

Recovery 4.0. Ageing labour markets, digitalization of the economy and Covid-19

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In light of the demographic trends and the consequences of the pandemic, this paper examines the implications of the shift in skills which is needed in order to favour business digitalisation. The consequences of digitalisation for the employability of both younger and older workers are discussed, and the acceleration of the tele-workability phenomenon, triggered by the pandemic on certain categories of jobs, is also explored. The strategy of the Italian PNRR is then described, looking for possible gaps concerning the employability of social groups and/or trade-offs between the strategy and the digital transformation of the economy.

Alla luce delle tendenze demografiche e delle conseguenze della pandemia, l'articolo prende in esame le implicazioni della trasformazione delle competenze, necessaria per favorire la digitalizzazione delle imprese. Si discutono le conseguenze per l'occupabilità dei lavoratori giovani e maturi e si esplora l'accelerazione impressa dalla pandemia alla remotizzazione di alcuni lavori. Viene infine esaminata la strategia del PNRR italiano, evidenziandone eventuali mancanze riguardanti l'occupabilità di specifici gruppi sociali e i contrasti con la trasformazione digitale dell'economia.

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Introduction

Italy and Europe entered the Covid-19 pandemic with a demographic situation which in perspective could have further undermined economic development, due to the shrinking of the labour force and possible labour and skills shortages in key sectors, including health and education systems, ICTs, advanced manufacturing and long-term care (European Commission 2019; OECD 2019).

As a matter of fact, the relative growth of the Italian workforce and its stable participation level

during the period 2002-2019 were made possible by an increase in the demographic weight of the older age classes, and by their higher participation in the labour market, also favored by pension reforms (Cicciomessere and De Blasio 2019). In this time span, the 15+ Italian work force grew in absolute terms by 6.8%, going from 24,287,000 almost up to 26,000,000. The larger contribution to this growth came from women, who grew by 13.4%, namely from 9,789,000 to more than 11 million. On the other side, men grew only by 2.3%,

going from almost 14,500,000 up to 14,836,000. The growth affected only 45+ population, with a great concentration on the 55-64 age bracket (+129.1%), followed by 65+ (+79.9%) and 45-54 (+42.8%), thus mirroring the demographics of the whole population.

Demographics were coupled by a different evolution in participation levels of the age groups. While the indicator appears stable if we consider the 15+ population (around 50%), the increase in the number of older workers (55-64) appears remarkable, going from 30.5% up to 57.4%. In the same period, the participation of younger people (15-24) and that of the first segment of prime age population (25-34) underwent a clear decrease, in the former case going from 39.4 to 26.1 and in the latter from 79.6% to 73.4%. The stability of the 35-44 class around 81% is juxtaposed with a significant growth in the 45-54 bracket, from 71.2% to 79%.

The pandemic thus impacted a labour market characterized by structural underutilization of human resources and still heavily dependent on older age classes in regards to workforce participation levels. Before 2019, not unlike other advanced countries, the Italian demographic dividend – namely the difference between the growth rate of the population of working age (in this case 15-64) and the overall population, which can be considered an indicator of the contribution of demographics to economic growth – was estimated to be negative at least until 2051, despite a partial compensation potentially due to immigration (Barbiellini Amidei *et al.* 2018). In this context, assuming a productivity level as that of 2016, over the next 45 years the national GDP would decrease by 24.4% (-16.2% per capita). According to these estimations, productivity should increase by 0.34% per year to counterbalance this drop (*ibidem*).

According to the European Commission (2020a) the working-age population (20-64) of the Euro Area is projected to undergo a continuous shrinking if compared to current standards. In particular, its share out of the total population is expected to fall from 58.9% in 2019, to 53.3% by 2040. In Italy, the percentage of the working population is expected to decrease even more, starting from 59.1% in 2019 and reaching 52.4% in 2040. For this reason, the total Italian dependency ratio, which is currently comparable to that of the Euro Area (69.2%) will

increase up to 90.7 by 2040, while the participation rate of older workers is expected to grow from current 57.5% up to 72.2% (*ibidem*).

Considering the ongoing demographic transition, which is likely to take place relatively quickly, in Italy, as in other advanced countries, maintaining and raising productivity levels of the economy and the recovery after the current crisis will probably call both for the increase in participation of social groups who are currently underrepresented in the labour market (namely women and younger people), the growing integration of immigrant workers, and the pervasive introduction of digital technologies. Indeed, Acemoglu and Restrepo, among others, contend that the automation of production processes, which are more advanced in countries with a larger share of the older population, will probably be aimed at counterbalancing the lower share of middle-aged workers, that is, those who should gradually replace older colleagues who will unavoidably retire during coming years (Acemoglu and Restrepo 2018).

The paper will explore (point 1) how the structure of Italian jobs tasks before the pandemic could influence the possible directions of penetration of digital technologies in various economic sectors, considering the share of the older workforce. The digital employability of Italian workers will be subsequently discussed, comparing the estimations on employment demand with the potential penetration of ICTs in various occupations (point 2). The contribution will then look (point 3) at the acceleration triggered by the pandemic towards the digitalization of the economy and society, discussing whether the potential remote workability of various occupations may further challenge the employability of Italian workers in general and the older ones.

Finally, the paper will identify the dimensions of older workers' employability which can play a key role in facilitating (or not) the skills shift which is required to take advantage of the innovative potential coming from the spreading of digital technologies (point 4). Potential risks and weaknesses in employability policies (including the Italian PNRR), rooted in the little consideration given to the simultaneous occurrence of both the demographic and the digital transition, will be highlighted and summarized in the conclusions.

1. Demographics and potential penetration of digital technologies in the economic sectors before the pandemic

According to OECD (OECD 2019)¹, in 2019, a relevant share of the Italian jobs was at high risk of automation (15.2%) or at risk of significant change due to digitalization (35.5%). Among 27 OECD countries, Italy was in the ninth position, after the Slovak Republic, Turkey, Greece, Japan, Germany, Chile, Slovenia, and Spain and more than five points over the average (45.5%).

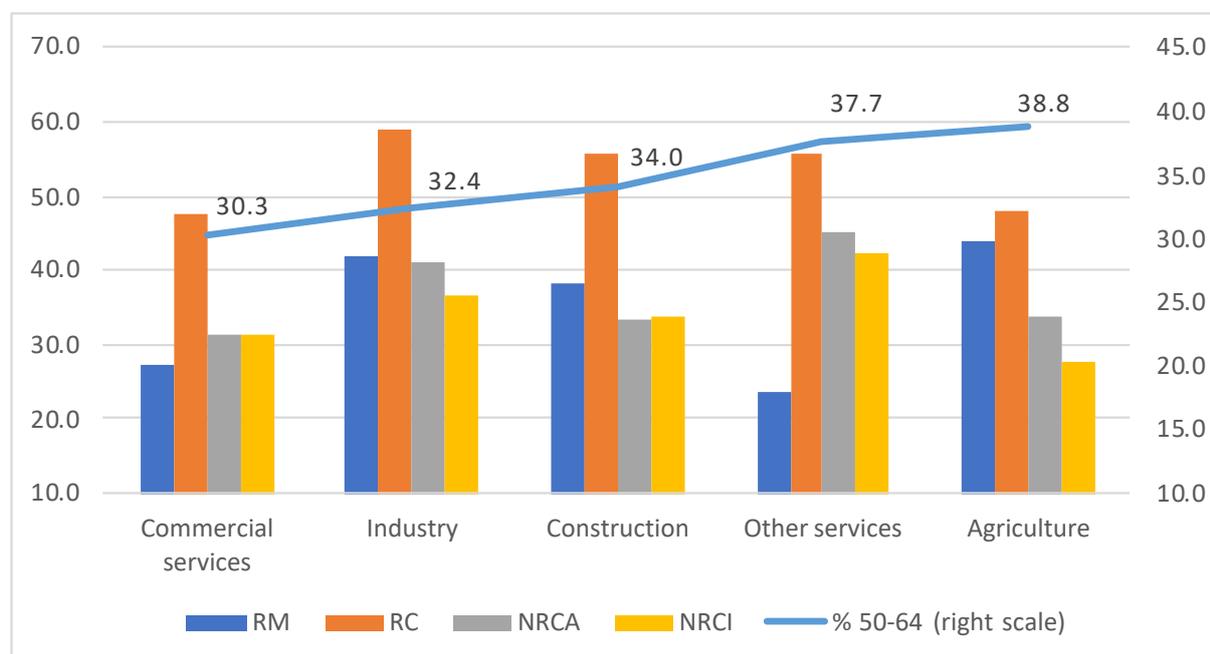
In this context, the interplay between demographics and digital innovation would have gained even more importance than it had in the recent past in determining the possible growth of inequalities, both on the labour market and in the society at large (Harris *et al.* 2018). Hence the importance of anticipating the sectoral trajectories of digitalization and its possible impact on different categories of workers (Chiattelli 2020).

The contemporary phenomenon of workforce

ageing and the current penetration of digital technologies in Italy can be assessed looking at the level of routinization of work tasks, as a measure of the probability of digital automation, by means of an effective machine/human replacement. Assuming that the level of routinization of certain work tasks can help to highlight their potential exposure to automation (Frey and Osborne 2017), the following analysis is conducted in line with the research carried out in recent years by Inapp through the elaboration of a Routine Task Index (RTI) of the Italian economy, based on the information obtained from the Sampling Survey on Professions, whose methodology is the same of the US O*NET system (Gualtieri *et al.* 2018; Cirillo *et al.* 2021).

Chart 1 compares by employment in broad economic sectors the components of the RTI likely to represent the probability of automation of the connected tasks, namely the indicator of routine manual tasks (Routine Manual indicator - RM) and that of the routinization of cognitive tasks (Routine

Chart 1. RM, RC, NRCA and NRCI 2015 and share of 50-64 in employment by broad economic sectors 2019 (RTI 0-100)



Source: Author's elaboration on Inapp-ICP 2015; Istat, FDL, 2019 and Eurostat 2021

¹ OECD calculations are based on the Survey of Adult Skills (PIAAC 2012) and Nedelkoska and Quintini (2018). Jobs are described at high risk of automation if the likelihood of their job being automated is at least 70%. Jobs at risk of significant change are those with the likelihood of their job being automated estimated at between 50 and 70%.

Cognitive indicator - RC). The two indicators are confronted with the opposite ones, namely Non-routine cognitive: Analytical (NRCA) and Non-routine cognitive: Interpersonal (NRCI) indicators. NRCA measures how often job tasks involve the analysis of data and information, the use of creative thinking and the interpretation of information received from others. NRCI scores the frequency with which tasks require establishing and maintaining social relations; guiding, directing and motivating subordinates; coaching and human resources development (Gualtieri *et al.* 2018). In opposition to RM and RC, these two indicators thus show the presence of non (or less) standardizable and more creative jobs, which mostly require higher education and specialization and for which the humans/machine substitution would seem less likely to occur.

RM expectedly scores higher in agriculture, industry and construction, while it decreases in the service sector. In a markedly different way, RC displays high values in all the economic sectors, with a particular concentration on industry (59.1), construction (55.6) and other services (55.8). The score of this indicator appeared at that time consistent with comparative studies which reported higher RC values in Central-Eastern and Southern Europe (Greece and Italy), together with Ireland and UK (Hardy *et al.* 2018). According to these studies, in these cases the relation between per capita GDP and the average RC suggested a reverse U relation, which associated the lowest values of routine cognitive tasks to countries with a lower development level on one side, and to Northern European countries and the US, on the other (*ibidem*).

Given that the share of 50-64 workers exceeded 30% in all sectors, also approaching 40% in agriculture and other services, RM and RC already depicted a clear challenge ahead for the employability of this segment of the work force, on the internal and above all on the external labour markets. On the one hand, their relevant share in sectors with several automatable tasks could have entailed a risk of machine/human substitution; on the other, a potential growing demand coming from vacancies with digital skills could have made finding new jobs more difficult.

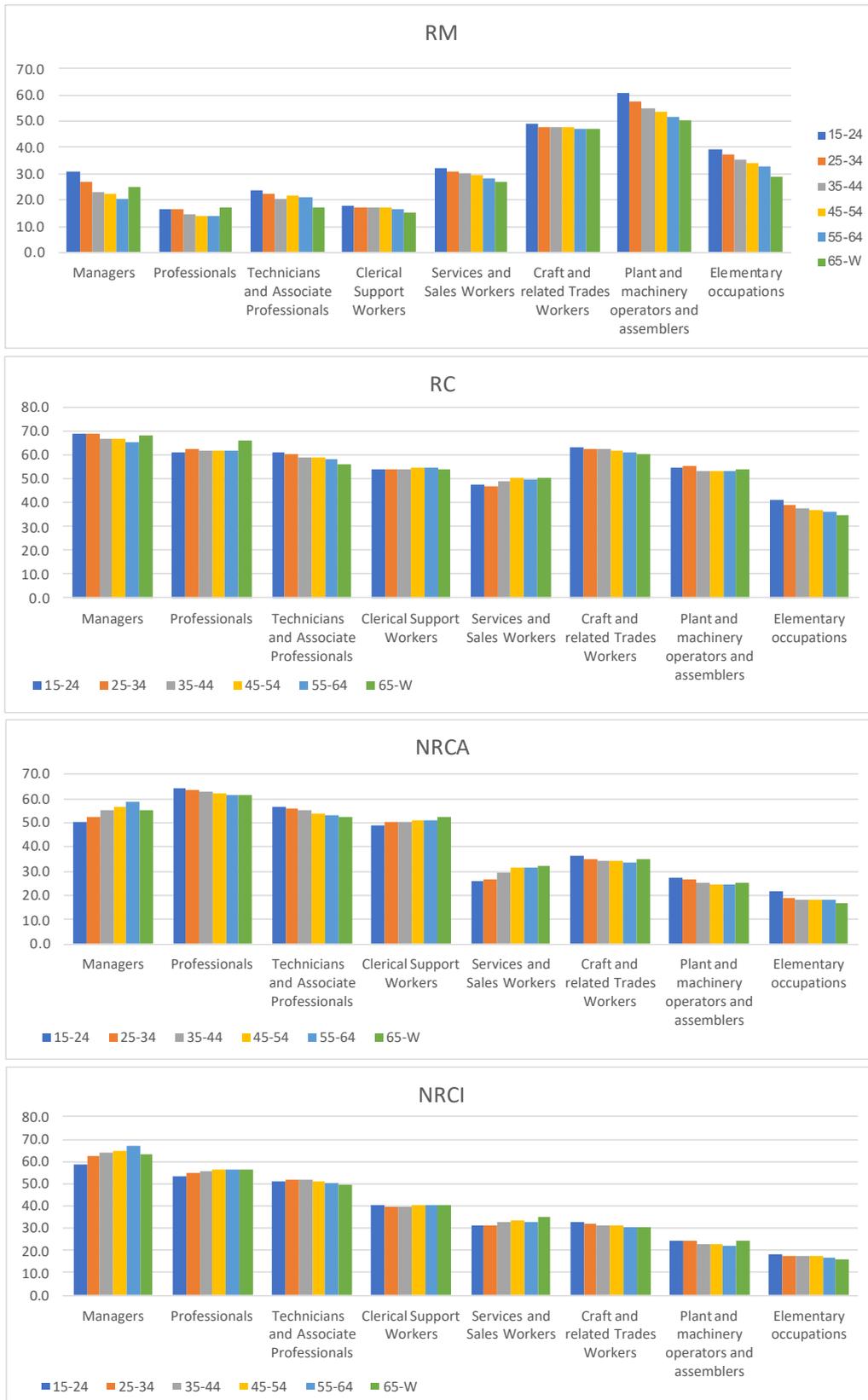
We elaborate RTI 2015 by the ISCO classification of occupations (Figure 1), so as to obtain a clearer picture of the potential digitalization of different

types of professional skills. As we can see, higher levels of routinization of manual tasks (RM) characterized plant and machinery operators and assemblers and craft and related trades workers. On the opposite, the RM indicator appeared expectedly low in the case of 'intellectual' occupations, while it scored an intermediate level among services and sales workers and elementary occupations. On the other hand, and as expected, managerial, technical, and scientific professions showed the highest levels of the 'high' skills identified by NRCA and NRCI, which merge technical knowledge and social competencies. By contrast, the area of commercial occupations in the service sector scored a much lower level for both these indicators, while both clerical occupations and craft and skilled workers show a higher level of cognitive non routine skills, in comparison to plant and machinery operators and elementary occupations.

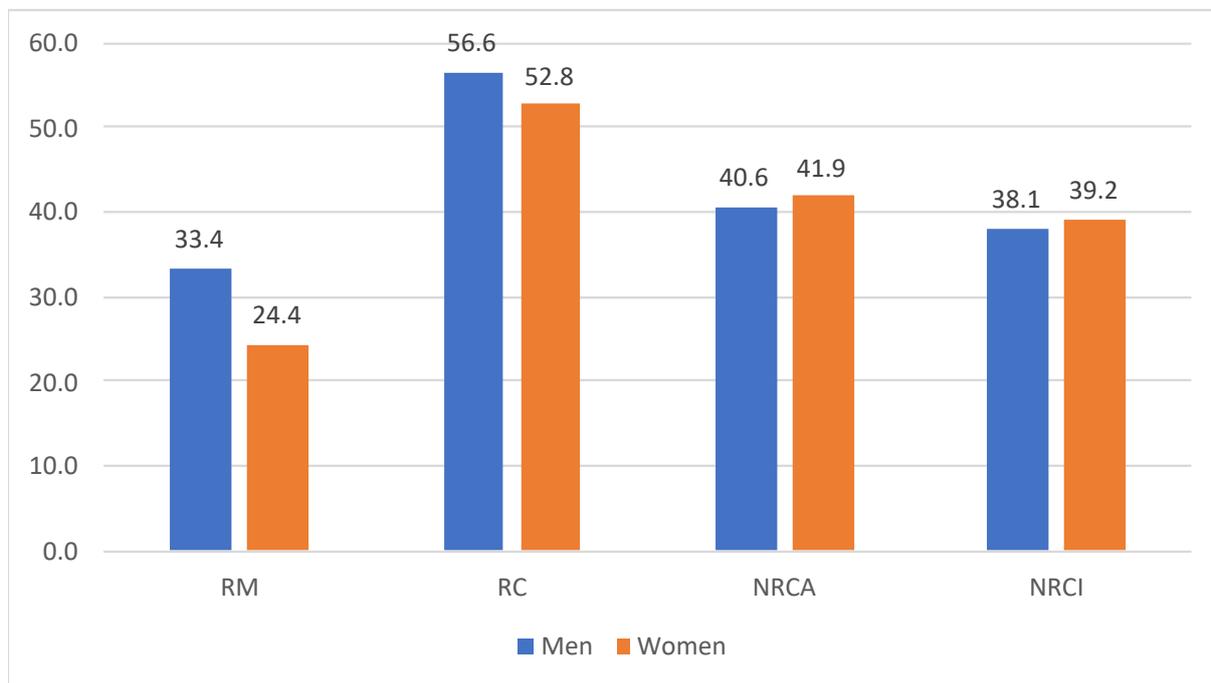
Before the pandemic, the possibility to automate work tasks characterized by a higher RM, thanks to their standardization and requested speed of execution, was supposedly thought to contribute to a lower employment demand and potential turnover, also taking into account the balance between the cost of technology and human capital and the productivity level that was considered necessary to maintain and strengthen competitiveness on the global market. In the case of occupations with a lower RM, with the relevant exception of services and sales workers, it was suggested that digitization would not hamper employment demand, both in the case of technical and scientific professions, as among clerical workers, where some manual tasks appeared more difficult to automate. The indicator of the routinization of cognitive tasks (RC) instead was telling a different story, because, in accordance with the previous analysis by economic sectors, it scored a relatively high level in all occupations, except for the elementary ones.

Concerning both RM and RC, the differences among the scores reported by the various age classes did clearly indicate that the space for digitalization of work tasks was about to put into question the employability of the whole workforce. Even from this point of view, RC appeared to foreshadow the main challenges, because differently from RM within plant and machinery operators and assemblers or elementary occupations, it did not

Figure 1. RM, RC, NRCA and NRCI 2015, by occupations and age classes 2019 (RTI 0-100)



Source: Author's elaboration on Inapp-ICP 2015; Istat, FDL, 2019

Chart 2. RM, RC, NRCA and NRCI 2015 of employed 2019 by gender (RTI 0-100)

Source: Author's elaboration on Inapp-ICP 2015; Istat, FDL, 2019

show any significant lowering in the older age group. Its relevance is confirmed also by looking at RTI by gender (Chart 2), given that it showed a very close score for men and women, differently from RM in which men ranked 9 points higher.

2. The digital employability of workers

In accordance with the data presented above, the digital employability of the older segment of the work force appeared critical during the last years. According to OECD, Italian older people 55-65 with low cognitive and digital skills amounted to 32% of the population in 2015, in comparison to an average of 17.1% among OECD members. In 2016 only 36.6% of Italian people were making a complex and diversified use of the Internet, namely the lowest share among OECD countries (58.3%). Workers needing medium training (up to 1 year) to transition to occupations at low or medium risk of automation were 13.8%, while those reporting high training needs (up to 3 years) were 4.2%, in comparison to an OECD average of 10% and 2.8% respectively (OECD 2019). The DESI indicator 2020 confirmed

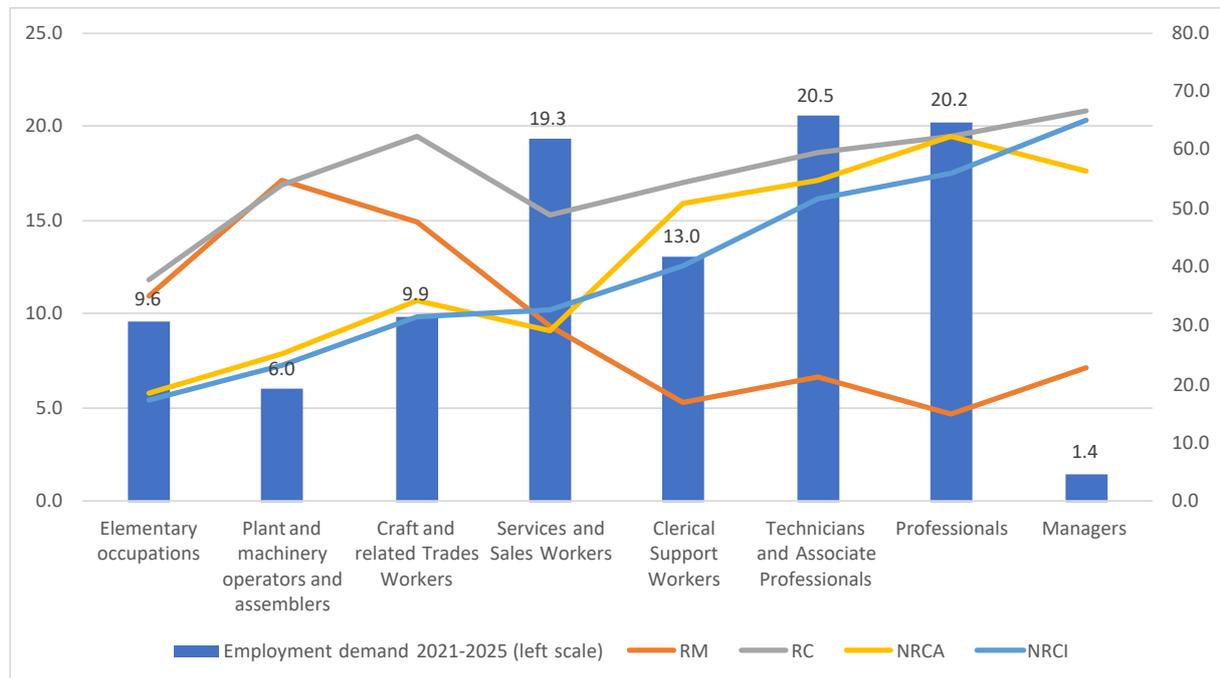
the situation: in the Human Capital Dimension² Italy was placed in the last position in EU28 (still including the UK), with a composite index of 32.4%, very far from the EU28 average of 49.3%. This score grew very little since 2015, when it was 30.8 (European Commission 2020b).

In the internal labour markets these findings were consistent with a persistent digital divide that characterized occupations (Cirillo *et al.* 2021), with high skilled profiles (managers, professionals, and technicians) being highly digitalized in opposition to low skilled ones (plant and machine operators and elementary occupations). A picture that mirrored other dimensions of labour market inequality, such as education level, type of contract or income (Sostero *et al.* 2020).

On the other hand, already in 2019 single high digital skills were considered difficult to find by recruiters in 28.4% of cases on the external labour markets; a mixed set of them (two or more) appeared difficult to find on the labour market in 36.4% of the cases (Unioncamere and Anpal 2019a). Italy has thus entered the Covid-19 pandemic, likely trapped in

² Calculated as the weighted average of the two sub-dimensions: 2a Internet User Skills (50%) and 2b Advanced Skills and Development (50%), <https://bit.ly/2ZaZO9T>.

Chart 3. RM, RC, NRCA and NRCI 2015, employment demand 2021-2025 by occupations (RTI 0-100; % on total employment demand, excluding Agriculture and Armed forces)



Source: Author's elaboration on Inapp-ICP 2015; Istat FDL 2019; Unioncamere, Anpal 2021, B scenario

low-skill equilibrium, namely a situation in which a low supply of skills was coupled with a low demand of skills by employers (OECD 2017). Indeed, before the pandemic, the Italian labour market has long witnessed a relevant mismatch between labour offer and demand, similarly to other advanced economies (Bertazzon 2019). According to the surveys on employment demand, high-skilled workers were difficult to find because there were few candidates on the market, compared to vacancies; on the contrary, in the opinion of employers, medium-level technical and expert candidates showed an inadequate level of preparation (Unioncamere and Anpal 2019b). These findings were confirmed by more recent forecasts which estimated a difficulty, in more than 43% of cases, in recruiting managers, professionals, technicians, and associate professionals and also craft and related trade workers (Unioncamere and Anpal 2020).

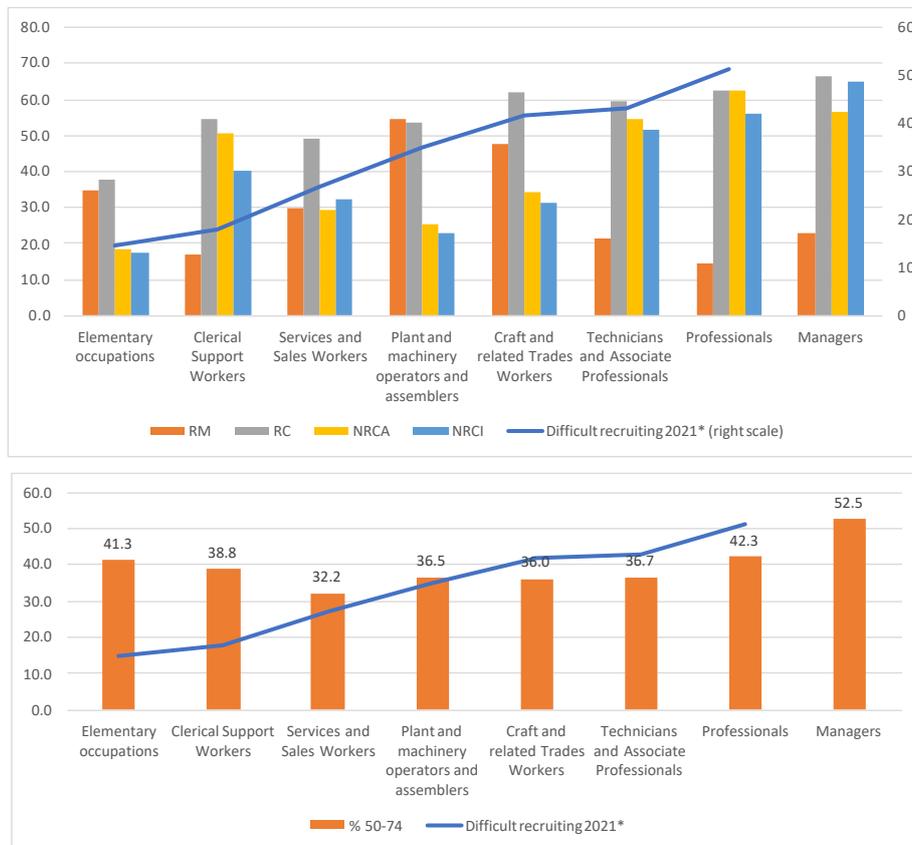
If we look at the employment demand, according to the forecasts by Excelsior (Unioncamere and Anpal 2021), as depicted in Chart 3, we can see that the occupations on which more than 42% of demand

is concentrated, namely managers, professionals and technicians and associate professionals, score the highest values of NRCA and NRCI, together with a high RC level. If we exclude managers, who represent a very small share, RC, NRCA and NRCI are positively correlated with employment demand, with a stronger correlation for the last two³ and a negative correlation with RM.

Currently, national forecasts (Unioncamere and Anpal 2021) estimate that between 2021 and 2025 our economy would need at least 2 or 2.1 million workers with intermediate digital skills (namely having basic skills in the use of the Internet and multimedia), which will share 57% of total employment demand. In the same period private and public employers would also look for workers able to manage at least two out of three skills in the so-called e-skill mix (mix of basic digital skills, use of mathematical languages and methods and innovative solutions). This need will represent 24-26% of total employment demand (from 886 to 924 thousand workers), 69% of whom will be concentrated among professionals and technicians and associate professionals (*ibidem*).

³ RC, NRCA and NRCI have a correlation index with ED of 0.31, 0.68 and 0.80 respectively.

Figure 2. RM, RC, NRCA and NRCI 2015, difficulty in recruiting in April 2021, by occupations (RTI 0-100; % difficult recruiting on total employment demand; % 50-74 workers)



* Managers and Professionals are calculated together in source data.

Source: Author's elaboration on Inapp-ICP 2015; Istat, FDL, 2019; Unioncamere, Anpal 2021; Eurostat 2021

In this situation, we must bear in mind that difficulties in recruiting increase as the cognitive content of routine and non-routine tasks increases, except for clerical support workers and, partially, craft and related trade workers (Figure 2). Indeed, the three indicators show a positive correlation with the difficulty in recruiting that is the highest for RC (0.83), followed by NRCI (0.65) and NRCA (0.56).

If we compare the difficulty in recruiting with the share of 50-74 employed workers on the employed population 15-74, we can see how in all occupations – except elementary and clerical ones – it could be necessary to provide specific age management strategies to overcome possible skills and qualifications mismatches (Bertazzon 2019).

All this information in our opinion suggests that the contemporary phenomena of demographic and digital transitions could hamper the skill shift which seems even more crucial to favor the post-crisis recovery. The potential trade-off between

demographic and digitalization could prevent the labour market from taking advantage of both the replacement and the expansion demand that will be available. On the one hand, the younger/older turnover will presumably be slower and more difficult in some sectors and occupations, for which required skills can be acquired after a long time of training and job experience (Cicciomessere and De Blasio 2019). On the other hand, employers could often be reluctant to invest in the improvement of older workers' digital skills. This reluctance could be firstly connected to the perceived disproportion between older workers wages and their (supposed) lower productivity (Fleischmann *et al.* 2015); an attitude that is even stronger in case of an increase in the mandatory retirement age (seniority principle). Employers could also be less inclined to invest in silver employees due to the shorter period available to obtain a significant return on investment before their retirement (*ibidem*).

3. The digitalization after the pandemic

The pandemic triggered an acceleration in the process of digital transformation of work speeding up the adoption of tele-work in several jobs, including mid and low skilled occupations which previously reported a lower level of digitalization, and compensating in some way, previous differences among EU countries (Sostero *et al.* 2020). During the pandemic, it was estimated (Boeri *et al.* 2020) that almost 24% of Italian jobs could currently be performed remotely, with a marked incidence in the services sector and among professional occupations. By contrast, only 14% of manufacturing jobs and 7% of construction jobs were estimated as remotizable (*ibidem*). Similarly, Cetrulo, Guarascio and Virgillito, elaborating on the same Inapp Sampling Survey on Professions (2016 data), estimated that only 30% of Italian employees could currently work from home (Cetrulo *et al.* 2020). Among different occupations, workers with a higher median monthly wage, permanent contracts and a higher position in the ISCO classification appeared more likely to have the opportunity and the means to work from home (*ibidem*).

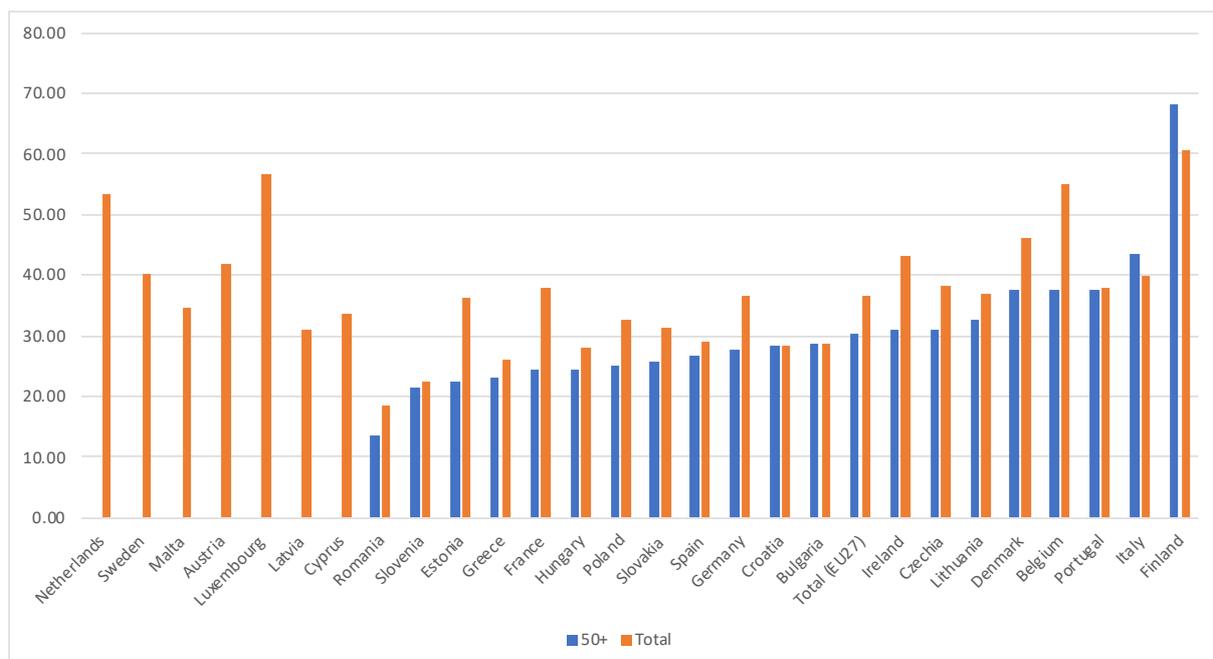
Other estimations also positioned Italy at a

lower level of remote workability compared to other advanced economies (Brussevich *et al.* 2020). According to these estimations, while 60+ workers generally appear slightly more likely to be in jobs with a high tele-workability score, even in cases of lower educational attainment compared to the under 30 age group – supposedly due also to some career seniority effect – Italy shows a similar score for both age groups. A low educational attainment is paired in Italy as in Spain, Ecuador, or Mexico to the lowest tele-workability scores, while a higher risk found for young employees probably reflects their higher share in the services sectors which were most hit by the current crisis (*ibidem*).

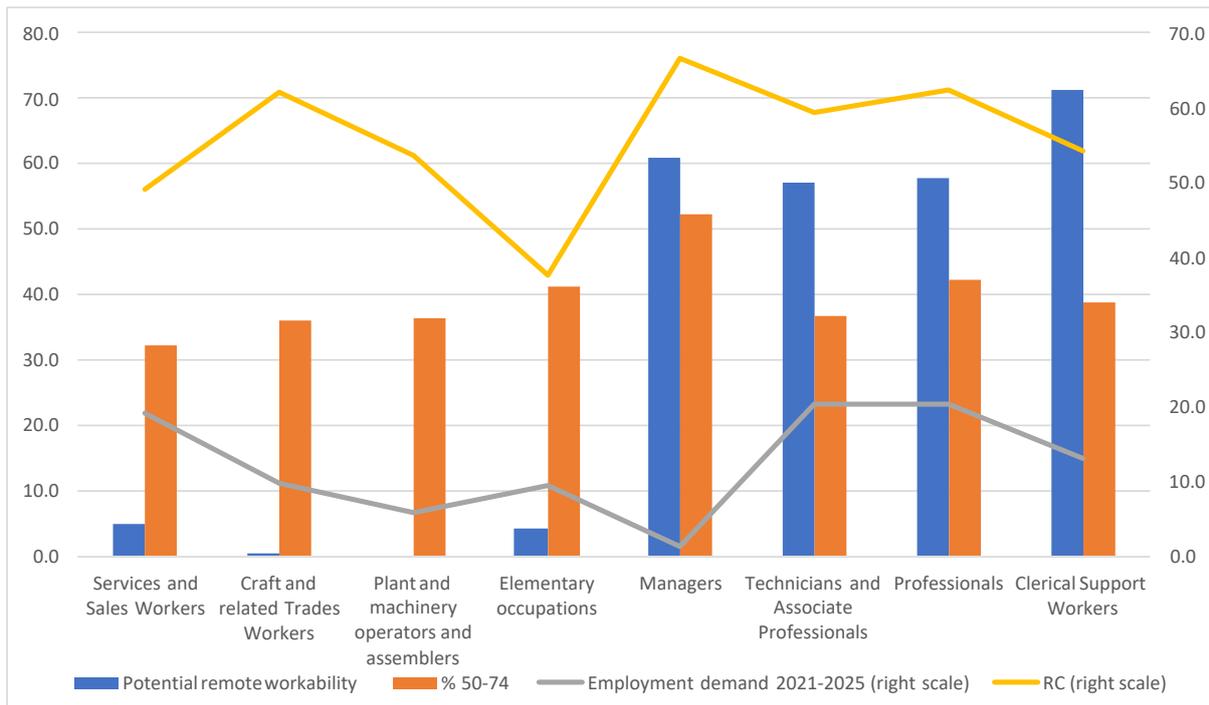
Despite this, Eurofound data (Eurofound 2020) show that Italy had in the first half of 2020 the highest share of 50+, after Finland, who started to work from home because of the situation caused by the pandemic (Chart 4). Excluding countries for which data are not available, Italy appears with Finland as the only country in which the share of 50+ is well above the national average. As concerns this latter, Italy falls instead to the ninth position.

In Chart 5 we compare the remote workability index based on the Inapp Sample survey on

Chart 4. Share of people who started to work from home as a result of the situation caused by the pandemic, total and 50+ (%)



Source: Author's elaboration on Eurofound (2020), Living, working and COVID-19 dataset, Dublin, <http://eurofound.link/covid19data>

Chart 5. RC 2015, potential remote workability and 50-74 share by occupations (RTI 0-100; % of tasks with potential remote workability; % of 50-74 workers)

Source: Author's elaboration on Inapp-ICP 2015; Unioncamere, Anpal 2021; Istat FDL 2019; Cetrulo et al. 2020; Eurostat 2021

occupations (Cetrulo *et al.* 2020), the employment demand 2021-2025 and the share of 50-74 employed persons in 2020 by occupations. We observe that the profiles which represent more than 55% of the estimated employment demand are also those showing the highest level of potential remote workability. This situation is however coupled, as we previously highlighted, with a high RC index.

The relevant share of repetitive and standardized cognitive tasks that according to RC scores characterize Italian occupations would therefore expose both workers in 'high' or 'low' level occupations to an automation risk. Due to different remote workability options, this automation could both be 'on site', for example by means of the implementation of artificial intelligence solutions, or it could occur by means of a 'digital offshoring' or 'tele migration' towards nations with a lower cost of human capital (Fonseca *et al.* 2018). In this regard, some scholars contend that the pandemic could represent an accelerator of tele migration at the global level (Baldwin and Forslid 2020).

Indeed, estimations that merge automation potential and the transmission risk of Covid-19 placed Italy high in the ranking, in the eighth position

after Japan, Spain, The Netherlands, Korea, Turkey, Greece, and Slovak Republic (Chernoff and Warman 2020). Italian female workers generally appeared more at risk than male ones, while in the age group 50-65 men were more at risk than women. Across the 25 countries examined, women with lower wages and educational attainment showed a higher risk of both Covid-19 transmission and automation. Italy could thus be among the countries in which employers could likely react to the pandemic by boosting automation and/or tele migration, in order to counter its productivity consequences and to safeguard the production process against future contagion risks (*ibidem*).

The significant share of 50-74 workers in all occupations suggests that age and skills management would play a relevant role also in this regard, considering the pervasive technological and organizational innovations that remote workability could entail. Finally, possible difficulties in skills recruiting for occupations with a high NRC (namely the same group of high skilled and highly remotizable occupations) could also in that case push employers to seek alternative solutions, which include offshoring decisions, in the absence of renewed immigration policies.

4. The dimensions of employability which will play a key role in the digitalization process

Business digitization will unavoidably re-shape work tasks and organizational functions, adapting traditional skills and making new ones emerge (Magone and Mazali 2016; Fantoni *et al.* 2017; Hecklau *et al.* 2016). However, this process will not be simple and straightforward, but it will call into question employability factors of various social groups involved, including younger, older workers and also women (Cirillo *et al.* 2021), on three levels (Guilbert *et al.* 2016): the micro-level, which addresses skills and characteristics of individual workers; the meso-level, concerning age management strategies implemented at the organizational level; the macro-level, involving public policies for employability. At each level different employability factors will come into play depending on whether technological strategies adopted by different players rely on internal resources or move towards outsourcing. At the same time, these options will have different implications within external or alternatively internal labour markets, as concerns employability of the older workforce or the other social groups (Table 1).

At the micro and meso levels, individual characteristics of workers will interface organizational objectives and strategies differently, depending on whether organizations will be able to transform production processes by means of 4.0 technologies on

their own, or will be forced to buy them on the market. Thanks to digital innovation, organizations will change their positioning along national and international value chains, thus implementing the transformation of production processes and redesigning tasks, roles, and functions accordingly. This innovation process will put into question workers characteristics differently, depending on how the digitization of business will take place. As pointed out by Acemoglu (Acemoglu 2021), in recent years automation may have contributed to a slow-down of economic growth due to the adoption of technological innovations which proved to be poorly complementary to human work. In this context, if not properly governed both at the political and technical level, digitization could increase its disrupting effects on the economy, contributing to further widen existing inequalities (*ibidem*). In the case in which organizations would be able to adopt 4.0 technologies, the employability of older workers could be challenged on the re-skilling/up-skilling side. On the external labour markets, social groups with low participation levels (e.g., women, NEET etc.) and long-term unemployed (notably older workers) may lack the digital skills/soft skills to meet job vacancies requirements.

In instances when organizations have to resort instead to buy 4.0 solutions on the market, there might be the risk of dismissal of less-skilled workforce and the unpreparedness of the same

Table 1. Employability at micro/meso level vs digitalization options

	Internal labour markets	External labour markets
Micro/Meso level	Adoption of 4.0 technologies within firms Workers' employability: Internal tasks and functions should be adapted accordingly Re-skilling and up-skilling by means of training	Recruitment strategies make-up for the need of skills not available in the internal labour market Workers' employability: Social groups with low participation level and long-term unemployed (notably older workers) may lack required digital skills/soft skills/STEM skills
	Organizations are not able to adopt 4.0 technologies Workers' employability: Lack of required skills can led to dismissal Only selected internal human resources govern outsourcing strategies of production	Outsourcing by means of: Remote workability Digital off-shoring Workers' employability: Social groups with low participation level and long-term unemployed (notably older workers) may lack required digital skills/soft skills/STEM skills unpreparedness to take advantage of the remote workability

Source: Author's elaboration

Table 2. Employability policies vs digitalization options

	Internal labour markets	External labour markets
Micro/Meso level	Make Support and incentives to the adoption of 4.0 technologies Support the identification of re-skilling/up-skilling needs Support and incentives for re-skilling/up-skilling	Active labour market policies aimed at facilitating business digitalization Tailored active labour market policies (older workers, women, younger workers etc.)
	Buy Procurement strategies for the digitalization of the public sector Support and incentives for the procurement of 4.0 technologies on the market Support and incentives for the development of internal digital management and governance	Support to self-employment in the digital world Regulation of the Gig-economy Regulation aimed at limiting offshoring and tele-migration

Source: Author's elaboration

social groups to take advantage of the opportunities offered by the remote workability of several jobs. This latter risk would be even exacerbated by the still uncertain regulatory framework which characterizes the Gig-economy in Europe, which worsens the quality of working life of workers and undermines job protection and employment protection rights (De Minicis *et al.* 2018; De Stefano 2017; Guarascio and Sacchi 2017; European Commission 2019).

In any case, attitude towards older workers will ever play a key role in determining whether employers would see age as a critical factor in the process of implementation of technological innovation, with the real risk of the occurrence of discrimination and ageism (Naegele *et al.* 2018; Ayalon 2019).

At macro-level (Table 2) each of the possible scenarios depicted in Table 1 calls on public policies to provide specific approaches and measures. Both on the internal and on the external labour markets, public policies must provide measures for the enhancement of the quality and employability of human capital and provide the regulatory framework within which employers, workers and their representatives will shape their respective strategies.

The role of public policies in facilitating the transition to the 4.0 paradigm has been systematized since 2016, in the context of the hearings organized by the Italian Parliament on the digitalization of the national industrial sector (Camera dei Deputati

2016). The final report clearly identified the labour market as one of the areas that would be strained by the digital transformation, and highlighted some of the issues currently under discussion, such as the lowering of demand for elementary occupations, the growth of the vacancies for high qualified ones, the need for the re-skilling of several jobs and the risks coming from the large-scale adoption of the technological solutions of the gig economy. Weaknesses directly connected to the human capital were prevalent in Italy due to the high number of small and micro enterprises and their limited capacity to manage the opportunities offered by digital technologies; employers' unwillingness to hire high qualified workers and the insufficient number of graduates in STEM curricula (*ibidem*).

To avoid the dispersion of resources and innovative capacities on the labour market and a further industrial decline and job losses, the report was calling for a national strategy aimed at creating national enabling infrastructures, a specific digital skills strategy, the enhancement of research and an open innovation approach to support made in Italy products by means of IOT technologies. Finally, the document built a conceptual link between digitalization and ageing, recalling the potential for convergence between Industry 4.0 and the silver economy, namely the economic activities useful for satisfying the needs of the older population, and the economic opportunities deriving from public spending and consumption linked to ageing (*ibidem*).

Following the implementation of the national plan *Piano nazionale Industria 4.0*, subsequently renamed *Piano nazionale Impresa 4.0*, in the period 2017-2020, the Italian Recovery Plan (PNRR) identified the conditions and characteristics of human capital as one of the structural problems at the origin of the national low economic growth during the first twenty years of this century, most of which have been clearly exacerbated by the effects of the pandemic (Governo italiano 2021). In line with this analysis, labour market and education and skills policies were inserted among the sectoral reforms which may represent key factors in support of the technological and infrastructural transformation envisaged by the other missions of the Plan. Despite this relevance, some scholars contend that this part of the Plan remains vague and probably constrained in its outlines by the division of responsibilities between State and Regions that shape active labour market policies (Corti and Ferrer 2021). The Plan also does not address central problems such as the low work intensity, the low wages, the large number of working poor or the large share of irregular work that characterize the Italian labour market (*ibidem*), all of which can hamper an inclusive and sustainable digital transition.

In the Plan, consideration is given to the ageing process, which is re-shaping the structure of the Italian population, but older people are considered only in relation to the interventions in support of non-autonomous persons, as part of the social cohesion mission (Mission 5). Both among the interventions in support of the business digitization and those concerning the strengthening of active labour market policies, no mention is made about the fact that – even in the hopeful case of further growth of the employment demand – younger and older cohorts of workers will have to coexist and collaborate within private and public organizations until baby boomers will reach their retirement age.

The failure to consider the intergenerational relationships within the labour force is coupled with an apparent ‘technological neutrality’, which recall the conclusions of the parliamentary discussion and the formulation of the first Plan 4.0, namely developing horizontal interventions, boosting enabling factors to facilitate technological shift and productivity, but without imposing mandatory

strategies and solutions to stakeholders, employers and trade unions.

Recalling our discussion, adopting technological neutrality probably means missing a critical perspective about the development of digital skills, as an alternative to a merely functionalist one (Collins 1971; Yang 2018). In this regard, as stated by Acemoglu (Acemoglu 2021), the dimensions of the automation risk which we examined in the previous paragraphs represent some of the most important milestones that should be taken into account to determine the type of technological innovation that should be supported by public policies.

Conclusions

The Covid-19 pandemic hit an Italian labour market characterized by structural underutilization of skills and human resources and still dependent on older age cohorts to maintain participation levels. Similarly, to other advanced countries, maintaining and raising productivity levels in the Italian economy and the recovery after the current crisis would call for an increased participation of underrepresented social groups – namely women and younger people – the contribution of high skilled immigrant workers, and the digitization of business and society.

In this situation, the digital employability of the workforce in general and older workers, in particular, appears critical under various points of view. On the one hand, despite a promising employment demand for both intermediate and high digital skills, the current phenomena of demographic and digital transition could hamper the skill shift necessary to favor the post-crisis recovery. The younger/older turn-over will presumably be slower and more difficult in some sectors and occupations, for which required skills can be acquired after a long time of training and job experience, while employers could be reluctant to invest in the improvement of older workers’ skills.

On the other hand, in the uncertain situation determined by the persistence of the pandemic (European Commission 2021), Italy could be among the countries in which employers could react to the pandemic by boosting automation to fight against its negative productivity consequences and to safeguard the production process against infection. The comparison between the RTI index and the

remote workability index, suggests that the relevant share of repetitive and standardized cognitive tasks that characterize all Italian occupations would expose both workers in 'high' or 'low' level occupations to an automation risk, both 'on-site' or by means of tele-migration.

Italian public policies in general and the Italian Recovery Plan in particular apparently do not take into consideration that, during the digital transition, younger and older cohorts of workers will have to coexist and collaborate, until complete retirement of baby boomers. Even the apparent 'technological neutrality' of the Plan, in relation to business digitization, could lead to neglect the consequences of the decisions about the typology of technological innovation to be supported, on the employability of the different social groups, taking into account the automation risks that our analysis has outlined.

The accurate and exhaustive identification of Italian structural labour market problems, exacerbated by the pandemic, will necessarily have to be coupled with a careful short and medium-term strategy addressing the demographic transition, also by means of immigration policies that cannot be postponed any longer. This strategy should prevent the potential trade-off between the speed that digital technology can further bring to the transformation of the economy and employability factors that education and active labour market policies should contribute to enhance.

Filling this gap will contribute to avoiding that in Italy the future depicted by the Fourth Industrial Revolution is not only a future told, tamed, and traded (Pfeiffer 2017) but also the collective realization of a more inclusive digital society for all ages.

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