶For further information <https://www.istat.it/it/archivio/8263>.

Database	Source	Year	Unit of Analysis	Observations	Variables
RILEVAZIONI FORZA LAVORO	ISTAT	2011-2017	Individuals	More than 85.000	<ul style="list-style-type: none"> • Monthly wage; • Employment status (employed, not employed, inactive); • Socio-demographic variables (age, gender, education, occupation, geographical area, sector).
INDAGINE CAMPIONARIA DELLE PROFESSIONI	INAPP-ISTAT	2012-2016 wave	4-digit occupation	506	<ul style="list-style-type: none"> • Selection from section G • Selection from section H.
BANCA DATI DELLE PROFESSIONI	INAIL	2017	4-digit occupation	506	<ul style="list-style-type: none"> • Number of accidents at work; • Number of diseases at work (e.g. osteo-muscular, oncological, nervous, mental diseases).

Table 1: Integrated datasets description

3.2 Working from home and teleworkability

Our first step entails the identification of those occupations which can and cannot be performed from home (FH and NFH respectively thereafter). With this purpose, we start with the analysis of the ICP dataset. To identify those jobs, thirty questions belonging to the “generalised activities” (G) and “work context” (H) sections of the ICP have been selected (see Table 7 in the Appendix for reference).⁷

Our analysis adapts and expands the methodology proposed by [Dingel and Neiman \(2020\)](#). The selected questions provide insights on the relative importance of:

1. performing activities involving (i) use, control and repairing of machines, equipment, vehicles, (ii) social contact, taking care of/or assisting others, (iii) email correspondence;
2. performing activities which (i) are carried out outdoors, (ii) require exposure to diseases and infections, (iii) imply the execution of risky movements or the wearing of protective equipment.

The correlation matrix in Figure 1 shows a relatively low degree of overlapping information among our selected variables, and this supports our choice of retaining all thirty entries.

For each 5-digit occupation,⁸ these variables are ranked according to an importance or frequency scale ranging from 0 to 100. In order for an occupation to be classified as “Not from home”, most of the respondents should spend a large fraction of their working time in external environments or use equipment, machinery, tools. Alternatively, they should have continuous contact with the public.

More in detail, our indicator “Not from home” is a binary variable taking value 1 if at least one out of 29 questions (except the use of e-mail) shows a score equal or higher than 60 (corresponding respectively to “once or several times per week” in the time scale of section H, and to “very important” in the importance scale of section G), or if the question on the use of e-mail takes a value lower than 40; vice

⁷This section largely draws upon [Cetrulo et al. \(2020b\)](#).

⁸The original unit of analysis in ICP is the 5-digit occupation. In order to link occupations data with National labour force survey, we aggregate information at the 4-digit level.

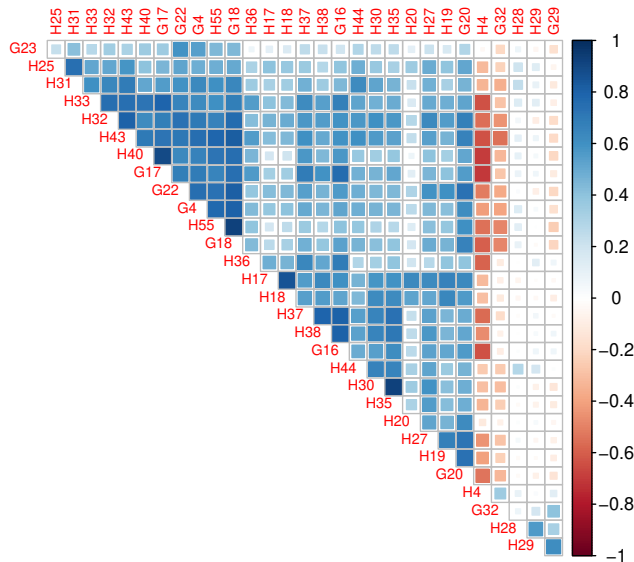


Figure 1: Correlation matrix among ICP questions to construct the binary indicator

versa the indicator is equal to zero if for all 29 questions, intensities are lower than 60, or alternatively if the question on the use of mail is higher or equal to 40.

Therefore, if for a given occupation most respondents report that it is very important to control machinery and use equipment, the latter cannot be carried out from home. Similarly, if most respondents report that they perform outdoor tasks for the majority of working time, this occupation cannot be carried out from home. Conversely, if sending e-mails represents a very infrequent activity, the occupation cannot be performed remotely. The classification is useful in order to identify jobs that can and cannot be executed from home on the basis of the actual performed tasks and work contexts, and starts by excluding all those occupations that require working in a well-defined physical space (e.g. because of the use of working instruments or because of intensive social contact). Of course, in case of compulsory social distancing, an occupation as primary school teacher which could not be carried out from home according to our classification, will eventually be done remotely. In fact, there are tasks, largely related to activities as “taking care of others” or “working with the public” that could potentially be digitized, however at the cost of entirely reconfiguring the very nature of the profession.

An interesting example to appreciate and validate our classification is the case of teachers which, according to the education-level, belong to different categories. In fact, while school teachers cannot work from home, almost all university professors and researchers can actually perform their job remotely. This result depends precisely on the different degree of importance attributed by workers to social contact variables, being the latter more relevant in primary education (as shown in Table 9 in the Appendix). Overall, the index performs quite well in consistently assigning the entire set of 4-digit occupations⁹ to the two groups *From Home* and *Not From Home*, in such a way that only eight occupations are manually moved from one group to another after an ex-post evaluation of the classification (as reported in Table 8 in the Appendix).

After identifying occupational categories at 4-digit, these are aggregated at 1-digit according to the ISCO classification, and then are linked to the Labor Force Survey providing information on the number of employees, wages, contractual types and socio-demographic characteristics of workers (age, gender and level of education). Table 2 presents top-ten occupations at 3-digit for each category. Occupations are ranked in terms of the number of variable co-occurrences, out of thirty selected variables. The higher the number of co-occurrences, the higher the ranking. Occupations like woodcutters, miners, construction workers, fishermen rank among the top-professions which cannot be performed remotely. On the

⁹We exclude military occupations and 7222 4-digit occupation because of the lack of labour force data.

TOP-TEN OCCUPATIONS WHICH CANNOT BE PERFORMED FROM HOME
644 Specialised forestry workers
711 Plant and machinery operators for the extraction and initial treatment of minerals
724 Machinery workers in plants for the mass production of wooden items
743 Agricultural machinery drivers
841 Unqualified mining and quarrying personnel
842 Unqualified construction personnel and similar professions
716 Plant operators for the production of thermal energy and steam, for waste recovery and for the treatment and distribution of water
645 Fishermen and hunters
712 Metal processing and hot working plant operators
612 Craftsmen and skilled workers in the construction and maintenance of building structures
TOP-TEN OCCUPATIONS WHICH CAN BE PERFORMED FROM HOME
252 Specialists in legal science
431 Employees in charge of the administrative management of logistics
254 Specialists in linguistic, literary and documentary disciplines
411 Secretarial and general affairs employees
121 Entrepreneurs and directors of large companies
122 Directors and general managers of companies
211 Specialists in mathematical, computer, chemical, physical and natural sciences
331 Technicians of the organization and administration of production activities
432 Economic, accounting and financial management employees
251 Management, commercial and banking science specialists

Table 2: Top-ten occupations which can and cannot be performed from home (3-digit, ISCO classification). Source: ICP-RCFL (2016)

contrary, occupations involving specialised field knowledge, as legal or linguistic experts, managerial and executive professions are among the top ones which can be performed remotely. In terms of organizational hierarchies, occupations that cannot be performed remotely tend to be located at the low-end of the employment structure. On the contrary, those who self-organize their working activity, give orders or are responsible for high-level administrative tasks can operate remotely.

Overall, only 30% of the workforce has a job that can be done remotely, corresponding to broadly 6.7 million workers (2016 data). For the remaining part, including more than 15 million workers, activities carried out, and work context to which they are exposed do not make working from home feasible (Cetrulo et al., 2020b). This figure is in line with Dingel and Neiman (2020) reporting 37% as the share of occupations which can be done from home for the United States.¹⁰ Notice that our estimate becomes consistent with the survey-based figure ranging between 6.5 and 8 million remotely workers recorded in Spring 2020, once we account for school teachers.

By aggregating at 1-digit according to the ISCO classification and distinguishing for gender, in Figure 2 a highly polarized occupational structure emerges with a strong concentration of opportunities to work from home for the upper four occupational groups. Working remotely is feasible for the majority of those who are at the top of the organizational hierarchy (managers, entrepreneurs and legislators), for scientific-intellectual professions, for technical professionals. It increases in administrative tasks. For the lower part of the ISCO classification the scenario radically changes. Service-based occupations, such as entertainment operators, sales workers, artisans, plant and machine operators, as well as elementary professions, see the chance for working remotely drastically shrinking or mostly nil.

The first take home message from this battery of analyses is that working from home is more a privilege for a tiny fraction of the workforce rather than a generalized and widespread possibility. Why teleworkability is so rare? We now turn to analyse which are the underlying determinants of working from home by employing for the two categories the factor analysis developed in Cetrulo et al. (2020a), the latter developed to identify the dominant traits of the Italian occupational structure. In this respect,

¹⁰The authors extended the same analysis to 85 developed and developing countries, applying results from the US O*NET to national ILO data and finding a positive correlation between GDP per capita and the share of jobs doable from home. Indeed, this “once for all” approach disregards the importance of taking into account country level information on work content and executed activities for each occupational category. In our case, thanks to the ICP availability, we are able to do a consistent country level assignment both in terms of work content and labour force data.

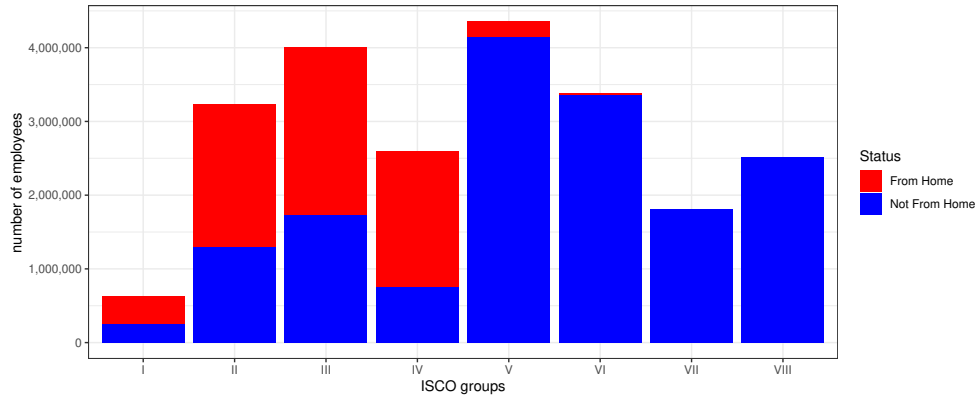


Figure 2: Distribution at 1-digit (ISCO groups) for employees which can and cannot work from home. Source: ICP-RCFL (2016)

the factor analysis conducted on the ICP dataset revealed that *power* attributes are the most important element to define inter-occupational variability, while *knowledge* attributes are quite widespread across occupations. Finally, *ICT skills* are very much concentrated among few occupations, mainly scientific workers.

To which extent teleworkability is affected by these determinants? Figure 3 shows the kernel density distributions at 4-digit level of the five latent factors emerging from the ICP analysis. The factors read as (i) power, entailed by activities requiring decision-making authority, influence and control over other people, (ii) cognitive and manual dexterity, entailed by activities requiring both physical and cognitive selection of appropriate tools, inspection, control over the process, (iii) ICT knowledge, (iv) team, entailed by those activities requiring coordination with others, (v) creative, involving those activities which require creative thinking.

For the first three factors, the distinctive kernel density distributions highlight structural differences among the two categories. First of all, performing activities which entail the exercise of power attributes within organisations prevalently characterises FH occupations, confirming empirical studies underlying the importance of holding a relevant degree of autonomy, authority in doing the job, and setting deadlines in order to be able of working remotely.¹¹ On the other hand, those workers performing activities which require manual dexterity and cognitive ability in dealing with production processes, or in keeping the sequence of machine tools, are largely employed in non teleworkable occupations. ICT skills, which are notably under-diffused in Italy, mainly characterise FH jobs. A similar pattern is shown by team-working which in general prevails in FH occupations. Being creative is instead an attribute not such distinctive. Box-and-whisker plots presenting median, interquartile ranges, maximum and minimum values are shown in Figure 16 in the Appendix. If teleworkability is not only a matter of executing (or non-executing) activities which require manual ability (Sostero et al., 2020), but it also regards the internal position inside organizations, say the hierarchical layer to which one belongs, it becomes even clearer why working from home is more a privilege for restricted social groups rather than a widespread opportunity.

We now turn to present some descriptive statistics on the employment evolution (2011-2016) of occupations according to the two categories (FH and NFH respectively). Indeed, if teleworking from being an organizational option becomes the only alternative, we need also to understand the degree of readiness of the Italian occupational structure in absorbing those teleworkable occupations. During the period under analysis no relevant discontinuity in the growth rate of two groups can be observed

¹¹Despite relatively similar “technical feasibility”, diffusion of telework practices has been significantly different between managers and keyboard clerks (Milasi et al., 2020).

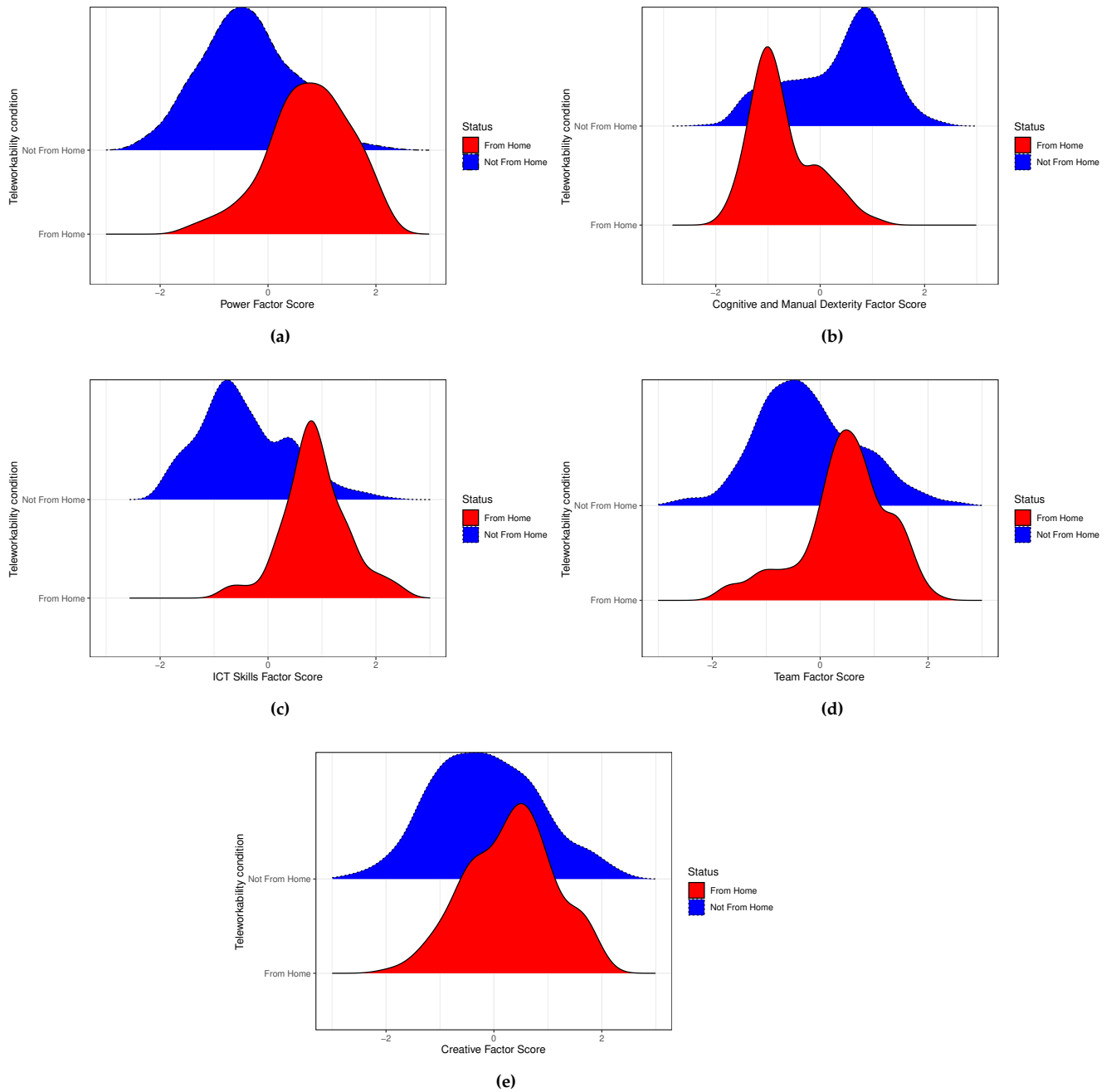


Figure 3: Factor scores - Kernel density distributions for FH and NFH occupations

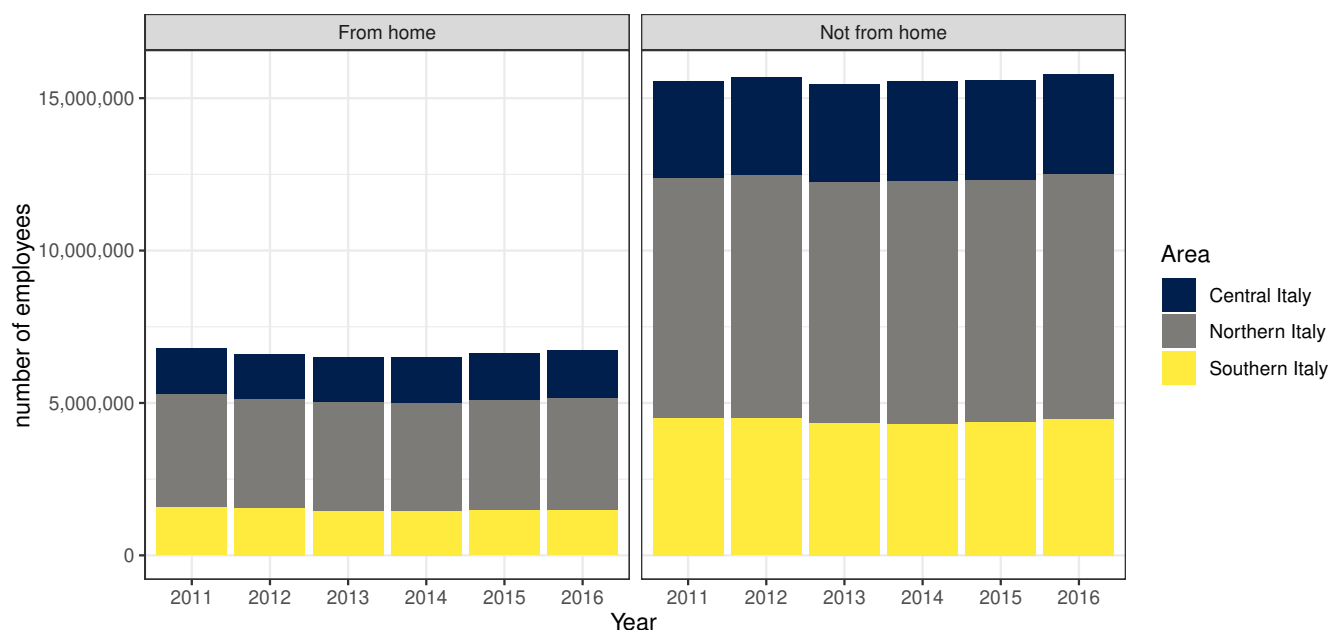


Figure 4: Time-evolution in the number of employees by regional area and teleworkability (2011-2016)

(Figure 4), with a stable figure of less than 7 million workers employed in teleworkable jobs with respect to about 15 millions in not teleworkable jobs. Together with a stable trend in NFH occupations, regional disparities clearly emerge, being those relatively few teleworkable occupations concentrated in the North.

3.3 Health risk at work: physical proximity, accident rates and occupational illness

If working from home represents a privilege in terms of employment stability and income security, with the outburst of the pandemic FH occupations appear also to be the most resilient to risk of contagion. Indeed, face-to-face interactions represent one of the thirty variables included to characterize the two populations: who can telework enjoys also the chance to reduce interpersonal contacts.

Physical proximity and face-to-face interactions have been used to identify sectors of activity and related occupations more exposed to contagion risk (Barbieri et al., 2020). However, the authors retrieve this information from the ICP variable defined as “physical proximity”. Although it might be sensible, we deem too restrictive the use of this ICP variable to estimate risk of contagion for two reasons: first of all, physical proximity might be the result of the very nature of working activity (primarily in the health sector), but also of the physical organization of workplaces (take the case of assembly workers using common spaces as canteens or wardrobes, or of open-space offices in administrative services). The use of this variable tends to confine contagion risk to a sector-specific event, leading to potential underestimation of the risk level in non-health and non-service sectors. For example, in manufacturing or in elementary occupations, workers tend to under-report face-to-face interactions and physical proximity. However many activities are actually performed in quite crowded workplaces, and sharing of workstations with other operators often occurs. Our doubt is confirmed by the distribution of physical proximity across 1-digit occupational groups: it is a prevalent variable, above 60%, only for service and sales workers while it disregards the majority of other occupations (Figure 5.a).

Indeed, relying on disease exposure, physical proximity and gathering, the first release of the INAIL classification on sectoral contagion risks, adopted to regulate workplaces during the post lock-down

Sector	% COVID-19 fatalities	% COVID-19 cases	Initial Estimated Risk
Q Health and social care	23.3	71.2	High
C Manufacturing	13.6	2.9	Low
H Transport and warehousing	11.7	1.2	Low
O Public Administration and Defence	10.7	9	Low
G Wholesale and retail trade	10.2	1.4	Low
M Professional, scientific and tech activities	n.a.	1.3	Low
F Construction	6.3	n.a.	Low
I Accommodation and restaurant services	4.4	2.5	Low
N Rental, travel agencies	3.9	4.4	Low
K Financial and insurance activities	3.9	n.a.	Low
A Agriculture, forestry and fisheries	n.a.	1.9	Low
P Education	n.a.	0.7	Medium Low
S Other service activities	3.4	1.5	Low
Other	3.3	2	n.a.

Table 3: Distribution across sectors of COVID-19 cases and fatalities (INAIL data January-August 2020)

phase, ranked doctors, nurses, pharmacists, police agents, funeral parlours and hairdressers as the most exposed workers, while low contagion risk was assigned to manufacturing and logistics workers (INAIL, 2020a). However, recent updates on contagion at workplaces show an increasing number of cases in logistics and meat processing plants (INAIL, 2020b), wherein working and employment conditions are far from being safe even in normal times (EFFAT, 2020). Indeed, although at the beginning the highest recorded cases were in hospitals, mainly because of the lack of protective devices and adequate sanitizing procedures, recent data show a significant increase in contagion rate within sectors of activity initially classified at low risk.

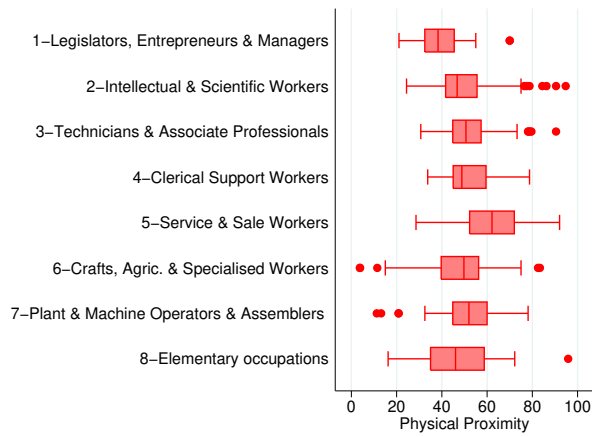
To overcome these limitations, we deem appropriate to consider a more comprehensive indicator of the actual conditions of safety and health, looking at cases of accidents and occupational illnesses at work, collected by the INAIL database. In fact, even if not directly informing about exposure to contagion, structural, pre-existing information on health and safety conditions at work might proxy the status of employee protection schemes at workplaces at each 4-digit level. Note that these events are *rare* because only certified by legal procedures (Figure 5.b and Figure 5.c), however more concentrated in the bottom part of the ISCO classification.

Looking *both* at occupational illness and accident rates (health risk in Figure 5.d) will prevent the analysis from focusing only on most dangerous NFH occupations, but rather it will offer a comprehensive understanding on safety conditions at work, considering a variety of physical and psychological risk factors. Not surprisingly, the explosion of the pandemic has also spurred inequalities in terms of health at work. As stressed by the ETUI (2020), these disparities do not only depend on the type of job performed, but they are strictly related to both socio-demographic and organisational factors. Adopting or not rigid health and safety protocols within firms becomes crucial to prevent contagion.¹²

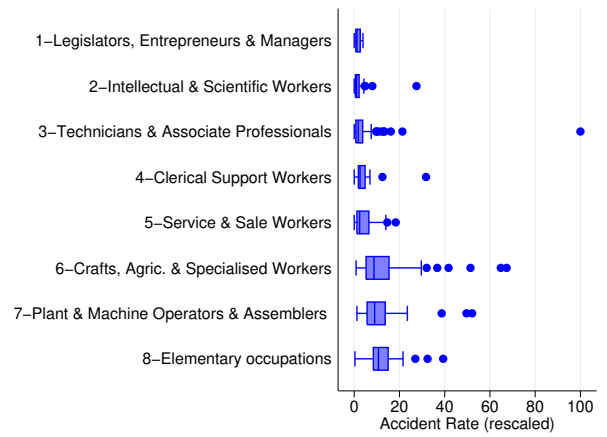
3.4 Gender divides

Up to the COVID-19 crisis, male and female occupations have never been such differently affected during downturns: indeed, recent empirical evidence documents the phenomenon of *she-recession* to underline how women have been dramatically hit by the pandemic-induced crisis, either for occupational segregation in sectors more exposed to closures (manly social consumption services), or for the highly

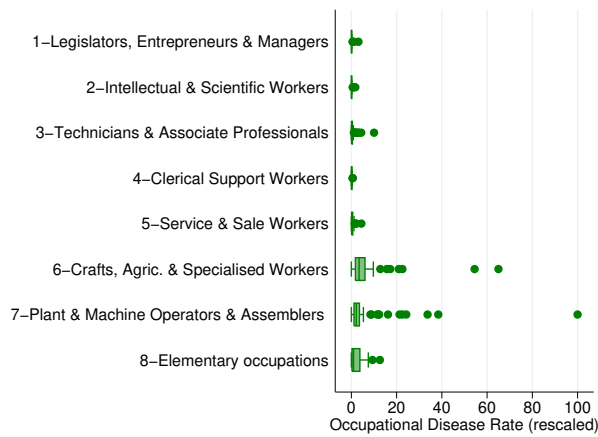
¹²For example, during the second wave of contagion in France, 29% of new detected clusters between May and September 2020 occurred in non-healthcare workplaces. According to ETUI, this is due to scarce workplace prevention and absence of improvements in terms of work-organisation: see <https://www.etui.org/news/france-work-key-covid-19-contaminator>.



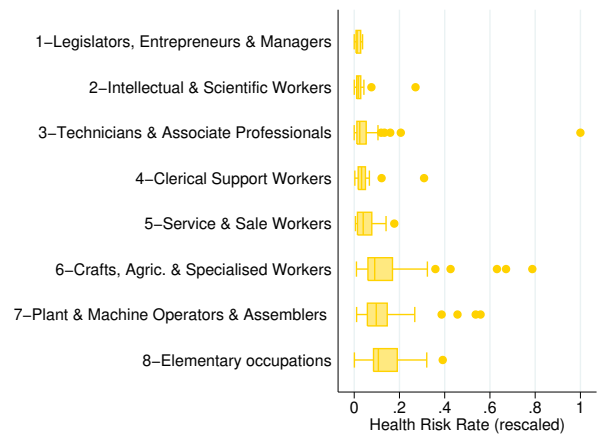
(a) Physical proximity



(b) Accident rate at work



(c) Occupational disease rate



(d) Health risk

Figure 5: Distribution of physical proximity (ICP), accident rate at work (INAIL), occupational disease rate (INAIL), health risk (authors' elaboration combining accident and disease rates) at 1-digit (ISCO classification)

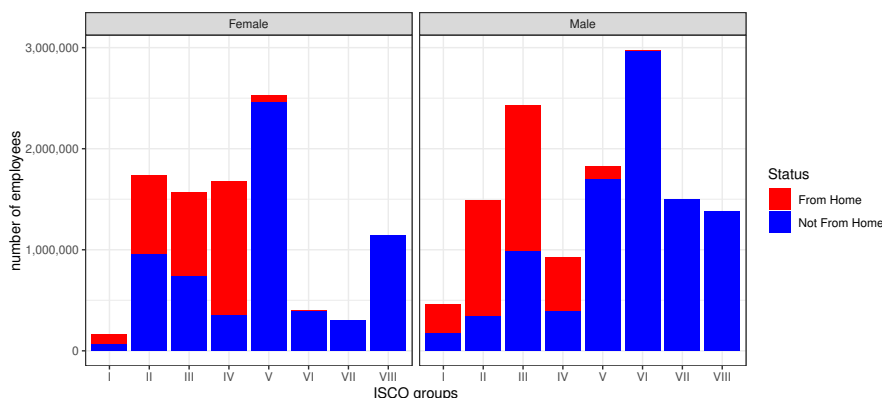


Figure 6: Gender distribution at 1-digit (ISCO classification) for employees which can and cannot work from home. Source: ICP-ILFS (2016)

unbalanced distribution of domestic burden, inducing many women to leave their job to taking care of children.¹³

Risks, vulnerabilities and socio-economic hardships affecting women intersect in the pandemic phase. With reference to Italy, on the one hand, many female workers kept working because employed in so-called *essential* sectors but, on the other hand, those who carried out domestic and care jobs, such as housekeepers and carers, were largely unable to access income and welfare supports due to the still predominantly irregular and informal nature of employment relationships in this sector.

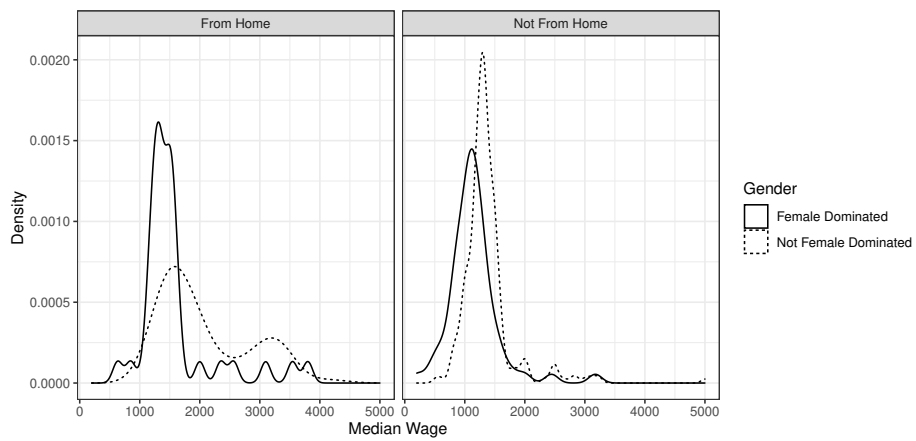
Therefore, to analyse and map vulnerabilities characterizing different professions, introducing a gender dimension enlarges our comprehension on those segments upon which the pandemic is hitting harder. Figure 6 presents the breakdown of FH and NFH occupations by distinguishing for male and female workers. Women working from home are mostly concentrated among clerical support workers doing administrative activities and to a less extent among scientific and technical professions. They hardly materialize among the top professions of the first ISCO group. Among these women, many had the chance to telework, therefore maintaining income and job, however enormously suffering the burden of conciliation between working and caring activities, primarily children education. Moving to those one who cannot telework, which indeed represent the largest fraction, they are mainly concentrated among service and sales, and elementary occupations. Those women not having the chance to telework, together with the care-work burden, had also to cope with income, employment and safety risks.

Patterns of occupational segregation, detailed at 3-digit level in Table 12 in the Appendix, map into lower income for women (Figure 7.a), lower power and autonomy in female dominated professions (Figure 7.b), which also look to be endowed by lower ICT skills (Figure 7.c). Indeed, power and ICT skills predominantly characterize teleworkable jobs and therefore appreciable heterogeneities regard FH occupations, in accordance with Figure 3.

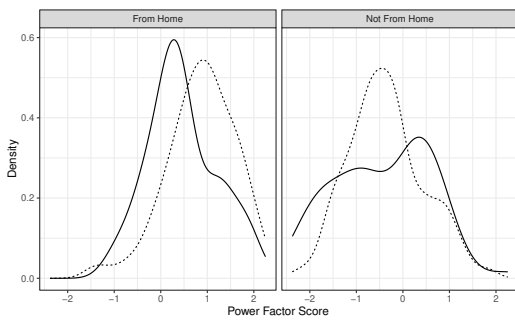
4 Estimates of risk stratification

After having identified (i) occupations which can and cannot be performed from home, (ii) the underlying attributes of teleworkability, (iii) the importance of considering a more comprehensive nature of safety conditions at work, we now move toward the empirical estimation of three forms of risks, namely employment, income and health safety. The goal is to verify whether a different risk profile emerges

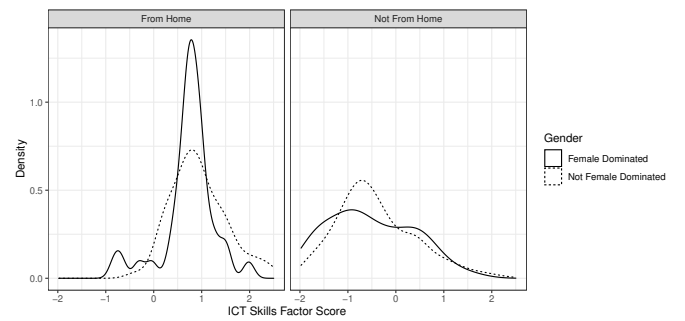
¹³<https://voxeu.org/article/shecession-she-recession-2020-causes-and-consequences>.



(a) Wage distribution by gender for FH and NFH occupations



(b) Power factor score by gender for FH and NFH occupations



(c) ICT skills by gender for FH and NFH occupations

Figure 7: Wage distribution, power and ICT skills factor scores by gender and status

with respect to the probability of losing the job, earning a low income and facing more frequently accidents at work and occupational illnesses, which will be our outcome variables, once we classify workers according to their teleworkability, also in line with the extant literature (Mongey and Weinberg, 2020).

Figure 8 shows the histograms of our three outcome variables distinguishing between FH and NFH occupations. Already at a first glance it emerges a distinctive pattern characterizing the two populations: indeed all three events are extremely concentrated among not working from home occupations, while the frequency of occurrence strongly decays for the other group.

Tables 13, 14, 15, 16 in the Appendix present the co-occurrence of the three events for occupations at 4-digit, considering all possible combinations. They are indeed quite revealing, pointing at occupations such as “Retail sales assistants”, “Industrial product packaging machine workers”, “Unqualified cleaning staff in accommodation services and ships” among the most exposed to multi-dimensional risks (Table 13). If we exclude health risk (Table 14), female dominated professions such as “Supervisors of children and similar professions”, “Personal care workers”, “Machinery operators for the treatment and conservation of food” come more prevalently, while occupations in essential and caring activities as “Workers in charge of hygiene and cleaning services” and “Qualified professions in health and social services” emerge when looking at the co-occurrence of low-income and health risks (Table 15). Finally, manual workers and machine operators are more exposed to combined employment and health risks (Table 16). We are therefore able to pinpoint stratifying vulnerabilities.

This evidence supports our following empirical investigation meant at quantifying the different probabilities of risk occurrence for the two groups, and the role played by other relevant socio-demographic, contractual and sectoral characteristics impacting on the latter probabilities. Additionally, as a further extension, we assess whether male and female workers are differently hit.

4.1 Empirical strategy and variables description

The empirical analysis applies the binary response methodology on two different databases:

- a micro data-set built merging ISTAT RLFC-ICP, on which we estimate for each individual i those factors affecting the probability of (i) transition to unemployment and (ii) earning a low income;
- an aggregated data-set merging ICP-INAIL-ISTAT, where for each occupation j at 4-digit we look at those characteristics having an impact on the probability of (iii) low income and (iv) high accident risk and illness at work.

We assume that the response probability takes the following form:¹⁴

$$P(y = 1|\mathbf{x}) = P(y = 1|x_1, x_2, \dots, x_k) = G(Z)$$

$$G(z) = \Phi(Z) = \int \phi(v)dv$$

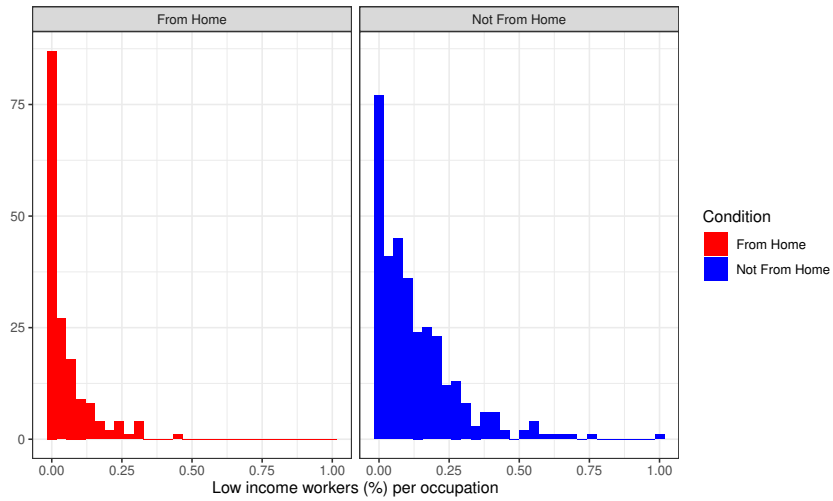
with $\phi(z)$ being a standard normal density function:

$$\phi(z) = (2\pi)^{-1/2} \exp(-z^2/2)$$

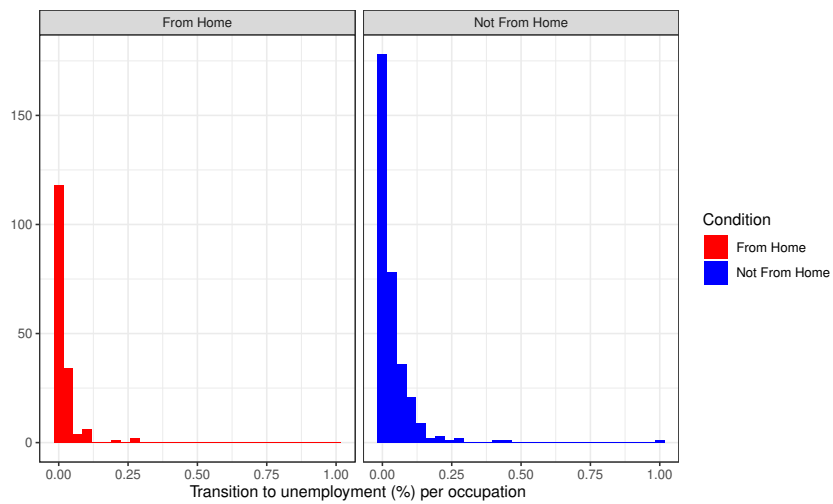
We perform four univariate probit models, with dependent variables expressed as binary dummies:

1. Transition to unemployment (i): $Y1_i = 0, 1$, where $Y1_i = 1$ if individual i is employed at time t but he becomes unemployed or inactive at time $t + 1$; $Y1_i = 0$ if otherwise;
2. Low income (i): $Y2_i = 0, 1$, where $Y2_i = 1$ if the income of individual i belongs to the lowest income quartile of the entire workforce wage distribution; $Y2_i = 0$ if otherwise;

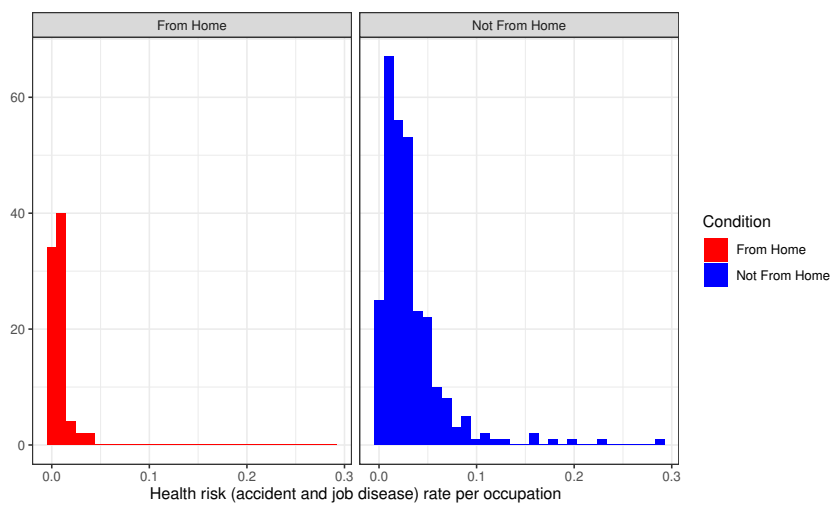
¹⁴See Wooldridge (2006) for further details.



(a) Low income distribution



(b) Transition to unemployment distribution



(c) Occupational disease and/or accident at work rates distribution

Figure 8: Histograms of the events: a) earning a low income; b) transition to unemployment ; c) having an accident at work and/or occupational illness.

3. Low median income (j) : $Y3_j = 0, 1$, where $Y3_j = 1$ if the median income of occupation j belongs to the lowest income tercile of occupations' median wages distribution; $Y3_j = 0$ if otherwise;
4. High health risk (j) : $Y4_j = 0, 1$, where $Y4_j = 1$ if the rate of accidents at work and occupational illnesses j belong to the highest tercile of the distribution; $Y4_j = 0$ if otherwise.

where i = individual with $i = 1, \dots, 85,763$ and j =occupation at 4-digit with $j = 1, \dots, 487$.

We estimate four univariate probit models, at individual and occupation-level, against the indicator "Working from home" built on the ICP dataset (2012) and a set of covariates expressed in terms of dummies or categorical variables, as described in Table 4. The choice of a parametric model implies the loss of information on potential heterogeneous effects for each population of interest. For example, it might be that employment risk increases for some particular 4-digit occupations, because of processes of restructuring of the sector of activity. However, being our covariates dummy or categorical variables it is not possible to proceed with non-parametric probit estimations allowing for local effects of the regression coefficients, changing with the intensity of explanatory variables. Fitness of the four models has been assessed through sensitivity (detection of true positives rate) and specificity (detection of true negatives rate) analysis. ROC curves (Figure 17 in the Appendix) show a strong positive concave relationship, with areas always above 70% which indicate a more than satisfying diagnostic ability of the model with respect to power and type I errors.

4.2 Employment and income risks

Our first variable of interest is the risk of losing the job for an individual employed in a FH occupation, as a baseline, compared with an individual in a NFH occupation. In order to define the employment risk we look at individual transition events from employment to unemployment or inactivity, from time t (2016) to $t + 1$ (2017).¹⁵ Given the lack of longitudinal panel data at individual level, we are able to capture only yearly based transitions to unemployment, therefore discarding information from longer transition spells. Likely, the baseline transition year, 2016, is not characterised by strong cyclical macroeconomic factors which could have alternatively impacted upon estimation results. Indeed, it was a period of anaemic recovery since the 2008 crisis. Additionally, we are not able to capture persistent unemployment and duration effects. Those caveats should clarify about the potential underestimated figures we provide.

Table 5 (column 1) presents the probit regression coefficients. Confirming the information from Figure 8, but now controlling for a comprehensive set of covariates, the variable "Not working from home", shows a positive and significant effect on the probability of transiting to unemployment status for a worker being employed in a NFH occupation as compared to a FH occupation. This positive sign confirms the presence of an inherent higher risk of losing the job, independently from external shocks such as the pandemic, which characterizes those occupations classified as NFH, after controlling for factors such as age, gender, education level and contractual framework. We also observe that being employed in sectors such as Construction, Art and other Services significantly increases the risk of losing the job (with respect to the manufacturing sector), whereas the opposite holds for those working in Public Administration, Education, Health and also Agriculture. Positive and statistically significant coefficients of the two geographical controls confirm the presence of regional disparities in terms of employment security, with workers located in Southern and Central Italy being more exposed to risks of unemployment with respect to their colleagues in the North.

Repeated cross-section estimations are presented in Tables 10 and 11 as robustness checks, confirming our results.

¹⁵We follow the definition of unemployment provided by ILO which includes unavailable job-seekers in labour force. For recent empirical studies applying this notion of "wide unemployment" see for instance [Cassandra et al. \(2020\)](#)

Variable	Type	Values
INDIVIDUAL LEVEL DATA		
$Y1_i$: Transition wide	Dummy	1 (if employed at time t and unemployed or inactive at time $t+1$), 0 (if otherwise)
$Y2_i$: Low income	Dummy	1 (if income belongs to the first quartile of income distribution), 0 (if otherwise)
OCCUPATIONAL LEVEL DATA		
$Y3_j$: Low income	Dummy	1 (if the median wage belongs to the lowest tercile of income distribution), 0 (if otherwise)
$Y4_j$: High health risk at work	Dummy	1 (if the health risk belongs to the highest tercile of the health risk distribution, that equals to the sum of job accidents and occupational illnesses), 0 (if otherwise)
Not From Home	Dummy	1,0
Female	Dummy	1 (if sex=female), 0 (if sex=male)
Age Group	Categorical	1 (if age=16-35), 2 (if age=36-50), 3 (if age=51-75)
Education level	Categorical	1 (if level =lower secondary), 2 (if level =secondary), 3 (if level = bachelor), 4 (if level = master)
Job Contract	Categorical	1 (if contract = permanent), 2 (if contract = temporary), 3 (if contract = autonomous)
Area	Categorical	1 (if area = Northern Italy), 2 (if area = Central Italy), 3(if area = Southern Italy)
Agriculture	Dummy	1 (if nace = 1), 0 (if otherwise)
Mining and Quarrying	Dummy	1 (if nace = 2), 0 (if otherwise)
Manufacturing	Dummy	1 (if nace = 3-9), 0 (if otherwise)
Electricity Gas Water & Waste	Dummy	1 (if nace = 10), 0 (if otherwise)
Construction	Dummy	1 (if nace = 11), 0 (if otherwise)
Wholesale Transport & Accommodation	Dummy	1 (if nace = 12), 0 (if otherwise)
Information & Communication	Dummy	1 (if nace = 13), 0 (if otherwise)
Financial & Insurance Act	Dummy	1 (if nace = 14), 0 (if otherwise)
Real Estate Activities	Dummy	1 (if nace = 15), 0 (if otherwise)
Professional Scientific Support Activities	Dummy	1 (if nace = 16), 0 (if otherwise)
Public Administration, Education & Human Health	Dummy	1 (if nace = 17), 0 (if otherwise)
Art & Other Services	Dummy	1 (if nace = 18), 0 (if otherwise)

Table 4: Probit's variables (individual and occupational level data)

	(1)	(2)
	Unemployment Risk	Low Income
Not From Home	0.187*** (5.31)	0.374*** (18.41)
Female	0.197*** (7.41)	0.749*** (44.76)
36-50 years old	-0.222*** (-7.90)	-0.257*** (-13.64)
50-75 years old	-0.358*** (-10.84)	-0.448*** (-21.05)
Lower secondary education level	0.230*** (4.67)	0.717*** (24.74)
Secondary education level	0.0815 (1.80)	0.498*** (18.94)
Bachelor education level	0.185* (2.52)	0.141** (3.19)
Temporary Contract	0.780*** (25.80)	0.271*** (12.11)
Autonomous Contract	0.0628* (1.97)	-1.458*** (-44.12)
Center Italy	0.119*** (3.71)	0.145*** (7.61)
Southern Italy	0.369*** (13.97)	0.348*** (20.08)
Agriculture	-0.236*** (-3.72)	0.671*** (16.84)
Mining & Quarrying	-0.223 (-0.89)	0.341* (1.97)
Electricity Gas Water & Waste	-0.153 (-1.13)	-0.0982 (-1.47)
Construction	0.280*** (5.95)	0.182*** (4.50)
Wholesale Transport & Accommodation	0.0602 (1.60)	0.451*** (19.07)
Information & Communication	0.0124 (0.12)	0.177** (2.72)
Financial & Insurance Activities	-0.301* (-2.16)	-0.206** (-3.22)
Real Estate Activities	0.298* (2.16)	0.573*** (5.25)
Professional Scientific Support Activities	0.130** (2.66)	0.790*** (26.86)
Public Administration, Education & Human Health	-0.396*** (-7.56)	0.0517 (1.85)
Art & Other Services	0.292*** (6.33)	1.067*** (35.60)
_cons	-2.339*** (-38.09)	-2.251*** (-60.73)
<i>N</i>	82,177	85,763
<i>PseudoR</i> ²	0.124	0.256

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Probit models (micro data 2016-2017)

Figure 9, left panel, presents the average marginal effects for NFH occupations. This effect, as expected, turns out to be relatively small (1.1%) because of the “rare” event we are measuring (one year based transition to unemployment), and to a lesser extent, because of the high number of observations.¹⁶ Other relevant worker attributes which increase the probability of transition to unemployment, or inactive status, are being woman and young, holding a low education title. Indeed, temporary workers experience an employment risk 8% higher with respect to workers with a permanent contract. In the current post lock-down phase, reports on the labour market released by the ISTAT record a huge rise in job losses for temporary workers (ISTAT, 2020).

Our second measure of risk concerns the probability of earning a low income. Income risks are particularly important to be analysed because of the reduced access to work for those individuals who cannot operate from home. Therefore, it is pivotal to understand the pre-existing probabilities of getting a low income whenever a worker employed in a NFH job stops doing its own activity for social distance measures and related policy regulation. To study the probability of earning a low income, we distinguish among four wage quantiles, namely low, medium-low, medium-high and high. We intentionally focus on the low wage quantile since we want to assess whether NFH occupations, receiving less income, have also less access to precautionary savings in case of income shocks.

Table 5, column 2, shows the probit regression coefficients for income risk. The coefficient of the NFH variable is positive and statistically different from zero, implying that belonging to an occupation which cannot be performed remotely inherently increases the probability of earning a low wage. Figure 9, right panel, presents the average marginal effects. The effect of NFH is now sizeable and much bigger than the corresponding one on employment risk (around 6%). This occurs also because of the higher persistence characterizing the wage distribution, which from year to year tends to show a relatively stable support. With respect to the role played by other covariates, being woman now increases the probability of earning a low income of 15%. Indeed, holding a temporary contract increases the probability of earning a low income of 8%. Also in this case regional disparities are at stage, with Southern and Central workers recording higher risks of earning a low income. With respect to sectoral heterogeneity, only workers in Finance and Insurance Activities exhibit a lower income risk (compared to the base manufacturing group), as shown by its negative and statistically significant coefficient.

Figure 10 presents differentiated marginal effects by gender and contractual categories highlighting gender divides and role of precariousness.

4.3 Safety risks

After having identified employment and income risks, we now move toward the estimation of safety risks. To accomplish the latter task, we employ the occupational level dataset ICP-INAIL-ISTAT whose unit of observation is not the individual (as in previous analyses) but the occupation at 4-digit level. More precisely, we investigate whether occupations that cannot be performed from home are more likely to be characterized by a higher health risk (built as the sum of accidents at work and occupational illnesses) and, as robustness check, also by a lower level of income. In order to control for several factors and to be consistent with the previous estimations, we exploit information from the labour force survey to build gender, regional, sectoral, education and contractual dummies. The routine adopted is as such that if the 60% of workers of a given occupation are e.g. female, that occupation is defined as “female dominated” and so on.

According to Table 6, the coefficient of NFH is positive and statistically different from zero in both probit models. This outcome confirms the result obtained in the previous analysis concerning the risk

¹⁶The average marginal effects have to be read, for each variable, as the difference between the probability that an event occurs for the baseline group (FH) and for the group of interest (NFH). For instance, in the case of NFH a positive average marginal effect implies that moving from an occupation executable from home to an occupation that cannot be done remotely implies a positive increase in the probability of unemployment.

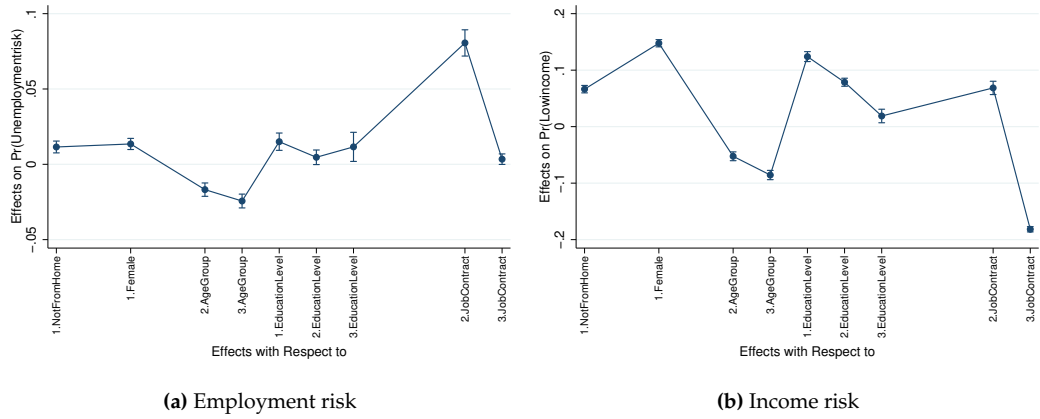


Figure 9: Average marginal effects on employment and low income risks - Regression in Table 5

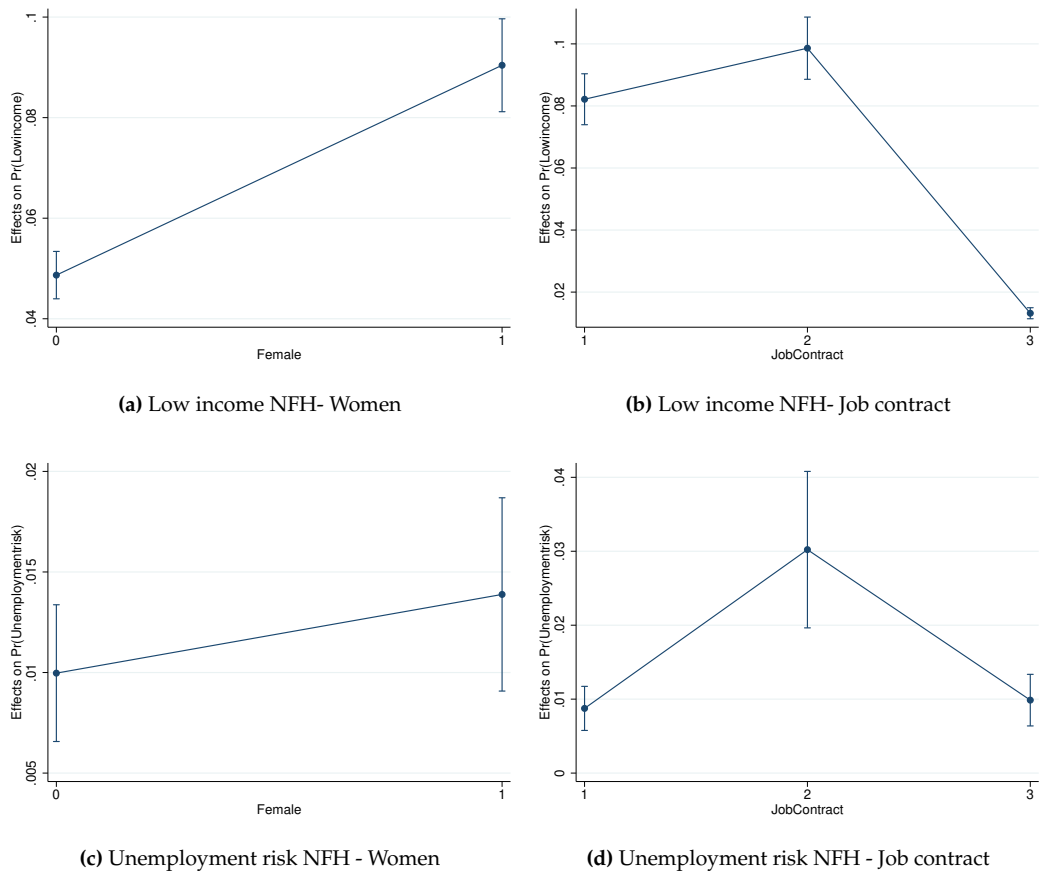


Figure 10: Differentiated marginal effects by gender and contractual categories from probit estimates in Table 5

	(1)	(2)
	Low Income	High Safety Risk
Not From Home	0.860*** (4.54)	1.169*** (4.74)
Female	1.160*** (6.13)	-0.445 (-1.95)
Permanent	-0.565*** (-3.59)	0.459** (2.61)
Degree	-1.488*** (-4.74)	-1.378** (-2.99)
North	-0.451** (-2.84)	-0.0580 (-0.34)
Agriculture	1.175*** (3.48)	0.462 (1.38)
Manufacturing	0.275 (1.37)	0.625** (2.92)
Electricity Gas Water & Waste	0.0409 (0.06)	1.335** (2.85)
Construction	-0.134 (-0.42)	0.667* (2.12)
Wholesale Transport & Accommodation	0.341 (1.38)	0.602* (2.30)
Real Estate Activities	1.856** (3.04)	0 (.)
Professional Scientific Support Activities	0.894* (2.41)	0.270 (0.67)
Public Administration, Education & Human Health	-0.408 (-1.46)	0.376 (1.26)
Art & Other Services	0.665* (2.16)	0.290 (0.84)
_cons	-0.887*** (-3.94)	-2.140*** (-6.95)
<i>N</i>	487	485
<i>PseudoR</i> ²	0.307	0.237

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Probit models (occupational level data 2016)

of low wage, but it also adds an important information related to the dimension of health and safety at work. Indeed, as shown in Figure 11, moving from teleworkable to not teleworkable jobs increases the probability of facing a higher safety risk at work by more than 30%. Clearly, the computed probabilities are much higher than the one presented in the previous section because in this case the analysis is based on occupational rather than individual level data, increasing by construction the average marginal effects. Regarding the role played by other covariates, while belonging to a female/temporary contracts dominated profession strongly increases the probability of getting a low income, safety risks are higher in male dominated professions with permanent contracts.

5 Discussion and conclusions

With the outbreak of the COVID-19 pandemic, although heterogeneously in terms of timing and intensity, governments opted for social distancing measures directed at reducing interpersonal contacts, the latter being identified as the main source of contagion. In this context, advising or requiring workers to work from home represented one of the key measures included in the 'anti-COVID 19' social distancing policy packages (OECD, 2020). Currently, telework keeps to be the preferred organizational option to meet a twofold goal: (i) ensuring the continuity of productive activities, (ii) keeping the frequency of social interactions (and the risk of contagion) low. Employers' interest to implement this flexible (and less costly) working practice is growing, despite a clear understanding on its functioning and effects is still missing. Big private companies and public administrations have very quickly allowed their employ-

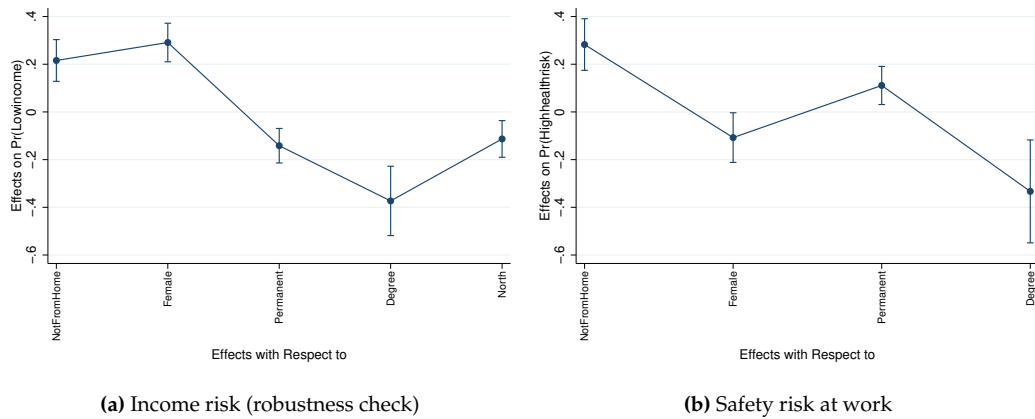


Figure 11: Average marginal effects on low income and health risks from probit estimates in Table 6.

ees to work from home. The second contagion wave has again fostered teleworking in public bodies, while trade unions are calling for national collective agreements to clearly define the boundaries and the modality of telework.

Such a pandemic-induced spreading of telework is showing heterogeneous effects on labour market segments: indeed, maintaining full-time working hours and switching to telework represent a suitable option only for a fraction of the working population, belonging to the upper echelon of hierarchies, being employed in occupations not requiring manual and cognitive dexterity, endowed by ICT-knowledge. Therefore, although telework represents an important safety net in terms of health, employment, and income security, it can also turn out into an inequality-enhancing mechanism between those who can and those who cannot work from home.

All in all, switching to telework requires good economic outlook for firms, organizational and technological capabilities. Companies with negative prospects are more likely to fire employees, reduce working hours (and wages), stop temporary hiring, rather than switching to telework. The lack of technological infrastructures (i.e. high-speed Internet, adequate computers, and ICT devices) and organizational capabilities might prevent to opt for telework, increasing unemployment risks for their employees, currently largely contained by lay-off suspensions. Therefore, telework, and thus opportunities for employment and income continuity, are likely to be unevenly distributed across sectors, firms, occupations and workers not only in the short but also in the medium term.

In this paper, we aimed at assessing the presence of enduring divides between Italian workers that can work from home and those who cannot. This distinction, grounded on the study of occupational characteristics and their telework feasibility, turns out to be revealing of stratifying vulnerabilities in terms of income remuneration, employment stability and safety at work. Our results show that NFH workers record higher probabilities of earning low wage, losing job, experiencing accidents at work and occupational illnesses with respect to FH workers. Women and temporary workers face stratifying and conflating risks.

The empirical evidence, referred to 2016-2017 Italian labour force data, shows the existence of enduring differences that are likely to explode in phases of downturns and crises, as already signalled by short-term occupational data. Indeed, first available statistics confirm the higher incidence of job losses among NFH and precarious workers (see, for instance, [Guven et al. \(2020\)](#) for Australia; [Montenovo et al. \(2020\)](#) for USA; [Adams-Prassl et al. \(2020a\)](#) for the UK). All this couple with a stagnant labour demand in teleworkable occupations, almost concentrated in the North of Italy. As a consequence, labour and social protection policies should aim at reducing rather than exacerbating those divides, starting with flexible shifts, extension of sick leaves, full-paid paternal and maternal leaves, secure income sta-

bility. At the same time, fostering social dialogue and promoting the adoption of effective health and safety protocols through the direct involvement of workers and trade unions is crucial (ILO, 2020).

Finally, when discussing about telework, we need to distinguish between telework as an organizational option and telework as the only choice. In the first case, it should be conceived as part of a policy strategy pushing for shorter and more flexible working time, preventing and limiting all the documented side effects, such as increasing work intensification and unpaid overtime, difficulties in balancing working and private life and risk of burnout, being only some of the drawbacks reported by workers (Messenger, 2019), by means of contractual regulations. Second, given the lack of conclusive evidence on firm performances, on the processes of knowledge diffusion, on creativity, on collaborative practices among workers, a complete switch to telework is not advisable as well.

Future lines of research entail the study of heterogeneity across teleworkers, in terms of occupational categories, sectors of activity and employer characteristics. What is more, if telework will essentially turn into working from home, availability of adequate private spaces, responsibility of looking after kids and doing houseworks will strongly influence the overall consequences of telework across hierarchical positions and gender.

References

- Adams-Prassl, A., T. Boneva, M. Golin, and C. Rauh (2020a). Furloughing. *Fiscal Studies* 41(3), 591–622.
- Adams-Prassl, A., T. Boneva, M. Golin, and C. Rauh (2020b). Inequality in the impact of the coronavirus shock: Evidence from real time surveys. CEPR Discussion Paper No. DP14665.
- Alipour, J.-V., O. Falck, and S. Schuller (2020). Germany's capacities to work from home. CESifo Working Paper.
- Arntz, M., B. Y. Sarra, and F. Berlingieri (2019). Working from home: Heterogeneous effects on hours worked and wages. *ZEW-Centre for European Economic Research Discussion Paper* (19-015).
- Bailey, D. E. and N. B. Kurland (2002). A review of telework research: Findings, new directions, and lessons for the study of modern work. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior* 23(4), 383–400.
- Bailey, N. and N. B. Kurland (1999). The advantages and challenges of working here, there, anywhere, and anytime. *Organizational dynamics* 28(2), 53–68.
- Barbieri, T., G. Basso, and S. Scicchitano (2020). Italian workers at risk during the covid-19 epidemic. Available at SSRN 3572065.
- Beland, L.-P., A. Brodeur, and T. Wright (2020). Covid-19, stay-at-home orders and employment: Evidence from CPS data. IZA Discussion Paper.
- Bloom, N., J. Liang, J. Roberts, and Z. J. Ying (2015). Does working from home work? Evidence from a Chinese experiment. *The Quarterly Journal of Economics* 130(1), 165–218.
- Boeri, T., A. Caiumi, and M. Paccagnella (2020). Mitigating the work-safety trade-off. *CEPR Covid Economics* 2, 60–66.
- Brussevich, M., E. Dabla-Norris, and S. Khalid (2020). Who will bear the brunt of lockdown policies? Evidence from tele-workability measures across countries. IMF Working Paper.
- Brynjolfsson, E., J. J. Horton, A. Ozimek, D. Rock, G. Sharma, and H.-Y. TuYe (2020). Covid-19 and remote work: An early look at US data. Technical report, National Bureau of Economic Research.

- Cassandra, N., M. Centra, P. Esposito, and D. Guarascio (2020). What drives employment-unemployment transitions? evidence from Italian task-based data. Technical report, GLO Discussion Paper.
- Cetrulo, A., D. Guarascio, and M. E. Virgillito (2020a). Anatomy of the Italian occupational structure: concentrated power and distributed knowledge. *Industrial and Corporate Change*. <https://doi.org/10.1093/icc/dtaa050>.
- Cetrulo, A., D. Guarascio, and M. E. Virgillito (2020b). The privilege of working from home at the time of social distancing. *Intereconomics* 55, 142–147.
- Cirillo, V., R. Evangelista, D. Guarascio, and M. Sostero (2020). Digitalization, routineness and employment: an exploration on Italian task-based data. *Research Policy Online first*, 1–21.
- Corso, M., A. Martini, L. Pellegrini, S. Massa, and S. Testa (2006). Managing dispersed workers: the new challenge in knowledge management. *Technovation* 26(5-6), 583–594.
- Dingel, J. I. and B. Neiman (2020). How many jobs can be done at home? Technical report, National Bureau of Economic Research.
- Dosi, G., L. Fanti, and M. E. Virgillito (2020). Unequal societies in usual times, unjust societies in pandemic ones. *Journal of Industrial and Business Economics* 47, 371–389.
- Dueñas, M., M. Campi, and L. Olmos (2020). Changes in mobility and socioeconomic conditions in Bogotá city during the covid-19 outbreak. *arXiv preprint arXiv:2008.11850*.
- Dutcher, E. G. (2012). The effects of telecommuting on productivity: An experimental examination. The role of dull and creative tasks. *Journal of Economic Behavior & Organization* 84(1), 355–363.
- EFFAT (2020). Covid-19 outbreaks in slaughterhouses and meat processing plants. Technical report. <https://effat.org/wp-content/uploads/2020/09/Covid-19-outbreaks-in-slaughterhouses-and-meat-processing-plants-State-of-affairs-and-09.2020.pdf>.
- ETUI (2020). Covid-19 point épidémiologique hebdomadaire du 10 septembre 2020. Technical report. https://www.etui.org/sites/default/files/2020-09/COVID19_PE_20200910.pdf.
- Eurofound (2020). Telework and ICT-based mobile work: Flexible working in the digital age. Publications Office of the European Union, Luxembourg.
- FondazioneDiVittorio (2020). Quando lavorare da casa è smart? Prima indagine Cgil/Fondazione Di Vittorio sullo smart working. Technical report. http://www.cgil.it/admin_nv47t8g34/wp-content/uploads/2020/05/Indagine_Cgil-Fdv_Smart_working.pdf.
- Gonzalez, D., M. Karpman, G. M. Kenney, and S. Zuckerman (2020). Hispanic adults in families with noncitizens disproportionately feel the economic fallout from covid-19. *Washington, DC: Urban Institute*.
- Güven, C., P. Sotirakopoulos, and A. Ülker (2020). Short-term labour market effects of covid-19 and the associated national lockdown in Australia: Evidence from longitudinal labour force survey. Technical report, GLO Discussion Paper.
- Harkness, R. C. (1977). Technology assessment of telecommunications/transportation interactions. Volume II. Detailed Impact Analyses. Technical report.
- Hensvik, L., T. Le Barbanchon, and R. Rathelot (2020). Which jobs are done from home? Evidence from the American time use survey. CEPR Discussion Paper No. DP14611.

- Huws, U. (1991). Telework: projections. *Futures* 23(1), 19–31.
- Huws, U., N. Jagger, and S. O'Regan (1999). *Teleworking and globalisation*. Institute for Employment Studies.
- ILO (2020). A safe and healthy return to work during the covid-19 pandemic. Technical report. http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/briefingnote/wcms_745549.pdf.
- INAIL (2020a). Documento tecnico sulla possibile rimodulazione delle misure di contenimento del contagio da sars-cov-2 nei luoghi di lavoro e strategie di prevenzione. Technical report. <https://www.inail.it/cs/internet/docs/alg-documento-tecnico-coronavirus-fase-2.pdf>.
- INAIL (2020b). I dati sulle denunce da covid-19 (monitoraggio al 30 giugno 2020). Technical report. <https://www.inail.it/cs/internet/docs/alg-scheda-tecnica-contagi-covid-30-giugno-2020.pdf>.
- ISTAT (2020). Nota metodologica: Occupati e disoccupati dati provvisori luglio 2020. Technical report. https://www.istat.it/it/files//2020/09/CS_Occupati-e-disoccupati_LUGLIO_2020.pdf.
- Lott, Y. and H. Chung (2016). Gender discrepancies in the outcomes of schedule control on overtime hours and income in Germany. *European Sociological Review* 32(6), 752–765.
- Makimoto, T. and D. Manners (1997). *Digital nomad*. Wiley.
- Mas, A. and A. Pallais (2017). Valuing alternative work arrangements. *American Economic Review* 107(12), 3722–59.
- Messenger, J. C. (2017). Working anytime, anywhere: The evolution of telework and its effects on the world of work. *IUSLabor*.
- Messenger, J. C. (2019). *Telework in the 21st Century: An Evolutionary Perspective*. Edward Elgar Publishing.
- Milasi, S., I. González-Vázquez, and E. Fernández-Macías (2020). Telework in the EU before and after the covid-19: Where we were, where we head to. Science for policy brief, JRC.
- Millett, G. A., A. T. Jones, D. Benkeser, S. Baral, L. Mercer, C. Beyrer, B. Honermann, E. Lankiewicz, L. Mena, J. S. Crowley, et al. (2020). Assessing differential impacts of covid-19 on black communities. *Annals of Epidemiology* 47, 37–44.
- Mongey, S. and A. Weinberg (2020). Characteristics of workers in low work-from-home and high personal-proximity occupations. Becker Friedman institute for economic white paper.
- Montenovo, L., X. Jiang, F. L. Rojas, I. M. Schmutte, K. I. Simon, B. A. Weinberg, and C. Wing (2020). Determinants of disparities in covid-19 job losses. Technical report, National Bureau of Economic Research.
- Neirotti, P., E. Paolucci, and E. Raguseo (2011). Diffusion of telework: Myth or reality? some stylized facts on telework diffusion in Italian firms. In *2011 10th International Conference on Mobile Business*, pp. 320–330. IEEE.
- Nilles, J. (1975). Telecommunications and organizational decentralization. *IEEE Transactions on Communications* 23(10), 1142–1147.

- OECD (2020). Productivity gains from teleworking in the post covid-19 era: how can public policies make it happen? Technical report.
- Olson, M. H. (1983). Remote office work: changing work patterns in space and time. *Communications of the ACM* 26(3), 182–187.
- Selden, T. M. and T. A. Berdahl (2020). Covid-19 and racial/ethnic disparities in health risk, employment, and household composition. *Health Affairs* 39(9), 1624–1632.
- Sostero, M., S. Milasi, J. Hurley, E. Fernandez-Macías, and M. Bisello (2020). Teleworkability and the covid-19 crisis: a new digital divide? JRC working papers series on labour, education and technology.
- Toffler, A. and T. Alvin (1980). *The third wave*, Volume 484. Bantam books New York.
- Vazquez, E. and H. Winkler (2017). How is the internet changing labor market arrangements? Evidence from telecommunications reforms in Europe. World bank regional report reaping digital dividends: Leveraging the Internet for Development in Europe and Central Asia, The World Bank.
- Wooldridge, J. M. (2006). Introduction to econometrics: A modern approach. *Michigan State University, USA*.
- Wright, E. O. (1980). Class and occupation. *Theory and Society* 9(1), 177–214.
- Wright, E. O. (1997). *Class counts: Comparative studies in class analysis*. Cambridge University Press.

6 Appendix

6.1 Additional material and descriptive figures on NFH/FH jobs

Question	Category
H.17 How often does your profession require you to work outdoors exposed to all weather conditions?	Outdoor activities
H.18 How often does your profession require you to work outdoors but sheltered (like in an open shack)?	Outdoor activities
H.19 How often does your profession require you to work in a piece of equipment or an open vehicle (such as a tractor)?	Outdoor activities
H.20 How often does your profession require you to work in closed equipment or vehicle (such as a machine)?	Use of machine or specific equipment
H.27 How often in your work are you exposed to vibrations throughout your body (such as when operating a jackhammer or bulldozer)?	Use of machine or specific equipment
H.32 How often does your work require you to expose yourself to dangerous equipment (such as working with saws, near machines with moving parts or vehicles)?	Use of machine or specific equipment
H.40 In your work, how long do you use your hands to manipulate, control or feel objects, tools or control systems?	Use of machines or specific equipment
H.43 In your work, how long do you wear protective or safety equipment such as shoes, glasses, gloves, earplugs, helmets or jackets?	Use of machines or specific equipment
H.44 In your work, how long do you wear specialist protective or safety equipment such as self-contained breathing apparatus, harnesses, full protective suits or radiation protection clothing?	Use of machines or specific equipment
H.55 How important is it in your work to keep sequences of machinery and equipment under control?	Use of machines or specific equipment
G.18 Managing machines and processes	Use of machines or specific equipment
G.20 Maneuvering vehicles, vehicles and equipment	Use of machines or specific equipment
G.22 Repair and maintain equipment	Use of machines or specific equipment
G.23 Repairing and maintaining electronic equipment	Use of machines or specific equipment
G.4 Inspect equipment, structures or materials	Use of machines or specific equipment
H.25 How often are you exposed to contaminants (such as polluting gases or dust) in your work?	Bio-chemical risk exposure
H.28 How often does your work require you to be exposed to radiation? This may happen, for example, to people working in chemistry or radiology laboratories)	Bio-chemical risk exposure
H.29 How often does your work require you to expose yourself to disease or infection? This may happen, for example, to people working in hospitals, or in medical or analytical laboratories, or to those engaged in disinfection activities.	Bio-chemical risk exposure
H.31 How often does your work require you to expose yourself to hazardous situations (such as working with high voltage electricity, flammable materials, explosives or chemicals)?	Bio-chemical risk exposure
H.33 How often does your work require you to expose yourself to small burns, small cuts, bites, stings?	Bio-chemical risk exposure
H.30 How often does your work require you to expose yourself in places or places high above the ground (such as working on poles, scaffolding, stairs, walkways higher than 2.5 m)?	Highly Physical or manual activities
H.35 In your work, how long do you climb ladders, poles, scaffolding, etc.?	Highly Physical or manual activities
H.36 How long do you walk or run in your work? (excluding home-work trips)	Highly Physical or manual activities
H.37 In your work how long do you kneel, crouch, crawl, crawl or bend ?	Highly Physical or manual activities
H.38 How long in your work do you maintain or recover your balance?	Highly Physical or manual activities
G.16 Perform physical activities that require moving the entire body, or...	Highly Physical or manual activities
G.17 Handling and moving objects	Highly Physical or manual activities
G.29 Assisting and caring for others	Social contact
G.32 Working in direct contact with the audience and performing	Social contact
H.4 How often does your profession require the use of e-mail?	E-mail Use

Table 7: Variables used to build *Not from home* index

Occupation	Initial Group	Final Group
2311-Biologists, botanists, zoologists and similar professions	From home	Not from home
2312-Pharmacologists, bacteriologists and similar professions	From home	Not from home
2414-Laboratories and clinical pathologists	From home	Not from home
3426-Coaches and technicians competitive sports	From home	Not from home
5472-Funeral parlour attendants	From home	Not from home
8161-Buildings surveillance unqualified personnel	From home	Not from home
2551-Painters and sculptors	Not from home	From home
2554-Composers	Not from home	From home

Table 8: Occupations manually moved from one group to another

Occupation	4-digit code
Lower secondary school teachers	2633
Primary school teachers	2641
Pre-primary school teachers	2642
Specialists in the education and training of people with disabilities	2651
Professors from academies, conservatories and assimilated educational institutions	2631
University professors in legal, political and social sciences	2617
University professors in antiquity, philological-literary and historical-artistic sciences	2614

Table 9: Educators not working from home

Figure 12: Social contact intensity among educators

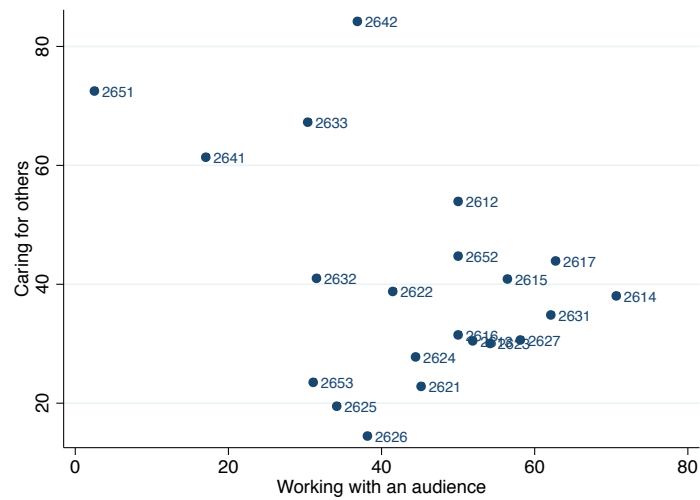


Figure 13: Job Contract and Status over time (2011-2016)

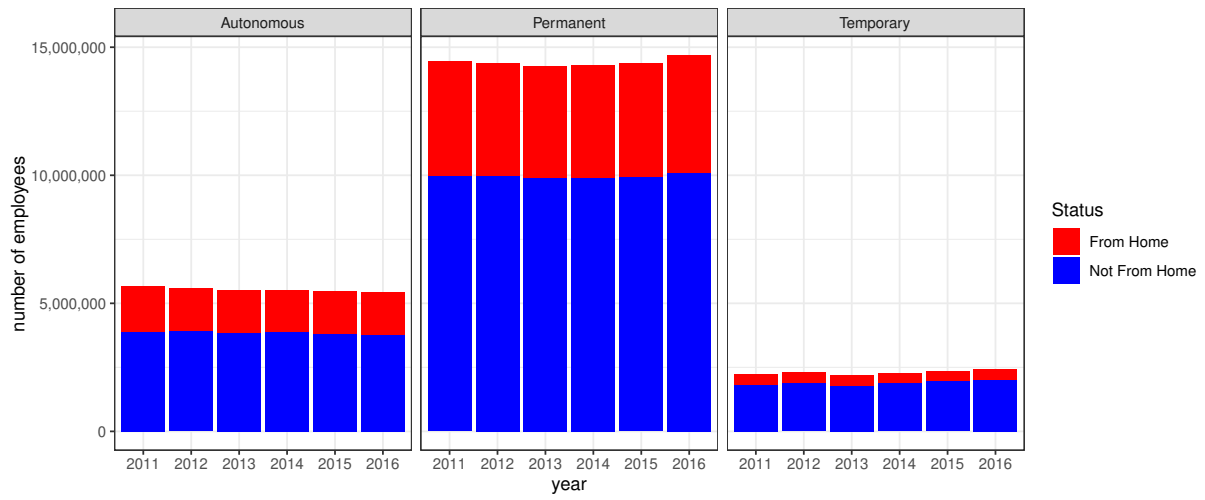
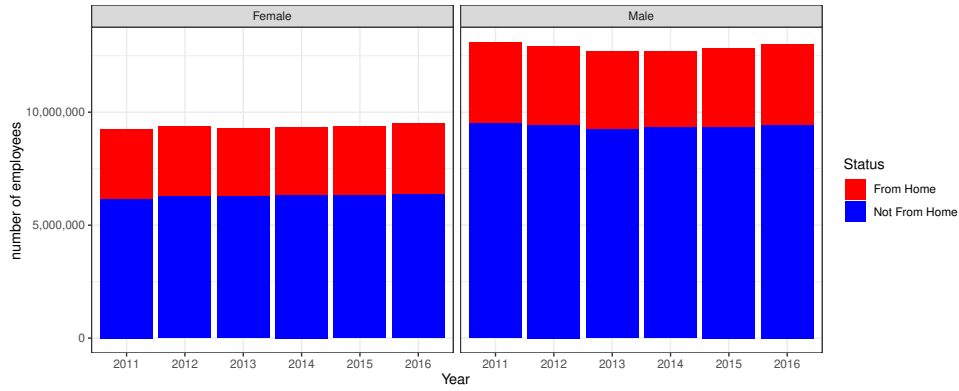
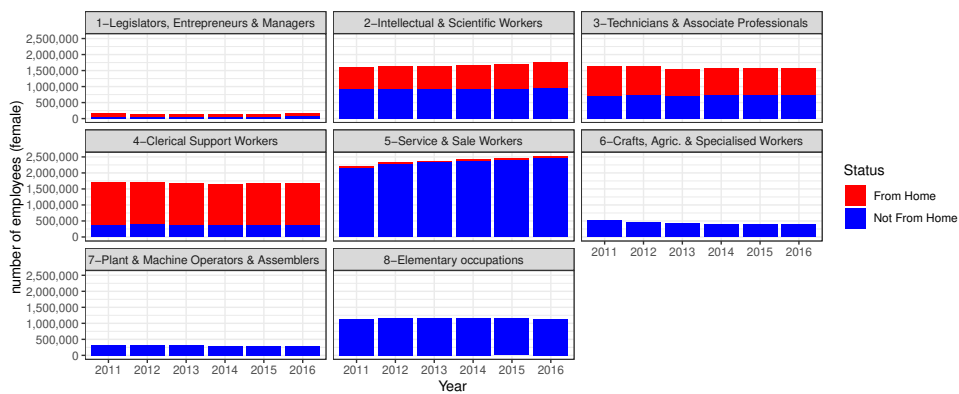


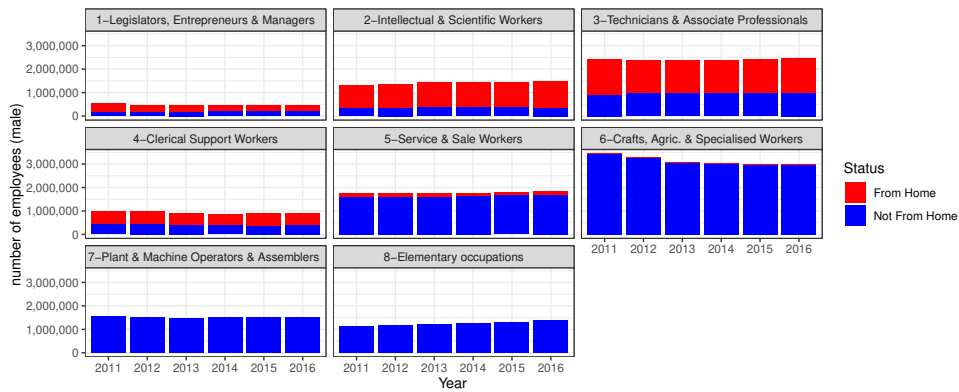
Figure 14: Contractual framework for employees which can and cannot work from home. Source ICP-RCFL (2011-2016)



(a) Total workers



(b) Female workers



(c) Male workers

Figure 15: Total and gender distribution at 1-digit (ISCO classification) for employees which can and cannot work from home. Source: ICP-RCFL (2011-2016)

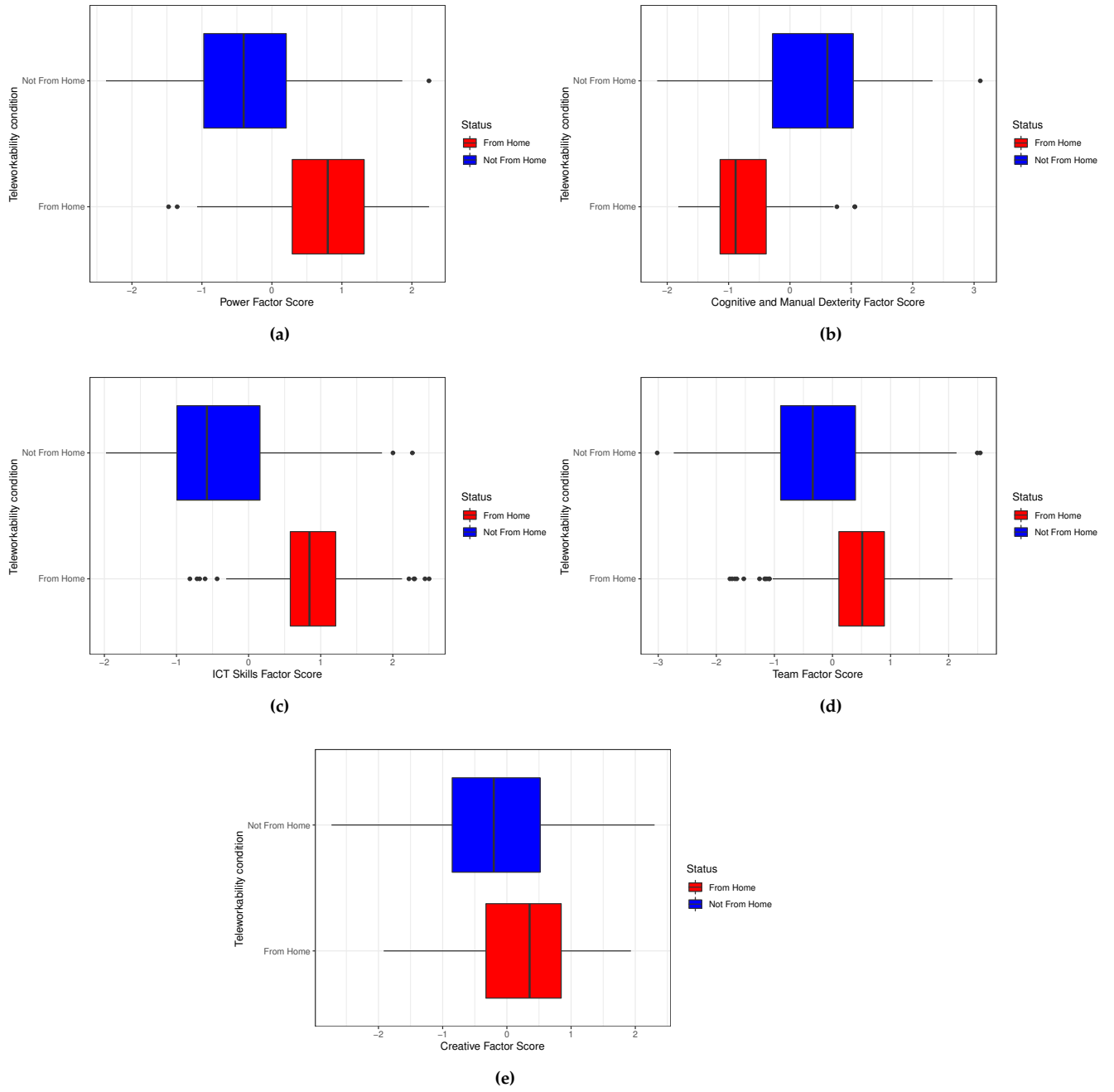


Figure 16: Factor scores box-and-whisker plots for not from home and from home employees

6.2 Repeated cross-section estimations

	(1)	(2)	(3)	(4)	(5)
	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Not From Home	0.372*** (19.02)	0.347*** (18.29)	0.409*** (20.57)	0.475*** (23.19)	0.425*** (20.52)
Female	0.781*** (48.75)	0.739*** (46.62)	0.774*** (46.55)	0.741*** (42.82)	0.753*** (45.37)
36-50 Years Old	-0.277*** (-16.08)	-0.272*** (-15.73)	-0.299*** (-16.21)	-0.253*** (-12.94)	-0.254*** (-13.44)
50-75 Years Old	-0.465*** (-21.90)	-0.474*** (-22.99)	-0.470*** (-21.99)	-0.404*** (-18.04)	-0.445*** (-20.55)
Lower Secondary Education Level	0.683*** (23.59)	0.744*** (26.07)	0.750*** (25.00)	0.719*** (23.46)	0.693*** (23.59)
Secondary Education Level	0.462*** (17.31)	0.492*** (18.80)	0.494*** (17.77)	0.496*** (17.81)	0.454*** (16.99)
Bachelor Education Level	0.193*** (3.91)	0.119* (2.47)	0.160** (3.00)	0.188*** (3.85)	0.171*** (3.62)
Temporary Contract	0.284*** (13.07)	0.267*** (12.41)	0.241*** (10.66)	0.320*** (13.81)	0.241*** (10.75)
Autonomous Contract	-1.546*** (-43.41)	-1.460*** (-43.24)	-1.494*** (-40.46)	-1.487*** (-41.15)	-1.531*** (-45.54)
Center Italy	0.139*** (7.15)	0.107*** (5.69)	0.147*** (7.77)	0.160*** (8.17)	0.177*** (9.37)
Southern Italy	0.266*** (16.00)	0.239*** (14.54)	0.265*** (15.26)	0.261*** (14.52)	0.326*** (18.57)
Agriculture	0.470*** (11.04)	0.505*** (12.59)	0.610*** (14.72)	0.631*** (14.78)	0.771*** (19.95)
Mining & Quarrying	-0.0422 (-0.27)	0.000777 (0.00)	-0.187 (-1.08)	-0.109 (-0.49)	0.0771 (0.40)
Electricity Gas Water & Waste	-0.193** (-3.01)	-0.00267 (-0.04)	0.0113 (0.17)	-0.0243 (-0.35)	-0.0306 (-0.48)
Construction	0.103** (3.25)	0.0325 (0.97)	0.171*** (4.85)	0.135*** (3.48)	0.180*** (4.57)
Wholesale Transport & Accommodation	0.224*** (10.32)	0.309*** (14.24)	0.345*** (15.15)	0.356*** (14.72)	0.463*** (19.66)
Information & Communication	-0.0227 (-0.37)	0.115 (1.66)	0.266*** (4.11)	0.217*** (3.36)	0.0724 (1.10)
Financial & Insurance Activities	-0.475*** (-7.52)	-0.294*** (-4.94)	-0.222** (-2.88)	-0.184** (-2.85)	-0.202** (-3.08)
Real Estate Activities	0.822*** (7.65)	0.646*** (6.72)	0.885*** (8.73)	0.749*** (6.87)	0.977*** (9.50)
Professional Scientific Support Activities	0.539*** (18.17)	0.574*** (20.09)	0.665*** (22.86)	0.730*** (23.64)	0.802*** (26.70)
Public Administration, Education & Human Health	-0.206*** (-8.08)	-0.0715** (-2.87)	-0.0249 (-0.93)	-0.0437 (-1.55)	-0.0306 (-1.10)
Art & Other Services	0.833*** (28.86)	0.861*** (30.23)	1.028*** (34.62)	1.037*** (33.56)	1.032*** (34.24)
_cons	-1.896*** (-53.46)	-1.934*** (-56.55)	-2.098*** (-55.62)	-2.243*** (-58.21)	-2.228*** (-59.01)
<i>N</i>	87,333	87,212	84,502	82,980	84,399
<i>PseudoR</i> ²	0.250	0.239	0.255	0.259	0.265

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Estimation of low income risk. Repeated cross-section estimations 2011-2016.

	(1)	(2)	(3)	(4)	(5)
	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Not From Home	0.0919** (2.88)	0.0586 (1.93)	0.0748* (2.41)	0.0249 (0.80)	0.0930** (2.75)
Female	0.0373 (1.45)	0.0873*** (3.67)	0.163*** (6.54)	0.140*** (5.64)	0.129*** (4.87)
36-50 Years Old	-0.174*** (-6.65)	-0.227*** (-9.05)	-0.200*** (-7.78)	-0.234*** (-8.34)	-0.248*** (-8.78)
50-75 Years Old	-0.311*** (-9.16)	-0.366*** (-11.64)	-0.387*** (-11.93)	-0.371*** (-10.73)	-0.386*** (-11.13)
Lower Secondary Education Level	0.261*** (5.42)	0.260*** (5.67)	0.241*** (5.45)	0.276*** (6.12)	0.398*** (7.88)
Secondary education level	0.104* (2.31)	0.142*** (3.36)	0.135** (3.28)	0.169*** (4.02)	0.265*** (5.54)
Bachelor Education Level	0.0490 (0.63)	0.208** (3.00)	0.225*** (3.35)	0.0832 (1.09)	0.344*** (4.68)
Temporary Contract	0.847*** (28.62)	0.691*** (24.12)	0.764*** (25.92)	0.681*** (22.27)	0.740*** (24.67)
Autonomous Contract	0.0402 (1.34)	-0.0752** (-2.61)	0.0487 (1.71)	0.00893 (0.29)	-0.0267 (-0.81)
Center Italy	0.0750* (2.24)	0.105*** (3.49)	0.141*** (4.84)	0.157*** (5.09)	0.159*** (4.90)
Southern Italy	0.313*** (13.03)	0.404*** (17.38)	0.373*** (15.15)	0.371*** (14.25)	0.367*** (13.39)
Agriculture	-0.340*** (-5.71)	-0.0848 (-1.53)	-0.156** (-2.60)	-0.218*** (-3.49)	-0.135* (-2.13)
Mining & Quarrying	-0.235 (-1.05)	-0.00710 (-0.03)	-0.121 (-0.46)	0.357 (1.77)	0.638* (2.21)
Electricity Gas Water & Waste	-0.183* (-2.09)	-0.125 (-1.22)	0.0269 (0.29)	-0.00309 (-0.03)	0.0944 (1.04)
Construction	0.327*** (8.31)	0.441*** (11.40)	0.516*** (12.34)	0.394*** (8.66)	0.505*** (10.90)
Wholesale Transport Accommodation	0.0182 (0.52)	0.0800* (2.45)	0.0573 (1.67)	0.0886* (2.53)	0.151*** (4.04)
Information & Communication	0.00786 (0.08)	0.00986 (0.11)	-0.0207 (-0.22)	0.0800 (0.82)	0.257* (2.06)
Financial & Insurance Activities	-0.227* (-2.00)	-0.315** (-2.88)	-0.119 (-1.21)	-0.638*** (-5.35)	-0.0894 (-0.68)
Real Estate Activities	0.118 (0.70)	0.288* (2.35)	-0.124 (-0.84)	0.309 (1.80)	0.184 (1.13)
Professional Scientific Support Activities	0.0836 (1.75)	0.0878* (2.02)	0.0669 (1.45)	0.0883 (1.92)	0.182*** (3.75)
Public Administration, Education & Human Health	-0.365*** (-7.59)	-0.469*** (-10.32)	-0.373*** (-8.02)	-0.272*** (-5.86)	-0.260*** (-4.99)
Art & Other Services	0.153*** (3.49)	0.238*** (5.71)	0.194*** (4.32)	0.251*** (5.44)	0.393*** (8.45)
_cons	-2.087*** (-36.41)	-2.018*** (-39.55)	-2.176*** (-42.21)	-2.164*** (-40.35)	-2.424*** (-42.34)
<i>N</i>	83,459	82,975	81,172	79,431	81,019
<i>PseudoR</i> ²	0.109	0.112	0.114	0.10	0.126

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Estimation of unemployment risk. Repeated cross-section estimations 2011-2016.

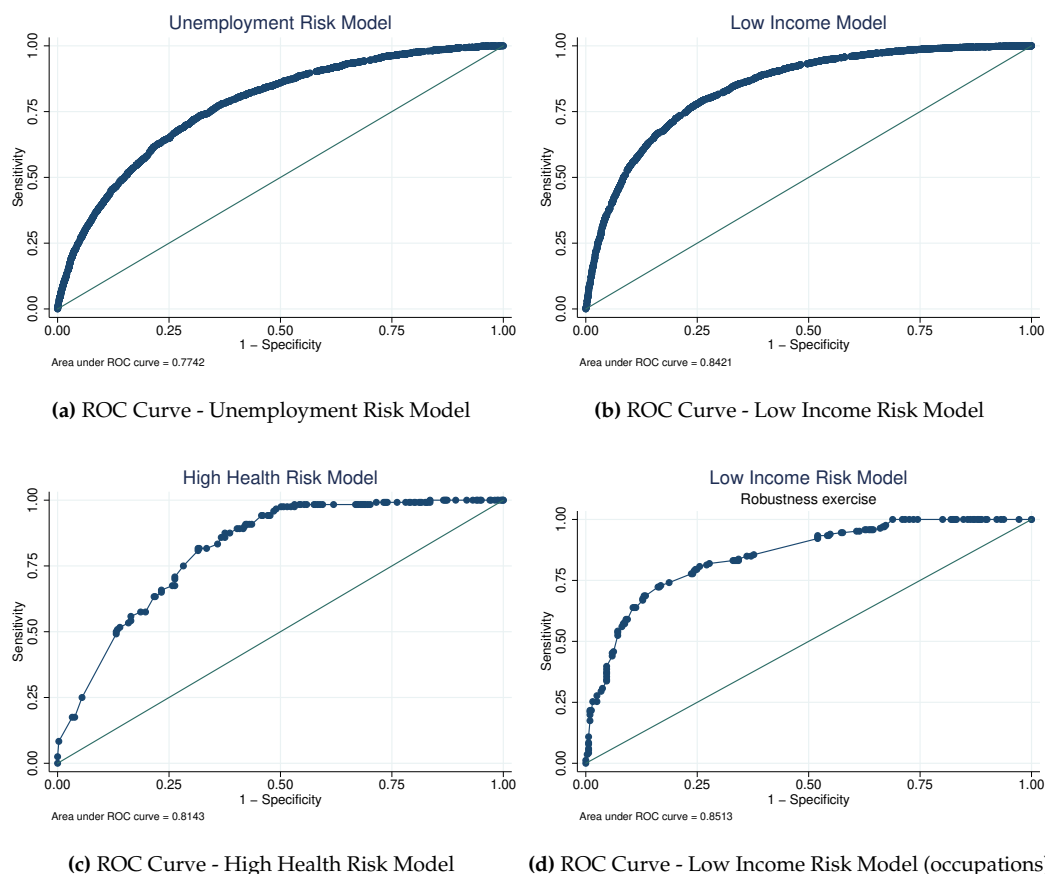


Figure 17: Model fitness (ROC Curves)

6.3 Stratification of risk

TOP-TEN OCCUPATIONS WHICH CAN BE PERFORMED FROM HOME	Female workers (share)
264 Primary and pre-primary school teachers and similar professions	95
345 Social services technicians	91
822 Unqualified personnel in charge of domestic services	89
531 Qualified professions in health and social services	82
545 Animal trainers and keepers	77
321 Health technicians	75
231 Specialists in life sciences	72
541 Masters of arts and crafts	72
523 Travel assistants and similar professions	71
544 Qualified professions in personal and assimilated services	71
TOP-TEN OCCUPATIONS WHICH CAN BE PERFORMED FROM HOME	Female workers (share)
112 Directors, executives and equivalent in public administration and in health, education and research services	100
411 Secretarial and general affairs clerks	88
265 Other education and training specialists	83
432 Clerical, accounting and financial management employees	82
412 Office machine employees	69
422 Employees in charge of welcoming and informing clients	68
113 Magistrate Directors	68
331 Technicians in the organisation and administration of production activities	66
346 Public service and security technicians	66
513 Other qualified professions in commercial activities	65
441 Employees in charge of checking documents and sorting and delivering mail	61

Table 12: Top-ten female-dominated occupations which can and cannot be performed from home (3-digit, ISCO classification). Source: ICP-ILFS (2016)

4 Digit Code	Status	Occupation	Female %
3413	NFH	Tourist entertainers and similar professions	56.8
3427	NFH	Athletes	5.66
5122	NFH	Retail sales assistants	67.84
5221	NFH	Cooks in hotels and restaurants	28.9
5222	NFH	Food preparation, cooking and distribution personnel	72.1
5223	NFH	Waiters and similar professions	60.9
5472	NFH	Funeral parlour attendants	8.3
5486	NFH	Private security guards	11.2
5487	NFH	Lifeguards and similar professions	14.9
6112	NFH	Stone cutters, stonemasons and stonemasons	1.2
6123	NFH	Carpenters and carpenters in the building industry (excluding parking lots)	0.50
6133	NFH	Plasterers	0
6216	NFH	Divers and diving workers	0
6221	NFH	Blacksmiths, ingotters and press operators for forging	1.02
6332	NFH	Artisans of handmade textiles, leather and the like	52.3
6413	NFH	Farmers and farm workers specialising in gardens and nurseries	15
6441	NFH	Specialised forestry workers	0
6452	NFH	Inshore and inland fisheries fishermen	1.15
6531	NFH	Fibre preparers	28.1
6532	NFH	Weavers and knitters by hand and on manual looms	52.4
7275	NFH	Assemblers in series of articles in wood and similar materials	28.3
7281	NFH	Industrial product packaging machine workers	54.7
7328	NFH	Industrial winemakers and brewers	6.3
7421	NFH	Taxi drivers, drivers of cars, vans and other vehicles	4.6
7431	NFH	Agricultural tractor drivers	0.54
8131	NFH	Porters, goods handlers and similar	7.3
8132	NFH	Unqualified packaging and warehouse staff	21
8133	NFH	Delivery staff	7.6
8141	NFH	Unqualified cleaning staff in accommodation services and ships	66.6
8142	NFH	Personnel not qualified in catering services	60.8
8143	NFH	Unqualified staff in charge of cleaning services in offices and shops	73.9
8145	NFH	Green operators and other waste collectors and separators	7.1
8311	NFH	Farm labourers	32
8312	NFH	Unqualified green maintenance personnel	5.7
8321	NFH	Unqualified forestry personnel	11.3
8411	NFH	Maneuvers and other unskilled personnel from mines and quarries	0
8421	NFH	Skilled workers and unskilled civil construction workers and similar professions	0.53
8422	NFH	Construction and maintenance of roads, dams and other public works	2.05
8431	NFH	Unqualified personnel from industrial activities and similar professions	35.7

Table 13: Occupations recording the co-occurrence of low income risk, unemployment risk (based on micro data) and health risk (based on occupation data)

up4	Status	Occupation	Female %
2655	NFH	Teachers of artistic and literary disciplines	80.5
3216	NFH	Other technical health professions	11.4
3333	NFH	Commissioners, evaluators and commercial auctioneers	71.7
3414	NFH	Travel agents	71
3423	NFH	Instructors of techniques in the artistic field	85.2
3424	NFH	Non-competitive sports instructors	47.7
3452	NFH	Reintegration and social integration technicians	74
4216	NFH	Travel agency counter clerks	90.3
4222	NFH	Receptionists in accommodation and catering services	51.8
4224	NFH	Information officers in Call Centres (without sales functions)	78.3
5124	NFH	Cashiers of commercial establishments	85.4
5224	NFH	Barmen and similar professions	59.9
5231	NFH	Hostesses, stewards and similar professions	71.2
5232	NFH	Tourist guides	65.6
5422	NFH	Bookmakers, croupiers and similar professions	35
5431	NFH	Hairdressers	66
5432	NFH	Beauticians and make-up artists	94
5442	NFH	Supervisors of children and similar professions	90.4
5443	NFH	Personal care workers	90.5
5452	NFH	Keepers and breeders of pets and show animals	47.3
6215	NFH	Equipment and assemblers of metal cables for industrial and transport use	0
6453	NFH	Deep sea fishermen	0
6512	NFH	Artisan bakers and pasta makers	22.5
6513	NFH	Confectioners, ice-cream makers and artisan canners	41.3
6533	NFH	Artisan tailors and cutters, modellers and hatters	82.3
6535	NFH	Whiteworkers, hand embroiderers and similar professions	86.2
6536	NFH	Upholsterers	35.4
6542	NFH	Craftsmen and skilled workers of footwear and similar products	40.8
6543	NFH	Suitcases, handbags and similar professions	63.2
7151	NFH	Conductors of oil product refining plants	0
7267	NFH	Shoe series production machinery operators	34.2
7324	NFH	Machinery operators for the treatment and conservation of food	75.2
8161	NFH	Unqualified personnel in charge of building and goods custody services	25.4
8211	NFH	Unqualified personnel in recreational and cultural services	36.5
8221	NFH	Domestic workers and similar professions	88.8
8322	NFH	Unqualified animal care staff	21.7
3442	FH	Museum technicians, libraries and similar professions	78.8
4111	FH	Secretarial staff	87.9
4121	FH	Video-writers, typists, stenographers and similar professions	69
4122	FH	Data entry officers	57.9
4215	FH	Ticket sales staff	53.6
4321	FH	Accountants	81.7
4324	FH	Statistical services employees	65.2
4422	FH	Employees in libraries and similar professions	64.8
5125	FH	Home and distance sellers and similar professions	64.1

Table 14: Occupations recording the co-occurrence of low income risk and unemployment risk (based on micro data)

up4	Status	Occupation	Female %
3215	NFH	Technical professions of prevention	60
4312	NFH	Warehouse management and similar professions	21.2
4412	NFH	Travel documentation checkers	25
5311	NFH	Qualified professions in health and social services	82
5481	NFH	Territorial guardianship staff	1.47
6111	NFH	Brillators (blastingers)	0
6151	NFH	Workers in charge of hygiene and cleaning services	46.7
6234	NFH	Refrigerators	5.1
6324	NFH	Painters and decorators on glass and ceramics	48
6331	NFH	Artisans of artistic woodworking and assimilated materials	12.4
6414	NFH	Farmers and specialized agricultural workers of mixed crops	32
6511	NFH	Butchers, fishmongers and similar professions	15
6515	NFH	Craftsmen and workers specialized in dairy craftsmanship	19.5
6521	NFH	Craftsmen and workers specialized in wood treatment	23.9
6523	NFH	Strippers, basket makers, sweepers, cork-blowers and similar professions	19.5
7131	NFH	Plant operators for the production of glass, ceramics and bricks	18.2
7241	NFH	Machinery workers in plants for the mass production of furniture and wooden articles	12.7
7312	NFH	Olive processing plant workers	7.6
7313	NFH	Workers in charge of refrigeration, hygienic treatment and first processing of milk	3.3
7322	NFH	Conductors of equipment for the industrial processing of dairy products	31.3
7325	NFH	Sugar production and refining machine operators	11.4
7413	NFH	Ropeway operators	0
8121	NFH	Ushers and similar professions	24.8
8122	NFH	Meter readers, coin collectors and similar professions	5.2
8144	NFH	Vehicle washers	3.2
8151	NFH	Bidels and assimilated professions	67.8
8152	NFH	Porters and similar professions	66.8
5121	FH	Wholesale shop assistants	20

Table 15: Occupations recording the co-occurrence of low income risk (micro data) and health risk (occupation data)

up4	Status	Occupation	Female %
4413	NFH	Mail sorting and delivery staff	38.2
6121	NFH	Stone, brick, refractory bricklayers	0.09
6122	NFH	Reinforced concrete masonry workers	0.59
6124	NFH	Scaffolders	0
6125	NFH	Tunnel owners, railway equipment operators and similar professions	0
6126	NFH	Road pavers and similar professions	0
6127	NFH	Prefabricated and pre-formed products assemblers	0.98
6132	NFH	Floor and wall tile installers	0.64
6135	NFH	Glassmakers	4.1
6136	NFH	Hydraulics and gas and hydraulic piping installers	0.58
6137	NFH	Electricians in civil construction and similar professions	0.16
6138	NFH	Window and door and window installers	0.27
6141	NFH	Painters, plasterers, lacquers and decorators	2.4
6152	NFH	Sewerage maintenance workers and similar professions	0
6213	NFH	Sheet metal workers and boilermakers, including tracers	1.1
6214	NFH	Metal carpentry fitters	1.2
6218	NFH	Ironworkers	2.7
6235	NFH	Mechanics and assemblers of industrial thermal, plumbing, air conditioning equipment	1.4
6244	NFH	Installers and repairers of telecommunications equipment	0
6342	NFH	Offset and press printers	19.4
6522	NFH	Woodworking machine carpenters and toolmakers	1.5
6541	NFH	Leather and fur tanners	11
6551	NFH	Stage machinists and toolmakers	0
7123	NFH	Metal heat treatment plant operators	4.4
7134	NFH	Kiln drivers and other plants for the production of bricks, tiles and similar products	5.5
7153	NFH	Operators of machinery for the manufacture of chemical derived products	17.4
7212	NFH	Machinery workers for the production of cement and similar products	0
7233	NFH	Machinery operators for the manufacture of plastic and similar products	21.9
7279	NFH	Other workers involved in the assembly and mass production of industrial items	22.1
7423	NFH	HGV and truck drivers	0.64
7432	NFH	Harvesting, harvesting, harvesting, chopping and pressing machine operators	12.7
7441	NFH	Earthmoving machinery drivers	0
6514	FH	Food and beverage tasters and classifiers	68.5

Table 16: Occupations recording the co-occurrence of unemployment risk (micro data) and health risk (occupation data)