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ABSTRACT

Italian workers at risk during the Covid-19 epidemic

We analyse the content of Italian occupations operating in about 600 sectors with a focus on the dimensions that expose workers to contagion risks during the Covid-19 epidemics. To do so we leverage extremely detailed and granular information from ICP, the Italian equivalent of O*Net. We find that several sectors need physical proximity to operate: the workers employed in Italy in sectors whose physical proximity index is above the national average are more than 6.5 million (most of them in retail trade). Groups at risk of contagion and complications from Covid-19 (mainly male above the age of 50) work in sectors that are little exposed to physical proximity, currently under lockdown or can work remotely. The sectoral lockdowns put in place by the Italian Government in March 2020 seem to have targeted sectors which operate in physical proximity, but not those directly exposed to infections (the health industry is not subject to lockdown). Most workers who can operate from home have not been put under lockdown and are currently working. Therefore, the number of workers who are not in workplaces could be up to 3 million higher than those whose sector has been shutdown.

KEYWORDS: working conditions, safety, crisis policies, Covid-19 epidemics

JEL CODES: J28, J81, H12, I18

1. Introduction and main message

The Covid-19 emergency in Italy is expanding at a fast pace and severe social and economic measures have been adopted to preserve public health and keep most workers safe (Baldwin and Weder di Mauro 2020), including locking down several industrial sectors. However, some workers are more at risk than others because they work in physical proximity to other people (customers, co-workers) or they are exposed to diseases and infections, or both¹. In this paper, we analyse the content of Italian occupations operating in about 600 sectors with a particular focus on the dimensions that expose workers to contagion risks during the Covid-19 epidemics. First, we classify the occupations according to the worker's diseases exposure, physical proximity and possibility to work from remote and map them into sectoral indexes. Then, we quantify the impact of the recent sectoral lockdowns put in place by the Italian government on March 11 and March 25, 2020, with a particular focus on workers exposed to disease risks.

We do so by leveraging extremely detailed information on the content of about 800 occupations derived from the Italian Sample Survey on Professions (ICP) run by Inapp, and we combine these data with the three most recent waves, from the first to the third quarter of 2019, of the Istat Italian labour force survey (LFS). The main advantage of the ICP data is twofold: first, it is extremely granular in terms of occupations and rich in terms of job characteristics; second, and most important, these characteristics are specific of the Italian productive system, its labour market and institutions. Thus, no international crosswalk (based for instance on US data) is needed. The analysis is run at the 4-digit sectoral level, which we match to the ICP occupational data based on a crosswalk constructed on the 2018 LFS data, by weighing each occupation-specific index by the occupational employment share in each sector (more details on the ICP data can be found at the end of this document).

The main results of the analysis are the following. First, workers in occupations that are exposed to infection and disease risks tend to work in close physical proximity to other people. This is especially true for occupations prevalent in sectors that are vital during an epidemic outbreak, mainly in the health industry: these sectors can hardly be put on lockdown, but specific subsectors could probably experience some restrictions (e.g., dentists). Second, several other sectors, mainly related to personal services, leisure and recreation are not directly exposed to infections and diseases, but need physical proximity to operate. The number of workers employed in the first three quarters of 2019 in sectors whose physical proximity index is above the national average, excluding healthcare and necessary goods, is above 6.5 million. Overall, the retail trade sector seems to be at higher risk of contagion because of physical proximity in the workplace. Finally, groups that are at risk of contagion and complications from Covid-19 (mainly male, and workers above the age of 50) work in sectors that are either little exposed to physical proximity (such as agriculture), currently under lockdown or can, at least in principle, work remotely (for instance, public administration and some education subsectors).

¹ This work was inspired by a recent article in *The New York Times*, which also contains a graph similar to our figure 2 (L. Gamio, The workers who face the greatest coronavirus risk, *The New York Times*, March 15, 2020, <https://www.nytimes.com/interactive/2020/03/15/business/economy/coronavirus-worker-risk.html>, last accessed March 25, 2020).

Moreover, we find that the first lockdown targeted sectors with a higher share of workers that perform tasks in high physical proximity to other people, whereas the second decree involved more sectors also more heterogeneous in terms of the proximity index score.

The sectors involved in the suspension of the activity, instead, do not have a higher share of workers at high risk of infections than those that stayed open: if anything, such share is lower in shutdown sectors. This result holds even if we do not include the health sector, which is currently operative. Last, the share of workers who have the possibility to do their work from home is significantly higher in sectors that were not forced to close. This implies that the number of people who needed to perform their job in a workplace is much lower than that just implied by the lockdown measures. Therefore, by working remotely, the risk of contagion among active workers in the service sectors has likely declined while keeping these activities largely operational.

Finally, it is worth remarking some important limitations of the paper. First, the information contained in the ICP survey noisily proxies of the real, unknown, characteristics of occupations. Yet, it is informative to understand whether workers are exposed to risks, and who among them can work from remote, in a context of an extremely sparse economic literature on these topics. Second, the scale of the physical proximity, disease exposure and working remotely indexes is arbitrary; therefore, they cannot be interpreted quantitatively, but only provide a qualitative judgment about these three job characteristics. Third, our focus is on sectors and workers' interactions among colleagues and with the public, not among customers themselves, and thus is not informative for the overall extent of Covid-19 contagion. For example, public transportation and theatres sectors do not necessarily involve high level of physical proximity for workers, but do so for all other customers and users. Fourth, the LFS data currently available refer to 2019, thus preceding the onset of the outbreak². Finally, and most importantly, the descriptive analysis of the lockdown measures should not be interpreted as an evaluation of these policies for two reasons. On the one hand, the data are only cross-sectional and refer to a period prior the implementation of the decrees. On the other, the aim of the decrees was much broader, i.e., reducing the Covid-19 contagion among the entire population, while keeping open core sectors, such as the health sector, the food industry and food retail trade, and all those producing necessities. Our analysis offers only a simple descriptive characterization of the sectors that are currently closed by the governmental decrees and of the workers who are in close physical proximity and more exposed to diseases and infections.

Building up on the literature that studies the labour market effects of technological change and classifies occupations according to their tasks (Autor *et al.* 2003; Firpo *et al.* 2011; Autor and Dorn 2013), this paper contributes to the characterization of economic activities along dimensions of risk and safety for the workers during the recent epidemic. Four recent contributions complement our work. Dingel and Neiman (2020) and Boeri *et al.* (2020) build indexes of working from home, but they use different O*Net questions from the ICP ones we use. Leibovici *et al.* (2020) and Mongey and Weinberg (2020) extended the occupational-level analysis by adding a measure of personal proximity in the workplace. Our measures differ from theirs as they are aggregated at the sectoral level rather

² The analyses are robust if we use just the third quarter of 2019, the most recent one available, but it may suffer of mild seasonal effects when looking at specific 4-digit subsectors. Moreover, the LFS could capture some undeclared working arrangements and therefore overestimate regular employment.

than at the occupational level. Moreover, we use data that are specific to the Italian economic structure and account for different dimensions of safety by looking at the same time at three different dimensions: proximity, diseases exposure and the possibility to work from home. A small, but important economic literature also studies the diffusions of viruses through specific sectors of the economy. Using data on viral diseases from France, Adda (2016) finds that measures aimed at reducing interpersonal contacts by means of school and public transportation closures have a significant effect on the incidence of a disease, although they are not cost-effective. National and international trade is also an important vector for the spread of viruses (Boerner and Severgnini 2012; Adda 2016; Oster 2012). To our knowledge, this is the first paper that describes the characteristics of sectors in terms of risks and possibility to work from remote relating it to the sectoral lockdowns that have now been put in place in many countries. Such evidence will be useful in the next phase of a gradual exit from the current lockdown, although it cannot provide a complete nor a sufficient picture, as we cannot take into account actual working conditions of each individual worker.

The rest of the article is structured as follows. Section 2 presents the data and the methodology, while section 3 shows some descriptive evidence on sectors at risk during an epidemic. A quantification exercise of the lockdown measures is presented in section 4. Section 5 concludes.

2. How to measure the job-related risk of exposure to Covid-19

ICP is a survey last run in 2013 by National Institute for Public Policies Analysis (Inapp) of about 16.000 workers occupied in around 800 occupations, according to the 5-digit CP2011 classification (the Italian equivalent of the ISCO-08 ILO's classification). The ICP investigates the characteristics of the occupations through a particularly rich and articulated questionnaire structured in seven sections (knowledge, skills, attitudes, generalized work activities, values, work styles and working conditions). The ICP directly asks workers to answer the questionnaire, rather than experts, to focus on the point of view of those who exercise daily occupational activities under consideration and have a direct and concrete assessment of the level of use of certain characteristics essential to carry out one's job. The survey describes all the professions existing in the Italian labour market: those operating in private companies, those present in public institutions and state-owned enterprises, and those carried out by the self-employed and regulated professionals. The survey is based on the US Occupational Information Network (O*Net) run by the Bureau of Labor Statistics³. As the ICP is based on Italian occupations, and not those in the US, it is more reliable in capturing characteristics of the Italian production structure, technology and industrial relations. Thus, we possibly avoid potential biases arising when information referring to the US occupational structure (those contained in the US O*Net repertoire) are linked to labour market data referring to different economies such as the European ones. The existing literature (Goos *et al.* 2014) and recent blog contributions (Boeri and Caiumi 2020) use instead US O*Net data and crosswalks between US and European and Italian occupations, respectively, which possibly reflect US-specific technology and ways of work.

³ For reference see <http://www.onetcenter.org/>.

The ICP survey includes questions that are particularly relevant to shed light on the potential risks for workers in the current Covid-19 emergency⁴. In particular, the survey directly asks about physical proximity and disease exposure for every profession, based on the following questions, respectively: “During your work are you physically close to other people?” and “How often does your job expose you to diseases and infections?”. A score that goes from a 0 to 100 scale (from less to more intense) is then calculated for each 5-digit occupation (more details in the Appendix)⁵. Moreover, we built a composite index (also ranging from 0 to 100) that proxies for the feasibility of a remote working arrangement, which we use in additional analyses in section 4. The index is computed by taking the average of the following seven questions: (i) importance of performing general physical activities (which enters with reversely); (ii) importance of working with computers; (iii) importance of maneuvering vehicles, mechanical vehicles or equipment (reversely); (iv) requirement of face-to-face interactions (reversely); (v) dealing with external customers or with the public (reversely); (vi) physical proximity (reversely); (vii) time spent standing (reversely; more details in the Appendix). Note that this index is similar to the offshorability index by Autor and Dorn (2013), the *face-to-face* and *on-site job* indexes by Firpo *et al.* (2011) and the measures of *safe jobs* recently developed by Boeri *et al.* (2020). These indexes are based on similar O*Net questions to those contained in the ICP survey we use to construct the remote working index.

In the spirit of Autor and Dorn’s routine employment share (RSH; see eq. 7, Autor and Dorn 2013), we also calculate the percentage of sectoral employment in the top tercile of the employment-weighted distribution of each index (physical proximity, disease exposure and working from remote) at the 4-digit occupation level. For the physical proximity index, for instance, such percentage is calculated for each sector j as follows:

$$\% \text{ Top Proximity}_j = 100 * \left(\sum_k L_{kj} * 1[\text{Proximity Index}_k > \text{Proximity Index}^{P66}] \right) * L_j^{-1} \quad (1)$$

L_{kj} is the employment in occupation k in sector j and $1[\cdot]$ is the indicator function, which takes the value of one if the occupation’s physical proximity is above the 66th percentile of the employment-weighted index. To give a sense of which workers are considered in the top proximity category, “Unqualified staff in restaurants and catering services” and “Motorboats conductors” are two of the occupations just above the threshold of the top tercile of the employment-weighted proximity index. Occupations that are just above the threshold of those with a highest exposure to disease are “Small trade firms managers” and “General chemistry machine operators”, which are either exposed to

⁴ The analysis by Gamio on *The New York Times* is based on O*Net data and carried out at occupation level, rather than at the sector level as we do for Italy (see L. Gamio, The workers who face the greatest coronavirus risk, *The New York Times*, March 15, 2020. <https://www.nytimes.com/interactive/2020/03/15/business/economy/coronavirus-worker-risk.html>, last accessed March 25, 2020).

⁵ The standardization formula is $X = \left(\frac{Y - \min}{\max - \min} \right) * 100$, where Y is the original answer (from 1 to 5) and \min and \max are the minimum and maximum value reported for that occupation. Each value for each occupation is then standardized over the about twenty answers received from workers in that occupation. The index, therefore, has no cardinal interpretation.

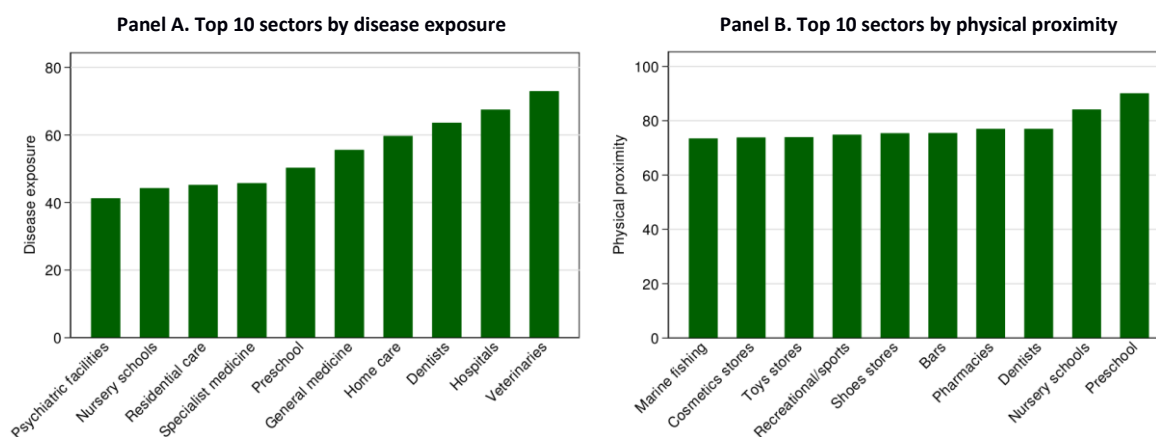
customers or potentially hazardous material⁶. Last, work from remote is possible for occupations very much heterogeneous among themselves: those just above the 66th percentile of the work from remote index include “Members of municipal government bodies”, “Directors of service companies”, “Radio announcers” and “Craftsmen of musical instruments”.

Finally, we derive the distribution of occupational employment at the 4-digit level across about 600 4-digit sectors from the 2018 LFS (using the ATECO 2007 classification, the Italian equivalent of Nace Rev. 2). These employment-based occupation weights are then used to derive indexes of physical proximity, exposure to disease and infections and working remotely at the sectoral level, as well as the percentage of workers in each of three top terciles of the indexes.

3. Sectors at risk

Sectors that are most exposed to infections and diseases heavily occupy workers in medical occupations and health services⁷: among the top 10 sectors in terms of disease exposure index, the first five are dentists, hospital services, veterinaries, general medicine and home care (figure 1, panel A). While dentists and veterinaries are not at the forefront of the current health emergency, the other are, as they are directly involved in the care of Covid-19-infected patients and in the care of the elderly population. In terms of physical proximity, however, most sectors are currently under lockdown, including bars, recreational and sport services, phones, clothes and shoes stores, as well as the education industry (figure 1, panel B).

Figure 1. Top 10 sectors by diseases exposure and worker’s physical proximity



Note: The indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector.
Source: Authors’ elaborations on ICP survey and LFS data

Note that hospitals are not among the top 10 sectors in terms of physical proximity possibly because of two reasons. First, there is noise in the index (which is based on a 5-digit occupational classification

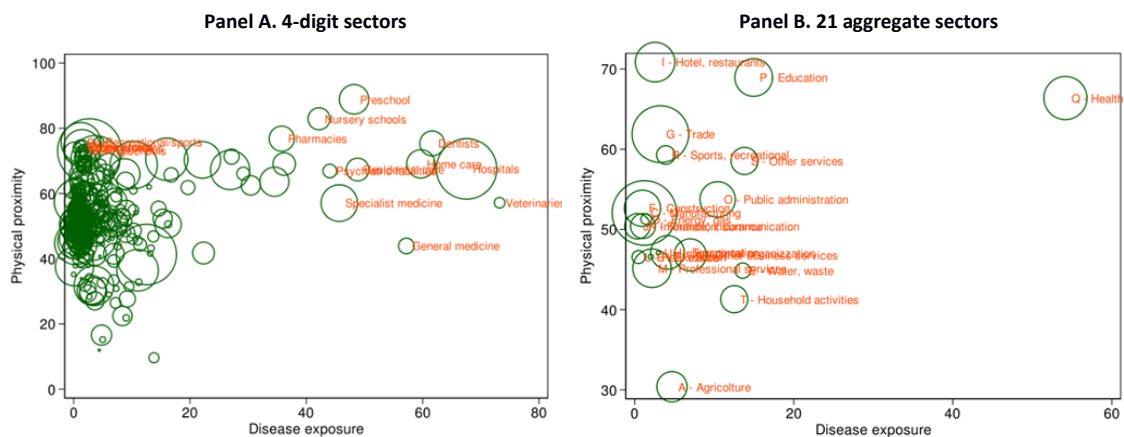
⁶ Note that the diseases exposure index is very skewed and most occupations with high value of the index are in the health sectors, while 42 percent of about 500 occupations have a value of zero.

⁷ See The Lancet (2020).

and aggregated at the 4-digit sector). Second, the professional composition within the hospital sector is more heterogeneous than, for example, in pharmacies, as it comprises doctors, but also nurses, administrative and cleaning staff. Yet, the hospital industry is in the top 7 percent over about 600 sectors.

Figure 2 allows appreciating what sectors both require physical proximity and are exposed to diseases. It shows, rather obviously, that workers in sectors most exposed to infectious diseases are also operating in physical proximity, although there is a large degree of heterogeneity at the 4-digit level (panel A). Some of these sectors are large as measured by the size of the bubble, which is proportional to the sectoral occupation in 2019 (as better appreciated in panel B, which aggregates to 21 main sectors). The health industry, in particular, records high values in both indexes (see also Ng *et al.* 2020). However, many of its subsectors, which are among the most exposed to infectious diseases, cannot be closed, as they serve primary needs, especially during the current health emergency. The figure also shows that physical proximity risks are present in many large sectors of the Italian economy. Many of these do not serve primary needs, and yet are exposed to personal contacts. The question on how, whether and when allowing again such working activities is of outmost importance during the phase-out of the lockdown, without compromising the efforts of the social distancing measures applied in this recent period.

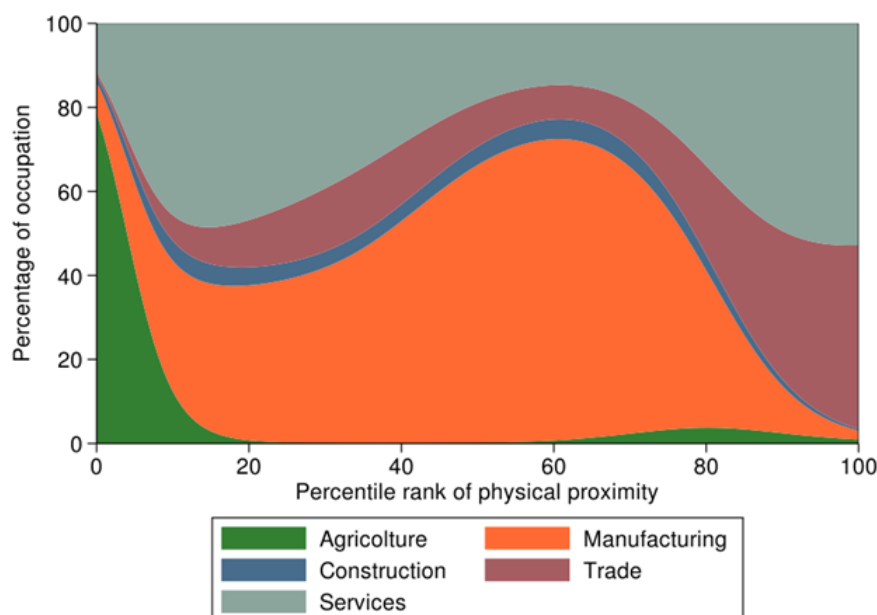
Figure 2. Correlation between exposure to infectious diseases and workers’ physical proximity



Note: The indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The size of the bubbles is proportional to sectoral employment.

Source: Authors’ elaborations on ICP survey and LFS data

To understand better the employment distribution across sectors exposed to a different degree of personal contacts on the job we first a graph showing the occupational distribution in each percentile rank of the physical proximity index in the main five sectors of the economy (figure 3). Most of the employment in occupations highly exposed to interpersonal contacts is in the services sector (including healthcare), and in retail trade. While manufacturing makes the bulk of employment between the 30 and the 80 percentile of the physical proximity index distribution. Agriculture, which also provides with necessary goods, accounts for most of the employment at the other end of the spectrum (little to no physical proximity).

Figure 3. Distribution of occupation by physical proximity and sector

Note: The indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The size of the bubbles is proportional to sectoral employment.

Source: Authors' elaborations on ICP survey and LFS data

Table 1 shows additional information in finer sectors (21 categories), such as the average value of the physical proximity and diseases exposure indexes (weighted by 4-digit sectoral employment), and the percentage of workers in each sector who are in the top tercile of the nationwide index distribution calculates as in equation (1)⁸. Moreover, the table provides information about the workers' demographics distribution, namely gender and age, which appear to be crucial dimensions along which the Covid-19 infection hits. In fact, according to the March 26 report from the Italian Centre for Diseases Control (Istituto Superiore di Sanità), about 45 percent of the diagnosed cases to date were males over the age of 50 and 30 percent were females over the age of 50 (overall, about 57 percent are males)⁹. Note that, however, there is not yet international consensus on whether the Covid-19 disease is more lethal for males than for females.

Three main message emerges. First, as already seen, the sectors with the highest physical index are hotel and restaurants, education, healthcare and trade (mainly retail), and whose average indexes are all above 60. The healthcare sector is fully operational in Italy to date and it employs about 1.9 million workers (about 8 per cent of total employment). The education sector, which employs mainly females above the age of 50, is sizeable (1.5 million people, 6 percent of total employment), but is also largely operational – in part, working from remote. While school and university teachers are working from home, preschool and nursery schools – the top 2 sectors in terms of physical proximity (figure 1, Panel B) – are currently shut down. The trade and the hotel, restaurants and bars sectors, instead, are largely

⁸ Table B1 in Appendix B reports the same information for the index that capture the possibility to working from remote.

⁹ See https://www.epicentro.iss.it/coronavirus/bollettino/Bollettino-sorveglianza-integrata-COVID-19_26-marzo%202020.pdf.

under lockdown (with the exception of food retail and other emergency stores such as pharmacies, which amount to about 1 million workers): overall, they occupy almost 5 million workers, about a third of them are over the age of 50. In the trade sector, moreover, there is high degree of heterogeneity in terms of size and physical proximity. The index is high also in subsectors that are rather small and involved in non-food retail (figure 4, panel A).

Table 1. Sectoral distribution: workers' demographics composition, disease exposure and physical proximity

Sectors	Physical proximity index	% workers > 66th pct	Disease exposure index	% workers > 66th pct	Workers	% male >50 y.o.	%female >50 y.o.	% male <50 y.o.	%female <50 y.o.
A - Agriculture	30.6	5.0	4.9	50.7	887,192	31.7	11.5	42.6	14.2
B - Extraction	45.7	6.1	1.6	35.0	24,965	31.4	2.6	57.9	8.0
C - Manufacturing	52.0	10.0	1.2	8.0	4,318,814	24.4	8.0	49.5	18.0
D - Energy, gas	50.9	11.2	1.3	10.3	113,241	33.9	7.1	40.0	19.0
E - Water, waste	44.2	3.2	13.7	66.6	241,209	39.3	5.4	45.6	9.6
F - Construction	52.6	8.5	1.0	8.8	1,331,231	33.0	1.9	60.6	4.4
G - Trade	62.0	56.1	3.1	13.1	3,283,268	20.6	11.7	38.3	29.4
H - Transportation	47.2	17.8	4.2	38.8	1,137,764	30.5	7.7	48.9	12.9
I - Hotel, restaurants	71.2	85.5	2.6	50.5	1,510,283	11.8	12.4	37.4	38.4
J - Information, comm.	50.5	8.0	0.3	1.3	619,220	21.7	9.6	48.1	20.6
K - Finance, insurance	50.4	13.5	1.0	12.8	635,502	24.9	14.5	30.4	30.2
L - Real estate	46.1	1.2	0.3	2.0	164,294	25.8	14.6	27.6	32.0
M - Professional serv.	45.3	1.5	2.2	8.9	1,512,434	20.8	12.3	31.8	35.2
N - Other business serv.	47.0	15.8	7.1	54.4	1,034,091	16.5	17.6	31.4	34.6
O - Public administr.	54.1	39.8	10.8	46.8	1,244,711	33.1	23.1	31.4	12.4
P - Education	69.3	73.1	15.5	81.2	1,580,162	13.0	39.7	11.6	35.7
Q - Health	67.0	66.4	54.0	86.7	1,923,859	15.7	27.1	14.6	42.6
R - Sports, recreational	59.7	32.5	3.6	34.0	317,876	17.5	11.3	40.6	30.6
S - Other services	57.9	42.9	13.6	67.2	709,981	14.9	19.9	22.8	42.4
T - Household activities	41.0	40.1	12.4	41.9	747,521	4.5	42.0	7.6	46.0
U - International org.	46.8	6.9	1.6	12.9	14,442	16.1	16.6	35.5	31.8
Total economy	55.2	34.9	8.8	34.1	23.352.062	21.6	15.5	36.1	26.8

Note: The table reports the size of the sectors in terms of employment, as reported by the Istat LFS as of the first three quarters of 2019. The average physical proximity and disease indexes reported are weighted by the 4-digit employment in each sector. The average sectoral indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The percentage of workers exposed to physical proximity and disease exposure is calculated as described in equation (1).

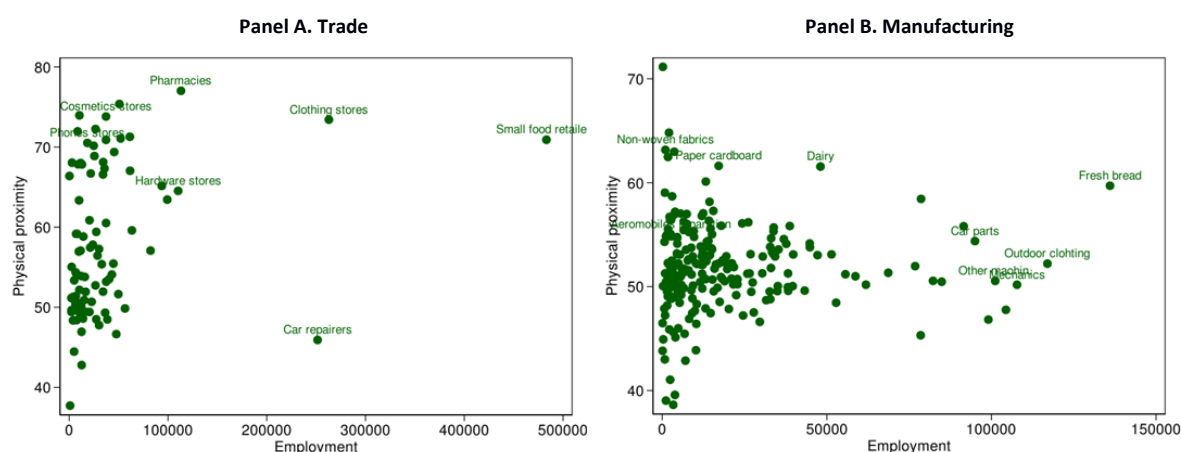
Source: Authors' elaborations on ICP survey and LFS data

Second, sectors that have the possibility to work remotely and have a low value of the physical proximity index, such finance and insurance and professional services, are rather small and employ mainly younger workers. Similarly, for the most part, parts of the public administration can work

remotely, but more than 50 percent of its employees are above the age of 50. Either those activities most exposed to the public (e.g., clerks) are closed or public contacts are highly regulated.

Third, the manufacturing sector, which employs alone about the 18 percent of total employment, and is indeed very heterogeneous in terms of physical proximity as seen in figure 3 and in figure 4 (panel B), has an average index below the national average. Few subsectors that produce food, such as the dairy industry and the production of fresh bread, are both large in size and workers are highly exposed to other people in the workplace. Moreover, two thirds of the workers are below the age of 50 (about 3 million people) and are probably less exposed to the Covid-19 infections and its complications¹⁰.

Figure 4. Physical proximity index in trade and manufacturing subsectors (top vs. bottom five)



Note: The index (Y axis) The index goes from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The size of the subsectors in terms of employment (X axis) is that recorded by the Istat LFS as of the first three quarters of 2019.

Source: Authors' elaborations on ICP survey and LFS data

Similar to table 1, table 2 reports the distribution of workers across regions, their main demographic characteristics, the average indexes at the regional level (calculated as a regional weighted average of sectoral the index, where weights are proportional to the employment of the sector in the region), and the percentage of workers in the top tercile of each index. While the index rather obviously shows much less variability, being averaged across many sectors, it is above the national average in regions where tourism activities are prevalent (Valle d'Aosta, Trentino Alto Adige, Liguria and Sardegna). Workers in other regions, especially in the South, may be at risk because of the demographic structure of the local workforce: in Campania, Molise, Puglia and Basilicata about one in four workers is a male above the age of 50, against a national average of about 22 percent. In northern regions that are suffering from the Covid-19 epidemics, the share of male workers above the age of 50 is lower, close to 20 percent¹¹. Moreover, there is more variability in terms of the share of workers who are most exposed, as measured by the two indexes.

¹⁰ More detailed analyses down to the 4-digit sectoral level are available, but not reported in this document for brevity.

¹¹ Note that Lombardia, where about 19 percent of the Italian workforce reside, also has almost 20 percent of the workers aged 50-year-old or more, about 2.9 million people.

Such variation largely depends on the sectoral distribution across regions and provinces, as better depicted in the maps in figure B1 and B2, respectively, in the Appendix.

Table 2. Regional distribution: workers' demographics composition, disease exposure and physical proximity

Regions	Physical proximity index	% workers > 66th pct	Disease exposure index	% workers > 66th pct	Workers	% male >50 y.o.	%female >50 y.o.	% male <50 y.o.	%female <50 y.o.
Piemonte	54.9	31.7	8.4	32.1	1,823,579	21.3	15.9	34.3	28.4
Valle d'Aosta	58.2	40.3	9.7	40.6	55,631	19.6	18.4	33.7	28.3
Lombardia	54.6	28.4	7.9	28.9	4,478,052	19.9	14.8	36.6	28.7
Trentino A. Adige	55.9	35.8	9.3	39.4	499,500	19.4	16.0	35.4	29.2
Veneto	54.8	31.3	8.6	31.7	2,169,356	21.4	15.2	35.8	27.6
Friuli V. Giulia	55.2	33.6	9.1	34.7	510,690	21.5	16.4	35.2	27.0
Liguria	56.7	38.9	9.7	37.0	612,689	23.2	19.3	32.7	24.8
Emilia Romagna	54.8	30.5	8.5	31.9	2,030,784	20.5	16.8	34.4	28.3
Toscana	55.7	33.9	8.7	33.4	1,603,042	21.0	17.2	33.6	28.2
Umbria	54.6	34.7	9.3	35.8	360,764	20.3	17.2	34.6	27.9
Marche	56.0	33.0	7.8	30.5	636,423	21.3	16.2	34.6	27.9
Lazio	54.6	34.9	9.3	35.5	2,392,163	21.0	16.9	34.6	27.4
Abruzzo	55.9	35.8	8.8	37.3	497,186	22.5	15.7	37.3	24.5
Molise	55.5	38.3	9.3	35.4	108,224	25.2	15.9	36.3	22.6
Campania	55.9	39.8	9.4	39.5	1,653,137	24.1	13.4	39.6	22.9
Puglia	55.4	38.2	9.0	35.7	1,237,639	24.8	12.8	39.5	22.9
Basilicata	54.9	36.6	8.9	37.0	189,381	24.7	15.3	38.5	21.5
Calabria	54.9	38.3	9.0	35.0	544,714	24.1	13.6	40.3	22.0
Sicilia	56.0	40.6	10.5	41.4	1,356,139	24.1	14.2	39.2	22.5
Sardegna	57.3	44.3	11.3	44.0	592,970	22.4	16.4	34.5	26.6
Italy	55.2	33.9	8.8	34.1	23,352,062	21.6	15.5	36.1	26.8

Note: The table reports the size of the sectors in terms of employment, as reported by the Istat LFS as of the first three quarters of 2019. The average physical proximity and disease indexes reported are weighted by the 4-digit employment in each sector. The average sectoral indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The percentage of workers exposed to physical proximity and disease exposure is calculated as described in equation (1).

Source: Authors' elaborations on ICP survey and LFS data

4. The Italian sectoral lockdowns and workers at risk

4.1 Descriptive evidence

To reduce the spreading of the epidemics the Italian government adopted several social distancing measures including two consecutive sectoral lockdowns, on March 11 and March 25. Each decree lists

the sectors that were forced to close their workplaces¹². Other sectors, such as the health and food industries as well as their value chains, were kept open; it was also strongly advised to work remotely for those who could (including primary to college education). In this section, we describe the lockdown in terms of employment, with a particular regard to workers exposed to risks because working in proximity to other people, or exposed to diseases because of their age and gender. Note that our focus is on sectors because the government enacted shutdown policies at this level. While we do not take a stand on whether this is the optimal observational unit on which adopting this kind of policies, it is a reasonable one, under the assumption that occupations within each sector act under perfect complementarity. That is, within each sector, a certain amount of input in terms of occupations is needed in order for the sector to produce output, where these amounts are given by the sector-specific occupational employment weights¹³.

Table 3 reports the number of workers that were forced to stay home in each aggregated sector, separately for the decree of March 11, and that enacted on March 25. The first decree has left 2.7 million of workers at home, which amounts to around 11.5 percent of total employment. The first decree has specifically targeted two service sectors: “Accommodation and food service activities” and “Arts, sports and recreational activities”. A relevant share of workers that score high in the proximity index (e.g. bars, restaurant) characterizes “Accommodation and food service activities”. After the March 25 decree, 78 percent of workers in this sector that perform tasks requiring a high level of physical proximity has been forced to stop working and stay home. The stop involves a great share of male over fifty that works in the sector (71.5 percent). The second decree enacted on March 25 shut also all non-strategic production and trade activities, thus affecting almost 8 million workers total. Three sectors have been completely locked: “Real estate”, “Arts, sports and recreational activities” and “Activities of extraterritorial organizations”. These sectors are small and characterized by a low score of the disease exposure index: only “Arts, sports and recreational activities” has a physical proximity index above the national average. It is worth noting that the second decree has shut 66 percent of the manufacturing sector, thus leaving about 2.8 million of workers at home, but only 54 percent of workers that have a high score of physical proximity and 38 percent of those that are highly exposed to disease have been secured by the decree. However, among manufacturing workers almost 67 percent of those at high risk of COVID-19 infection, i.e. male over 50, were forced to stay home. On

¹² The decree of March 22, implemented on March 25, lists the sectors at the 6-digit level, which we aggregate to 4-digit by taking simple means (the list used is the latest made available by the Ministry of Economic Development). In about 1 percent of the cases, some 6-digit subsectors of a 4-digit sector were forced to shut down and other were not. In the regression analysis, we attribute a value of zero if such share is below 0.5, and a value of 1 if equal or above 0.5.

¹³ Note that our quantification of the lockdown may differ from other available estimates because of different sources of data, reference period or measurement error. In particular, we may overestimate the number of people currently not working because the LFS accounts also for undeclared work and because the data refer to the first three quarters of 2019. For instance, Istat reports two different, and lower, numbers of workers in the document filed to the Italian Senate, one based on 2017 administrative data (table 4 of the Istat report) and the other on the entire year of the 2019 LFS (table 5; see <https://www.istat.it/it/files//2020/03/Aggiornamento-26-marzo-2020-Memoria-Istat-AS-1766.pdf>). In a previous version of the paper, the number of workers in lockdown was slightly higher due to a different method of aggregating 6-digit sectors.

the opposite, in the “Other services” sector, even if greatly affected by the lockdown – 60 percent of workers forced to stay home – only about 40 percent of male workers over 50 is affected.

Table 3. Sectoral lockdowns and workers affected

Sectors	Sector employment	Workers affected	% workers affected	% affected among top 66th physical proximity	% affected among top 66th diseases exposure	% affected among > 50-y.o.	% affected among males > 50-y.o.
<i>Panel A. Lockdown implemented on March 11, 2020</i>							
G - Trade	3,283,268	904,423	27.5	36.4	10.6	25.0	21.1
I - Hotel, restaurants	1,510,284	1,089,357	72.1	78.6	68.2	63.1	71.3
J - Information, communic.	619,220	4,769	0.8	4.0	2.8	0.3	0.4
P - Education	1,580,162	40,324	2.6	2.6	2.1	1.2	2.1
R - Sports, recreational	317,876	254,078	79.9	85.0	92.5	78.6	74.5
S - Other services	709,981	392,794	55.3	78.4	71.8	44.1	27.1
Total economy		2,685,743	11.5	25.8	13.0	7.9	6.8
<i>Panel B. Additional lockdown implemented on March 25, 2020</i>							
A - Agriculture	887,192	53,235	6.0	41.1	1.9	8.4	10.5
B - Mining and quarrying	24,965	15,317	61.4	30.1	63.3	71.8	73.6
C - Manufacturing	4,318,814	2,862,660	66.3	53.8	38.1	66.1	66.8
F - Construction	1,331,231	805,275	60.5	78.7	48.6	63.4	64.0
G - Trade	3,283,268	1,575,039	48.0	49.0	22.9	48.6	50.1
I - Hotel, restaurants	1,510,284	1,171,420	77.6	80.5	71.9	70.7	77.5
J - Information, communic.	619,220	4,769	0.8	4.0	2.8	0.3	0.4
L - Real estate	164,294	164,294	100.0	100.0	100.0	100.0	100.0
M - Professional services	1,512,434	70,956	4.7	30.6	3.6	3.3	2.2
N - Other business services	1,034,091	387,860	37.5	42.0	22.5	36.0	44.8
P - Education	1,580,162	40,324	2.6	2.6	2.1	1.2	2.1
R - Sports, recreational	317,876	317,876	100.0	100.0	100.0	100.0	100.0
S - Other services	709,981	427,286	60.2	79.0	71.9	51.5	40.4
T - Household activities	747,521	5,695	0.8	0.9	0.9	0.7	2.0
U - International organiz.	14,442	14,442	100.0	100.0	100.0	100.0	100.0
Total economy		7,916,447	33.9	34.6	18.5	28.6	34.2

Note: The table reports the sectoral employment, as reported by the ISTAT LFS as of the first three quarters of 2019. The percentage of workers exposed to physical proximity and disease exposure is calculated as described in equation (1).

Source: Authors' elaborations on ICP survey, LFS data and sectors under lockdown listed in the governmental decrees of March 11 and March 22 (implemented on March 25)

After March 25, only few sectors are fully operative: Energy and gas, Water supply and waste management, Transportation and storage, Finance and insurance, Public administration and, rather obviously, the Health and social assistance and the agricultural sectors (note that a very small agricultural subsector involved in forestry activities has been put under lockdown). Many workers in Energy, Finance, and in the Public administration have the possibility to work from remote. Given the

share of those who can easily work from home (table B1 in the Appendix), there could up to 3 million persons who are currently working in open sectors, but not in a workplace¹⁴.

To understand better whether sectors that were forced to close were also more exposed to risks, we correlate the sectoral lockdowns with the physical proximity and disease indexes in a simple OLS regression. Two main caveats about this analysis. First, the indexes have no quantitative meaning by themselves, so the coefficients of the regression carries little information. Second, the goal of the Government was not that of targeting most exposed sectors, but that of slowing down the epidemics for the entire population. Therefore, our analysis is not meant at evaluating the governmental policies, but to describe how these affected certain sectors and workers.

Table 4 reports the correlations at sectoral level between the lockdown indicators and the indexes of physical proximity and diseases exposure. These results indicate that the first lockdown targeted sectors where workers' physical proximity was particularly high (panel A), while this was much less so if we consider the March 25 lockdown that involved way more sectors. In terms of exposure to diseases (panel B), instead, none of the policy measures seems to have interested sectors with a high level of the index, and if anything they hit sectors with a lower value of the index. However, this is partly expected because the health industry (the most exposed to diseases and infections) has never been included among the shutdown sectors (and it is excluded from the analysis in columns (2) and (4)), nor was the education industry, which is currently operating from remote¹⁵.

Table 4. Lockdowns and indexed and the sectoral level

	(1)	(2)	(3)	(4)
<i>Panel A</i>	Physical proximity	Physical proximity	Physical proximity	Physical proximity
Lockdown 11/3	12.691** (1.242)	13.031** (1.239)		
Lockdown 25/3			1.800* (0.746)	2.426** (0.735)
Obs.	603	591	603	591
R2	0.127	0.144	0.009	0.018
Health ind.		No		No
<i>Panel B</i>	Disease exposure	Disease exposure	Disease exposure	Disease exposure
Lockdown 11/3	0.320 (0.833)	1.264 (0.786)		
Lockdown 25/3			-3.741** (0.639)	-2.072** (0.423)
Obs.	603	591	603	591
R2	0.000	0.004	0.052	0.039
Health ind.		No		No

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The average sectoral indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

¹⁴ In particular, we consider the share of workers who can easily work from home (as measured by those whose index is in the top tercile of the national distribution) in the following sectors: Energy and gas, Water management, Finance and insurance, Professional services and Public administration. This number sums up to about 3 million workers.

¹⁵ Some robustness analyses corroborate the estimates. For instance, our results remain robust if we weight the regressions by sectoral employment, or if we take standard transformation of the indexes, such as by differencing out their mean and dividing by their standard deviation (available upon request).

4.2 Workers most exposed at risk and sectoral lockdowns

The analysis above is uninformative about whether these policies implicitly also targeted workers at high risk. Tables 5 and 6 report simple OLS regressions of the share of workers at high risk on the sectoral lockdown dummies (column 1): in the other columns we report different specifications, in turn excluding the health industry and weighting the regressions by sectoral employment¹⁶. Panel A of table 5 reports as outcome variable the share of workers in the top tercile of the physical proximity index, defined as in equation (1). These simple correlations suggest that the first decree involved sectors with a relatively higher percentage of workers at high risk, having involved workers in the restaurants and accommodation industries and in some retail stores: such percentage is higher by up to 52 percentage points. The second decree, by targeting many more sectors, was not significantly associated with a high share of workers at risk: notably, also the R-squared drops from 0.28 in column (3) to 0.01 in column (6). Similar to what is shown in the previous table, the correlations differ when looking at the share of workers exposed to the disease: the first decree did not keep home people at high risk of diseases, while the second one, if anything, lets sectors open where the percentage of people exposed to diseases was higher by up to 17.8 percentage points. Again, this is partly due because education was not a targeted sector, but it does not explain the entirety of the effect (results available upon request).

Table 5. Percentage of workers in the top tercile of risk indexes and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A</i>	% Empl. Top66 Proximity	% Empl. Top66 Proximity	% Empl. Top66 Proximity	% Empl. Top66 Proximity	% Empl. Top66 Proximity	% Empl. Top66 Proximity
Lockdown 11/3	41.977** (4.487)	42.968** (4.480)	51.956** (6.476)			
Lockdown 25/3				0.624 (2.093)	2.344 (2.057)	6.936 (7.919)
Obs.	603	591	591	603	591	591
R2	0.181	0.204	0.279	0.000	0.002	0.010
Health ind.		No	No		No	No
Empl-we'd			Yes			Yes
<i>Panel B</i>	% Empl. Top66 Disease	% Empl. Top66 Disease	% Empl. Top66 Disease	% Empl. Top66 Disease	% Empl. Top66 Disease	% Empl. Top66 Disease
Lockdown 11/3	3.876 (4.314)	5.346 (4.298)	8.609 (11.173)			
Lockdown 25/3				-13.563** (1.978)	-11.127** (1.899)	-17.879** (6.851)
Obs.	603	591	591	603	591	591
R2	0.002	0.003	0.008	0.071	0.055	0.074
Health ind.		No	No		No	No
Empl-we'd			Yes			Yes

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The average sectoral indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

¹⁶ These results are robust if we modify the indexes by including only the top 25 percent of workers at risk, or if we include the top 50 percent (Tables B2-B5 in the Appendix). In this latter case, the main difference is that the March 11 decree seems to have reduced the share of workers in the upper median of the disease exposure distribution (table B4).

Table 6 shows another important dimension of risk, that of workers' demographics: in particular, we focus on male workers above the age of 50. The regressions results indicate that there was a negative association between the sectors locked-down and their percentage of above-50 male workers; namely, the sectors that stayed open had a higher share of workers who were male above the age of 50. The second lockdown, by targeting many sectors, hits indistinctly sectors regardless of their percentage of above-50 male workers.

Table 6. Percentage of male workers above the age of 50 and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
	% Males >50- y.o.	% Males >50- y.o.	% Males >50- y.o.	% Males >50- y.o.	% Males >50- y.o.	% Males >50- y.o.
Lockdown 11/3	-6.798** (2.454)	-7.076** (2.455)	-10.407** (1.674)			
Lockdown 25/3				1.778 (1.218)	1.320 (1.223)	-0.653 (2.176)
Obs.	603	591	591	603	591	591
R2	0.014	0.016	0.104	0.004	0.002	0.001
Health ind.		No	No		No	No
Empl-we'd			Yes			Yes

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of male workers is calculate over the total sectoral employment. + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

4.3 Additional evidence on working from home and sectoral lockdowns

As seen in table 4, the sectoral lockdowns did not involve the finance, banking and insurance industries, the public administration and most of the professional services. Most of the workers in these sectors have jobs that can be done from home. To formally test this hypothesis, we run a simple regression similar to those reported in table 5 and 6, where on the left hand side there is the percentage of workers in the sector whose job is among those with the highest chance to be performed from remote. In this case, we expect to see a negative association between such percentage of workers and the lockdown measures.

Table 7. Percentage of workers in the top tercile working remotely index and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
	% Top66 Working Remotely	% Top66 Working Remotely	% Top66 Working Remotely	% Top66 Working Remotely	% Top66 Working Remotely	% Top66 Working Remotely
Lockdown 11/3	-19.758** (3.934)	-20.107** (3.939)	-28.521** (4.090)			
Lockdown 25/3				-8.738** (2.399)	-9.496** (2.432)	-18.279** (5.149)
Obs.	603	591	591	603	591	591
R2	0.030	0.031	0.091	0.021	0.025	0.077
Health ind.		No	No		No	No
Empl-we'd			Yes			Yes

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of workers in the top tercile of the working from remote index is calculated as described in equation (1). + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

The results in table 7 confirm this hypothesis: on average, the sectors that were shut down by the two decrees, had a lower share of workers with a high possibility to work from remote: this goes from about 29 percent after March 11 decree, to 18 percent after the March 25 adoption of the second decree. The much broader scope of this latter lockdown, also reflected in a lower R-squared (see columns (3) and (6)), may have contributed few workers with a lower need to work from a specific workplace to keep working from home.

5. Conclusions

This paper is the first, to our knowledge, that describes the sectors and workers most exposed to risks during an epidemic, such as the recent COVID-19 outbreak. We do this in the Italian context by creating synthetic indexes that proxy for physical proximity in the workplace, exposure to diseases and infections, and the possibility to work remotely at the occupational level. Such information is obtained from a very detailed occupational characteristics survey, ICP, the Italian equivalent to the BLS O*Net. These indexes, on about 800 occupations, are then matched to sectoral employment data recorded by the 2019 Italian LFS. We find that several activities, mainly in trade, personal services and leisure sectors are not exposed to infections and diseases, but need physical proximity to operate. The number of workers employed in Italy whose physical proximity index is above the national average, excluding healthcare and necessary goods, is above 6.5 million.

We then describe whether, and to what extent, the lockdown measures adopted by the Italian Government involved sectors with a relatively higher percentage of workers at high risk of proximity and disease, and a higher proportion of workers whose activities can be easily carried out from home. The sectoral lockdowns put in place by the Italian Government in March 2020 involved up to about 8 million workers. The lockdowns targeted sectors that, on average, had a relatively higher share of workers who operate in physical proximity, but not sectors with a higher exposure to infections, even excluding the health and the education industries. Our results also show that the sectors whose activities have not been suspended involve a larger share of workers who can work from home.

The evidence we provide in this paper can inform policy decisions on the implementation of the lockdown phasing-out, without compromising the efforts of the recently adopted social distancing measures, and by preserving workers' health. For instance, it can provide valuable information for policy makers who plan to adopt strategies such as letting young adults coming back to work (and being isolated from the elderly even in their private lives), while those at higher risk, because of their demographics characteristics, should work from home as much as possible (Ichino *et al.* 2020). The paper, however, does not take into account many important dimensions, such as interactions across sectors and among workers' of different sectors (through input-output linkages) and interactions occurring during commuting. Further research in these areas, as well as research that strengthen our understanding of which professional groups and sectors can safely operate from remote (as in Boeri *et al.* 2020), is clearly warranted.

Appendix

A. Further description of the Italian Sample Survey on Professions

A1. Institutional details

The Italian Sample Survey on Professions (ICP) was jointly created by the National Institute for Public Policy Analysis (Inapp) and the National Institute of Statistics (Istat), late in 2004. It is currently carried out by Inapp in the context of the initiatives launched for the construction and constant updating of a permanent national system for the observation of professional needs. The survey, of institutional relevance, is included in the National Operational Program - Systems of active employment policies (PON SPAO), co-financed by the European Social Fund, 2014-2020 programming period. It provides an innovative contribution to the production of statistical information on employment. Traditional data on employment regard methods and degrees of participation in the labour market. They usually quantify the composition of main aggregates of the working - age population and sometimes investigate some the qualitative aspects, the tasks performed and the equipment used by the various occupations.

The information recorded during the survey is used to improve public policies and investments for the training of workers in our country and to reduce the gap between the current knowledge of workers' skills and those really necessary for the productive world to respond in effective way to market demands. Thus, ICP may represent a relevant instrument to design tailored policies on specific local needs.

A2. Sample design

The workers interviewed in the context of the sample survey are around 16.000, representative of the approximately 800 professional units (PUs), which cover the entire Italian Classification of professions (CP 2011, the Italian equivalent to the international classification ISCO-08) at the highest level of detail (5-digit). Few occupations are not covered by the survey, mainly armed forces officers, supervisors and troops (about 240,000 workers in 2018). The selection of the sample of workers takes place from lists of companies or entities in which it is highly probable to identify the PUs under investigation. A mixed strategy is envisaged for sample selection. The procedures for extracting the names of the workers to be interviewed vary in fact, depending on the context in which the work is carried out:

- i) occupations in private businesses: for each profession a list of 120 companies is extracted from the statistical archive of the active enterprises (Istat ASIA). The extraction is carried out on the subset of companies that they declare to carry out an economic activity pertaining to the PU in question, that is to say those which maximize the probability of identifying within them the workers of such a profession. Moreover, in the extraction, the stratification based on the geographical location of companies and their size in terms of number of employees is ensured.
- ii) occupations in public institutions: a list of 120 entities is created. It is extracted from Istat internal archives or requested ad hoc to external institutions. Also in this case the extraction is carried out on archives of institutions related to the professions being investigated, stratifying on the basis of the single geographical location of entities.

iii) occupation in regulated professions: For each profession of this third type, i.e. regulated by a specific professional register, a list of 120 names is created, being extracted from the members of the Order. The archives of the members of the registers are requested from the provincial colleges selected by Istat on the basis of a territorial representativeness criterion.

The administration of the questionnaire requires a random rotation of the sections based on methodological needs. The sampling plan was defined in close scientific and methodological collaboration between Inapp and Istat.

A3. Structure of the survey and main variables

The survey is composed by seven sections:

- knowledge (33 questions, regarding both importance and complexity);
- skills (35 questions, regarding both importance and complexity);
- attitudes (52 questions, regarding both importance and complexity);
- generalized work activities (41 questions, regarding both importance and complexity);
- values (21 questions);
- work styles (16 questions);
- working conditions (57 questions).

The main variables used in the paper, exposure to disease or infection, physical proximity and working remotely, are constructed on the ICP questions described in table A1. The answer to these questions are on a 0-5 scale based on how frequent or important is the activity, work style or working conditions (where 5 means very frequent or very important).

Table A1. Variables description

Code	Title	Question	Entered as its reverse
Exposure to disease or infection			
H.29	Exposed to disease or infections	How often does this job require exposure to disease/infections?	
Physical proximity			
H.21	Physical proximity	To what extent does this job require the worker to perform job tasks in close physical proximity to other people?	
Working remotely			
G.16	Performing general physical activities	Performing physical activities that require considerable use of your arms and legs and moving your whole body, such as climbing, lifting,	yes
G.19	Working with computers	Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information.	
G.20	Maneuvering vehicles, mechanical vehicles or equipment	Running, maneuvering, navigating, or driving vehicles or mechanized equipment, such as forklifts, passenger vehicles, aircraft, or water craft.	yes
H.1	Face-to-face discussions	How often do you have to have face-to-face discussions with individuals or teams in this job?	yes
H.8	Deal with external customers	How important it is in carrying out your work to interact in first person with external customers (for example in a retail store) or in general with the public (such as the traffic policeman)	yes
H.21	Physical proximity	To what extent does this job require the worker to perform job tasks in close physical proximity to other people?	yes
H.39	Spend Time Standing	How much does this job require standing?	yes

B. Additional tables and figures**Table B1.** Sectoral and regional distributions: working from remote

Sectors	Working from remote index	% workers > 66 th pct	Sector employm	Regions	Working from remote index	% workers > 66 th pct	Regional employm.
A - Agricolt.	46.4	9.2	887,192	Piemonte	49.6	35.1	1,823,579
B - Extraction	53.8	38.6	24,965	Valle d'A	46.6	29.0	55,631
C - Manufact.	51.7	33.9	4,318,814	Lombardia	50.6	39.0	4,478,052
D - Energy	59.1	70.4	113,241	Trentino	47.8	30.6	499,500
E - Water	52.0	29.0	241,209	Veneto	48.9	33.3	2,169,356
F - Construct.	42.2	13.6	1,331,231	Friuli VG	48.9	34.0	510,690
G - Trade	40.3	15.3	3,283,268	Liguria	48.2	35.1	612,689
H - Transp.	50.6	30.2	1,137,764	Emilia R.	49.8	35.2	2,030,784
I - Accomod.	34.6	7.4	1,510,283	Toscana	48.6	34.7	1,603,042
J - Info, com.	66.8	91.5	619,220	Umbria	48.3	33.4	360,764
K - Finance	61.6	72.9	635,502	Marche	49.0	35.1	636,423
L - Real est.	60.3	47.2	164,294	Lazio	50.7	43.1	2,392,163
M - Profess.	65.5	92.5	1,512,434	Abruzzo	47.5	28.5	497,186
N - Other bus	53.5	31.4	1,034,091	Molise	47.2	28.0	108,224
O - Public ad	55.3	73.0	1,244,711	Campania	47.2	29.7	1,653,137
P - Education	48.6	19.0	1,580,162	Puglia	46.8	28.2	1,237,639
Q - Health	42.9	23.0	1,923,859	Basilicata	47.3	25.5	189,381
R - Sports	48.6	44.4	317,876	Calabria	47.3	28.5	544,714
S - Oth. Serv.	43.5	26.8	709,981	Sicilia	46.7	28.1	1,356,139
T - HH act.	53.5	54.6	747,521	Sardegna	46.1	29.3	592,970
U - Inter. Org.	61.2	74.4	14,442				
Tot. economy	49.0	34.6	23,352,062	Italy	49.0	34.6	23,352,062

Note: The table reports the sectoral and regional employment, as reported by the Istat LFS as of the first three quarters of 2019. The average working from remote indexes reported are weighted by the 4-digit employment in each sector and region, respectively. The average sectoral indexes go from 0 to 100 according to the definition in section 2, where 100 means the most exposed sector. The percentage of workers that have the possibility to work from remote is calculated as described in equation (1).

Source: Authors' elaborations on ICP survey and LFS data

Table B2. Percentage of workers in the top 25 percent of risk indexes and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A</i>	% Empl. Top75 Proximity	% Empl. Top75 Proximity	% Empl. Top75 Proximity	% Empl. Top75 Proximity	% Empl. Top75 Proximity	% Empl. Top75 Proximity
Lockdown 11/3	27.672** (3.605)	28.740** (3.592)	44.653** (8.114)			
Lockdown 25/3				-0.928	0.945	4.941
Obs.				(1.643)	(1.565)	(7.732)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.127	0.158	0.263	0.001	0.001	0.007
<i>Panel B</i>	% Empl. Top75 Disease	% Empl. Top75 Disease	% Empl. Top75 Disease	% Empl. Top75 Disease	% Empl. Top75 Disease	% Empl. Top75 Disease
Lockdown 11/3	5.378 (3.865)	6.957+ (3.842)	-0.563 (8.674)			
Lockdown 25/3				-11.871**	-9.205**	-16.998**
Obs.				(1.740)	(1.611)	(5.135)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.004	0.008	0.000	0.070	0.052	0.083

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of workers in the top 25 percent of each index is calculated as described in equation (1). + p<0.10, * p<0.05, ** p<0.01.

Table B3. Percentage of workers the top 25 percent of working remotely index and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
	% Top75 Working Remotely	% Top75 Working Remotely	% Top75 Working Remotely	% Top75 Working Remotely	% Top75 Working Remotely	% Top75 Working Remotely
Lockdown 11/3	-17.580** (2.540)	-17.971** (2.548)	-24.605** (3.636)			
Lockdown 25/3				-7.699**	-8.522**	-16.058**
Obs.				(2.051)	(2.087)	(4.978)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.032	0.034	0.083	0.023	0.027	0.072

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of workers in the top 25 percent of the working from remote index is calculated as described in equation (1). + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

Table B4. Percentage of workers in the top 50 percent of risk indexes and sectoral lockdown

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A</i>	% Empl. Top50 Proximity	% Empl. Top50 Proximity	% Empl. Top50 Proximity	% Empl. Top50 Proximity	% Empl. Top50 Proximity	% Empl. Top50 Proximity
Lockdown 11/3	31.609** (3.704)	32.349** (3.703)	40.954** (5.130)			
Lockdown 25/3				4.391*	5.752**	15.757*
Obs.				(2.174)	(2.170)	(6.200)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.094	0.103	0.195	0.007	0.012	0.059
<i>Panel B</i>	% Empl. Top50 Disease	% Empl. Top50 Disease	% Empl. Top50 Disease	% Empl. Top50 Disease	% Empl. Top50 Disease	% Empl. Top50 Disease
Lockdown 11/3	33.299** (4.132)	34.527** (4.125)	22.302* (8.644)			
Lockdown 25/3				-14.196**	-12.306**	-17.729**
Obs.				(2.399)	(2.390)	(6.623)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.081	0.093	0.048	0.055	0.043	0.062

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of workers in the top half of each index is calculated as described in equation (1). + p<0.10, * p<0.05, ** p<0.01.

Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

Table B5. Percentage of workers the top 50 percent of working remotely index and sectoral lockdown

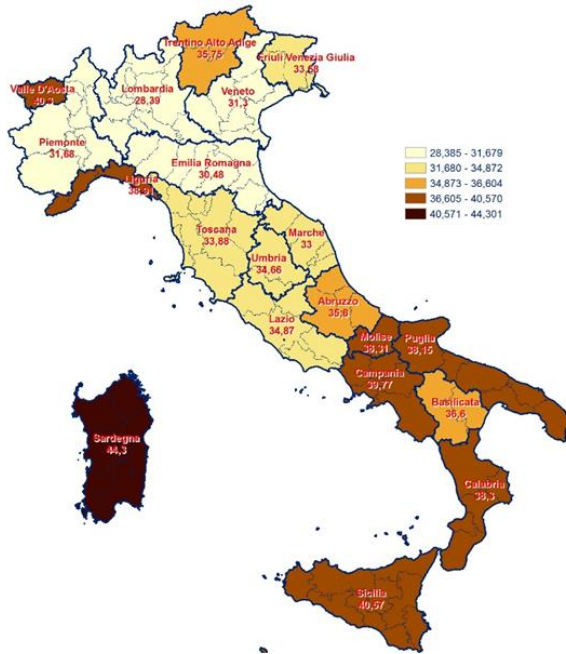
	(1)	(2)	(3)	(4)	(5)	(6)
	% Top50 Working Remotely	% Top50 Working Remotely	% Top50 Working Remotely	% Top50 Working Remotely	% Top50 Working Remotely	% Top50 Working Remotely
Lockdown 11/3	-29.742** (4.628)	-30.110** (4.633)	-41.736** (5.322)			
Lockdown 25/3				-8.101**	-8.853**	-23.337**
Obs.				(2.411)	(2.442)	(6.193)
R2						
Health ind.	603	591	591	603	591	591
Empl-we'd	0.067	0.070	0.164	0.018	0.022	0.104

Note: The table reports OLS regression coefficients and heteroscedastic-robust standard errors (in parenthesis). The percentage of workers in the top half of the working from remote index is calculated as described in equation (1). + p<0.10, * p<0.05, ** p<0.01.

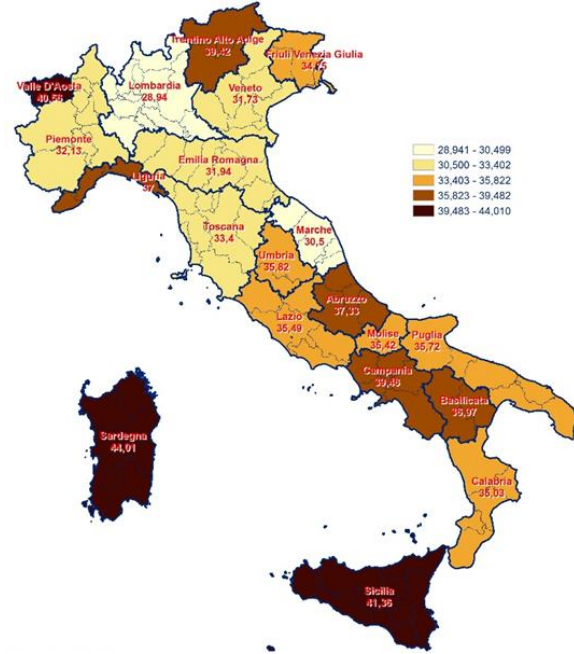
Source: Authors' elaborations on ICP survey and LFS data and sectors under lockdown listed in the governmental decree of March 11 and March 22 (implemented on March 25)

Figure B1. Regional distributions: maps reporting the percentage of workers in the top national tercile of the physical proximity, disease exposure and working from remote indexes

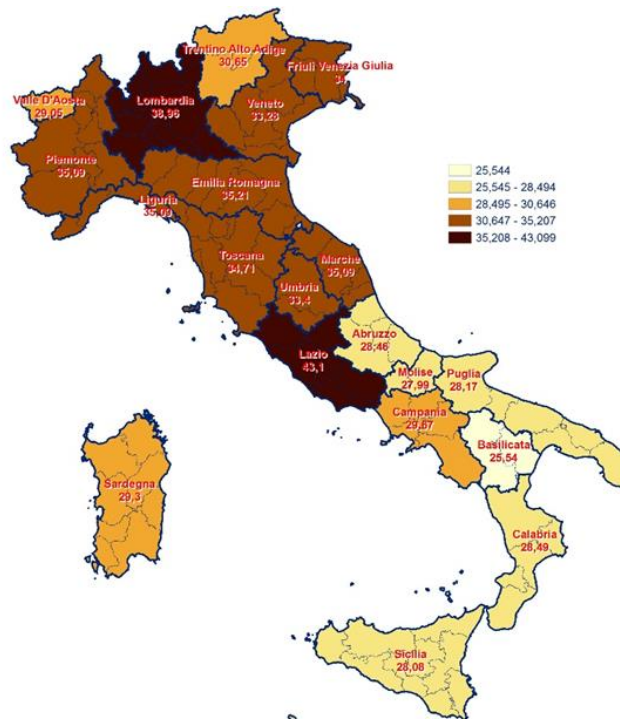
Panel A. % of workers most exposed to physical proximity



Panel B. % of workers most exposed to diseases and infections



Panel C. % of workers most likely to be able to work from remote

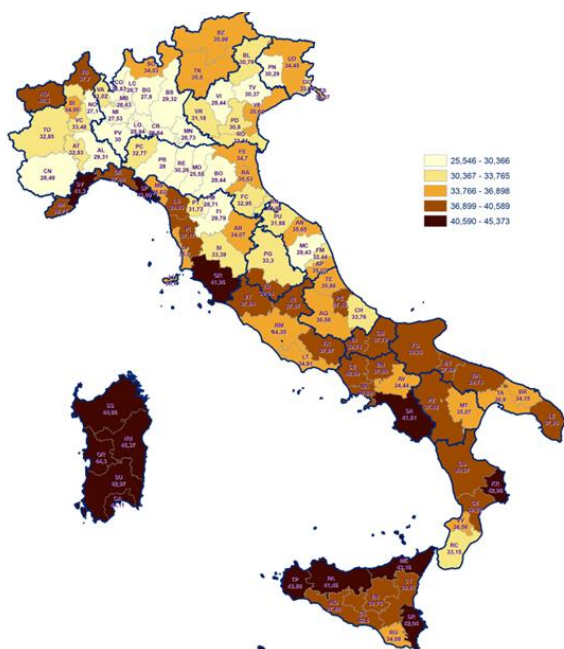


Note: The percentage of workers in the top tercile of each index is calculated as described in equation (1).

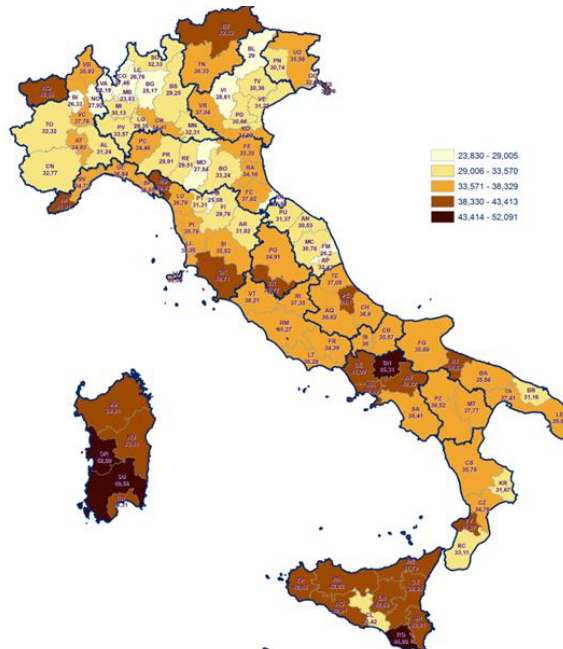
Source: Authors' elaborations on ICP survey and LFS data

Figure B2. Provincial distributions: maps reporting the percentage of workers in the top national tercile of the physical proximity, disease exposure and working from remote indexes

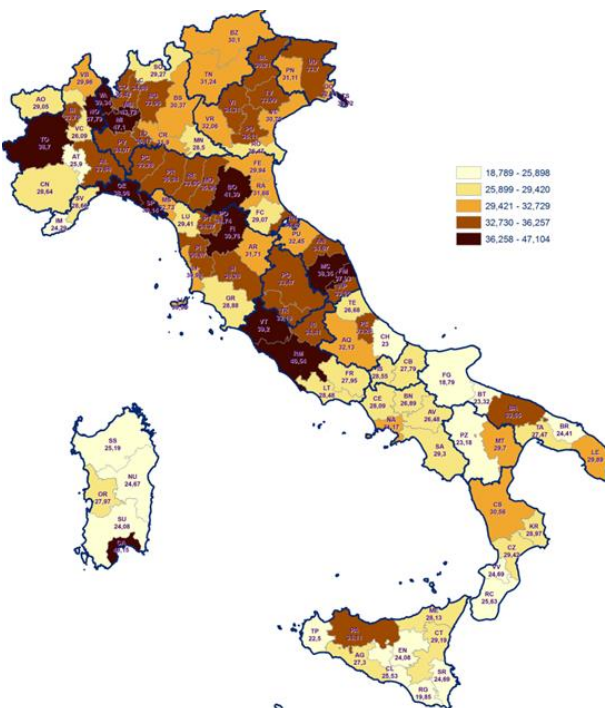
Panel A. % of workers most exposed to physical proximity



Panel B. % of workers most exposed to diseases and infections



Panel C. % of workers most likely to be able to work from remote



Note: The percentage of workers in the top tercile of each index is calculated as described in equation (1).

Source: Authors' elaborations on ICP survey and LFS data

References

- Adda J. (2016), Economic activity and the spread of viral diseases. Evidence from high frequency data, *The Quarterly Journal of Economics*, 131, n.2, pp.891-941
- Autor D.H., Dorn. D. (2013), The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market, *American Economic Review*, 103, n.5, pp.1553-1597
- Autor D.H., Levy F., Murnane R.J. (2003), The Skill Content of Recent Technological Change. An Empirical Exploration, *Quarterly Journal of Economics*, 118, n.4, pp.1279-1333
- Baldwin R., Weder di Mauro B. (2020), *Economics in the Time of COVID-19*, London, CEPR Press
- Boeri T., Caiumi A., (2020), Lavori che possiamo continuare a svolgere <<https://bit.ly/39UzTCr>>
- Boeri T., Caiumi A., Paccagnella M. (2020), *Mitigating the work-security trade-off*, Mimeo online printing
- Boerner L., Severgnini B. (2012), *Epidemic Trade*, EHES Working Papers n.24, Vienna, European Historical Economics Society <http://www.ehes.org/EHES_No24.pdf>
- Dingel J., Neiman B. (2020), *How Many Jobs Can be Done at Home?*, NBER Working Paper n.26948, Cambridge MA, NBER <<https://www.nber.org/papers/w26948>>
- Firpo S., Fortin N.M., Lemieux T., (2011), *Occupational Tasks and Changes in the Wage Structure*, IZA Discussion Papers n.5542, Bonn, IZA
- Goos M., Manning A., Salomons A. (2014), Explaining Job Polarization. Routine-Biased Technological Change and Offshoring, *The American Economic Review*, 104, n.8, pp.2509-2526
- Ichino A., Calzolari G., Mattozzi A., Rustichini A., Zanella G., Anelli M. (2020), Transition steps to stop COVID-19 without killing the world economy, VoxEU.org, 25 March <<https://bit.ly/2xlxJPd>>
- Leibovici F., Santacruce A.M., Famiglietti M. (2020), Social Distancing and Contact-Intensive Occupations, On the Economy Blog, Federal Reserve Bank St. Louis <<https://bit.ly/2V0k7SB>>
- Mongey S., Weinberg A. (2020), *Characteristics of workers in low work-from-home and high personal-proximity occupations*, BFI White Paper, Chicago, Becker Friedman Institute
- Ng K., Poon B.H., Kiat Puar T.H., Li Shan Quah J., Jia Loh W., Jun Wong Y., Raghuram J. (2020), COVID-19 and the Risk to Health Care Workers. A Case Report, *Annals of Internal Medicine*, Letters 16 March <<https://bit.ly/2JVgjf2>>
- Oster E. (2012), Routes of infection: exports and HIV incidence in Sub-Saharan Africa, *Journal of the European Economic Association*, 10, n.5, pp.1025-1058
- The Lancet (2020), COVID-19. Protecting health-care workers, Editorial, 395, n.10228, March 21, <<https://bit.ly/3aT7n5D>>