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Retirement Decisions in the Age of COVID-19 pandemic: Are Older Employees in Digital Occupations Working Longer?

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Retirement Decisions in the Age of COVID-19 pandemic: Are Older Employees in Digital Occupations Working Longer?*

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Abstract

This paper investigates the retirement response to the pandemic and to the resulting acceleration in the adoption of new technologies. Using the European Union Statistics of Income and Living Conditions datasets and leveraging the natural experiment of many workers being forced to work from home in Europe during the lockdown, we compare the retirement response of older workers in digital occupations (i.e. more exposed to the accelerated adoption of new technologies) *versus* non-digital occupations to detect any differences in retirement behavior, which we interpret as digitalization effects. In addition, we analyze changes in retirement decisions by gender and geographic area. We find that retirement rates increased during COVID-19 in Europe, especially in Mediterranean countries and among women. This trend may be linked to gender occupational segregation. In Mediterranean countries, digitalization increases female retirement, likely due to challenges in balancing digital work and family responsibilities while working from home. In Eastern countries, and to a lesser extent in Northern countries, digitalization leads to postponing retirement among women, likely due to greater gender equality in unpaid work. In contrast, the retirement age for men is less affected by the pandemic with no significant differences between digital and non-digital occupations. This may exacerbate the existing gender gap in labor force participation and pension outcomes.

Keywords: Remote working; Early retirement; Working conditions; COVID-19; Digitalization.
JEL codes: J14; J24; J26.

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1. Introduction

The COVID-19 pandemic caused severe disruptions in workplaces, and many organizations shifted to remote working mode almost overnight. Specifically, during the first COVID-19 lockdowns, all jobs that were teleworkable were performed from workers' homes (Sostero et al., 2020). Building on this context, we investigate how the pandemic has affected the retirement age by comparing older workers' retirement behaviour before and during the first period of COVID-19 lockdowns. The sudden shift to remote work at the onset of the COVID-19 pandemic necessitated the adoption of new technologies, positioning COVID-19 as a significant driver of technological advancement (Amankwah-Amoah et al., 2021). This particularly affected digital occupations that are more likely to be teleworkable. By examining the distinct effects of the pandemic on digital versus non-digital occupations, we shed some light on the sudden digitalization effect on retirement decisions.

This shock provides an opportunity to learn how the labor supply of older workers responds to a pandemic crisis and sudden changes in new technologies. Understanding the retirement behaviour of individuals can help in designing effective policies to keep older workers in the workforce longer, thereby improving the sustainability of pension systems and ensuring adequate old-age benefits.

A priori it is not clear how the pandemic crisis could have affected individuals' retirement due to opposite forces playing together. On the one hand, older people may have retired earlier than planned due to job restrictions and deteriorating working conditions. Other factors include shifts in preferences favoring more leisure over work and fear of catching the virus while working, as observed in the Netherlands and Cyprus (Eurofound, 2022). On the other hand, some individuals may have delayed retirement, finding the prospect of increased leisure time less appealing during the pandemic, as seen in Finland (Eurofound, 2022).

In addition, the impact of the pandemic on labour market outcomes may differ by gender. According to Hupkau and Petrongolo (2020), ex-ante it is unclear if women are more severely affected than men as they are over-represented in sectors subject to lockdowns and social distancing measures, but also in sectors that have been defined as essential and in occupations that can be performed from home. They find that, in the

United Kingdom, both men and women experienced comparable labor market outcomes in terms of job loss or furloughing, although on average, women incurred slightly smaller reductions in working hours and earnings. In contrast, Brugiavini et al. (2022) using SHARE COVID-19 Survey data for European countries find that women aged 50 and over have experienced more and longer job interruptions.

COVID-19 is seen as the "great accelerator" of adopting new technologies and digital platforms, which in turn facilitate remote working (Amankwah-Amoah et al., 2021). According to Hodder (2020), the digitalization of work potentially enhances flexibility for both employers and employees, while reducing time and energy lost in long commutes. Furthermore, it has raised concerns about trust, new forms of worker electronic surveillance, and the intrusion into leisure time. Employees and employers face challenges in transitioning to digital technology that are underexplored in the literature.

In this paper, we explore the labor supply response of older workers transitioning to digital technology during the first stage of the pandemic by comparing the impact of COVID-19 on retirement transitions of those in digital versus non-digital occupations. The sudden technological shift may induce older workers struggling with digitalization to choose retirement, or it may encourage those desiring more flexibility or less commuting to work longer.

Women and men may have responded differently to the accelerated adoption of digitalization, driven by the shift to working from home (WFH), in their transition from work to retirement. According to Eurofound (2022), older women faced heightened challenges in work-life balance problems. This might be due to work negatively impacting home life and to the unequal intra-household division of tasks. Kohlrausch and Zucco (2020) find that traditional role models re-emerged among German employees during the pandemic. During the pandemic (especially its initial stage), older individuals, particularly women, often took care of their grandchildren, children, or other relatives such as parents or spouses. Bergmann and Wagner (2021) find that the frequency of providing personal care to parents by people age 50+ increased in almost all European countries.

Using survey data from European Union Statistics on Income and Living Conditions (EU-SILC), we study the change in the retirement hazard of paid older workers employed in February 2019 and February 2020 over the following three months, distinguishing between digital and non-digital occupations. We also show heterogeneous effects by gender and geographic area.

We estimate a country fixed effects Probit model through a difference-in-differences approach. Country fixed effects will capture the variations in policy responses to the pandemic, the substantial differences in pre-pandemic levels of digitalization and remote work prevalence, as well as the distinct characteristics of welfare systems and labor market institutions.

We find that older workers retired significantly more often during the COVID-19 outbreak than in the same period in the previous year. This result is mainly driven by the retirement behaviour of women in Mediterranean and Eastern European countries. Digitalization increases female retirement in Mediterranean countries and leads to delayed retirement among women in Eastern European countries, and to a lesser extent in Northern countries. Men's retirement, however, was relatively unaffected by COVID-19 or the digital transition. As there are numerous demand-side and supply-side factors influencing retirement decisions that we cannot disentangle due to data limitations, we propose potential mechanisms to explain these findings.

The remainder of the paper is organized as follows. Section 2 summarizes the literature review. Section 3 describes the data and provides some descriptive statistics. In Section 4 we present our identification strategy and the econometric models. Section 5 discusses the main results. In Section 6 we carry out the sensitivity analysis and Section 7 concludes.

2. Literature review

With this study, we contribute to the literature on the impact of recessions, particularly the COVID-19 crisis, on older workers' exits from employment. Goda et al. (2023) highlight the unique characteristics of the COVID-19 recession compared with previous ones: *"The profound risk of in-person work, the dramatic increase in the availability of telework, caregiving needs from school closures, and the immediate and sustained financial response providing stimulus payments and expanded unemployment benefits."* Goda et al. (2023) and Forsythe et al. (2022) find that older workers' employment dropped substantially more than expected prior to the pandemic in the

U.S. Davis et al. (2023) take this analysis further, showing that although the pandemic caused many workers to leave the labor force, there was no immediate increase in retirement among full-time workers under 70 in the U.S.

By studying the effects of digitalization on retirement during the pandemic, we contribute to the literature on the impact of working conditions on individual retirement decisions. Elderly workers in unpleasant jobs are more likely than those in attractive occupations to trade income from continued work for increased leisure (Blekesaune and Solem, 2005). Dal Bianco et al. (2015) found that work quality (measured in various ways) plays a significant role in transitions from employment to full retirement. Previous studies provide evidence that physically demanding work increases the risk of early retirement (Henkens and Tazelaar, 1994; Filer and Petri, 1988; Hayward and Grady, 1986; Hayward et al., 1998; Quinn, 1978). Similarly, repetitive and monotonous jobs (Henkens and Tazelaar, 1994; Filer and Petri, 1988; Quinn, 1978; Solem and Mykletun, 1997) and low-autonomy jobs (Blekesaune and Solem, 2005; Quinn, 1978) are associated with early retirement.

The sudden adoption of new technologies requires workers to learn digital tools and adapt to changes. There is no consensus in the literature on the flexibility, willingness to learn new skills, and adaptability of older workers. Some studies (Adler, 1988; Ivanov et al., 2020) suggest that older workers are less likely to acquire new skills, less flexible, and less willing to invest time in retooling themselves for the workplace. In contrast, other studies (McNaught and Barth, 1992; Sterns and Miklos, 1995) indicate that older workers are as flexible, trainable, and cost-effective as younger employees. More recently, Wong and Tetrick (2017) highlight that, despite stereotypes, older workers may choose to learn how to navigate new computer systems based on their interest in technology.

However, the advancement of new technologies, particularly automation, appears to drive early retirement. This is particularly evident in Europe, especially among workers without higher education and women (Casas and Román, 2023). Solem et al. (2024) find that experiencing digital difficulties at work correlates with a preference for early retirement in Norway. Additionally, older workers facing new process technologies exhibit a higher likelihood of transitioning to retirement (Hægeland et al., 2007).

The digitalization process during the pandemic was accompanied by a significant shift in workplace arrangements due to the widespread transition to WFH. Little is known about the relationship between WFH and retirement, likely because WFH was not prevalent before the COVID-19 crisis. However, there is a growing body of literature on the relationship between teleworking and productivity. This research documents a positive association between teleworking and productivity (Deole et al., 2023; Tavares et al., 2021; Bloom et al., 2015), suggesting that teleworkers may be less vulnerable to unemployment. Bonacini et al. (2021) find that the expansion of teleworkable occupations benefits workers aged 51 or older in terms of wage opportunities.

WFH offers benefits such as saving commuting time and avoiding commuting stress. However, women, who tend to work in jobs with shorter commutes than men (Le Barbanchon et al., 2021), may experience fewer benefits from avoiding commuting. According to Bäckström et al. (2016), commuting can delay retirement due to the increased value of employment (e.g., higher earnings and greater incentives to remain employed). Conversely, commuting may lead to early retirement due to the disutility associated with commuting or the income effects that increase the demand for leisure. Bäckström et al. (2016) found that earlier retirement was associated with long-distance commuting among men, particularly those with higher education. In contrast, highly educated women with long commutes tend to remain in the labor force longer. Similarly, Chapela (2012), using U.S. data from 1976–1987, finds that commuters traveling more than five minutes to the workplace retire approximately two years earlier.

Changes in work arrangements forced by WFH during the COVID-19 pandemic are also relevant to understanding the timing of retirement. Pelly et al. (2021), using UK data, provide evidence that homeworkers felt more engaged and autonomous during the pandemic. This has been shown to increase job satisfaction (Bloom and van Reenen, 2011) and reduce early retirement (Blekesaune and Solem, 2005). However, WFH entails changes in the working environment, such as reduced access to supervisor support and teamwork, less in-person social interaction, and greater reliance on digital tools for communication.

During the lockdown, the absence of external support at home and the forced closure of schools led to in time spent on housework and family care,[1] significantly affecting work-family balance (Bonacini et al., 2024). This impact was particularly pronounced among employed women in certain countries, such as the U.S. (Alon et al., 2020; Zamarro and Prados, 2021), the UK (Sevilla and Smith, 2020), and Italy (Del Boca et al., 2020).

3. Data and descriptive statistics

3.1. Dataset

To study the effect of the pandemic and the associated impact of the abrupt shift to new technologies (e.g., WFH) on the probability of early retirement during the initial stages of the pandemic, we use the European Union Statistics on Income and Living Conditions (EU-SILC) survey dataset in its cross-sectional version for the years 2020 and 2021 (with incomes and occupational status referring to the preceding year). This dataset is rich and representative, enabling the analysis of heterogeneity across European countries through perfectly comparable information on employment, social, and living conditions.

The EU-SILC dataset includes data from the 27 EU Member States and 5 EU Associate Members (Iceland, Norway, Serbia, Switzerland, and the UK). However, we excluded countries for which model estimation was not feasible for various reasons. Specifically, we excluded Iceland, Norway, Slovakia, and the UK due to their absence in the 2021 EU-SILC dataset; Malta because age information is available only in aggregated terms; and Serbia because its exceptionally low statutory pension age for women results in no observed cases of retirement among working women in the 2021 sample. Our final sample comprises 26 European countries and is representative of their total populations, as we apply the sample weights provided by Eurostat to all descriptive statistics and estimations.

[1] It is worth noting that older workers are rarely affected by the presence of dependent children at home, a factor identified as a significant determinant primarily for women's labor supply.

Additionally, leveraging the availability of 2-digit ISCO information, we categorize occupations as digital or non-digital. Occupations are classified as "digital" if their digital use index exceeds 50, following common practices in the relevant literature.[2] According to Cirillo et al. (2021), the digital use index (ranging from 0 to 100) was constructed for each occupation at the 4-digit level. This index is based on responses from the Survey on Italian Occupations (*Indagine Campionaria sulle Professioni*, ICP, 2012), which included questions assessing the importance of computer use and the frequency of email usage as part of the job.

To explore differences in retirement decisions between digital and non-digital workers, we assume that individuals in digital occupations have a significantly higher probability of WFH compared to those in non-digital occupations.

In this study, we identify two labor market states: employment and retirement. Both economic statuses are self-reported by EU-SILC respondents for each month of the year preceding the interview.[3] Other exits, such as unemployment, disability, and other inactive status are treated as right censored. Retirement is considered an absorbing state.

3.2. Sample

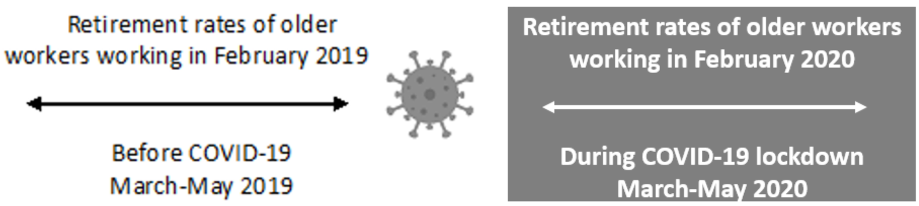
For our analysis, consistent with the existing literature on the topic (Blekesaune and Solem, 2005), we focus on workers born between 1952 and 1960 who were employed in paid jobs as employees in February 2019 and February 2020.[4] We observe their employment status over a three-month period, comparing transitions into retirement during March to May of 2019 and 2020, as illustrated in Figure 1.

[2] As a sensitivity test, we replicated the main analysis using the sample mean (53.3) as a threshold instead of the canonical value of 50. The results of this test, available upon request from the authors, generally confirm the robustness of the findings presented in Section 5.

[3] For additional robustness, we also adopted a broader definition of retirement, including transitions from employment to unemployment. As with retirement, the unemployment occupational status is self-reported by individuals during the interview.

[4] It is worth noting that the EU-SILC dataset provides information on the year of birth but not the month of birth starting from the 2021 wave. Consequently, we calculate age as the simple difference between the income reference year and the year of birth.

Figure 1. Timeline of the sample selection



Source: Own elaboration.

We chose to focus our analysis on dependent employees because self-employed workers often fall under specific pension regulations, which could potentially influence the estimated results (Nagore et al., 2021). Additionally, we excluded observations with missing ISCO information, given the critical role of this variable in our analysis.

It is important to note that retirement decisions among paid workers are the result of an employer-employee agreement and are influenced by both supply- and demand-side factors. Unfortunately, our data do not allow us to distinguish between these factors, although we provide speculative insights based on prior evidence and other datasets.

3.3. Descriptive statistics

We compare the characteristics of older workers employed in February 2019 and February 2020. Table 1 presents the descriptive statistics for all workers in the two groups (February 2019 and February 2020), as well as by gender. Across the groups, there are significant differences in age (by construction)[5] and household incomes at the 1% level, except for women, where the difference in household income is significant at the 10% level. Additionally, differences are observed in the category "household with more than three members and an employed partner," which is significant at the 10% level for men and women (and at the 5% level for all workers combined). Men and women also show marginal differences in occupation types: men in mid-skilled

[5] We obtain similar results for the main analysis when restricting the two samples (before and during COVID-19) to the same age brackets (eliminating sample differences by age) rather than the same cohorts. The corresponding estimation results are available upon request.

occupations at the 5% significance level and women in low-skilled occupations at the 10% significance level. For all workers, slight differences are noted at the 5% level in low-skilled occupations and university degree attainment.[6]

Table 1. Descriptive statistics of all older workers working in February 2019 and February 2020 and by gender

Variable	All			Men			Women		
	February 2019	February 2020	Mean difference	February 2019	February 2020	Mean difference	February 2019	February 2020	Mean difference
Women	0.475	0.467	-0.008						
Aged 59-60	0.417	0.241	-0.176***	0.398	0.232	-0.166***	0.439	0.252	-0.187***
Aged 61-62	0.300	0.376	0.076***	0.308	0.367	0.060***	0.292	0.386	0.094***
Aged 63-64	0.185	0.236	0.051***	0.195	0.244	0.049***	0.173	0.226	0.053***
Aged 65-68	0.098	0.147	0.049***	0.099	0.156	0.057***	0.096	0.136	0.040***
Lower secondary or less	0.207	0.196	-0.011	0.199	0.189	-0.01	0.216	0.204	-0.012
Upper secondary	0.438	0.433	-0.005	0.459	0.453	-0.006	0.414	0.410	-0.004
University degree	0.355	0.371	0.016**	0.342	0.358	0.016	0.370	0.386	0.016
High skill level	0.425	0.443	0.018**	0.416	0.433	0.017	0.436	0.455	0.018
Mid skill level	0.281	0.269	-0.012*	0.209	0.190	-0.019**	0.361	0.359	-0.002
Low skill level	0.294	0.288	-0.006	0.376	0.377	0.002	0.203	0.186	-0.017*
Digital occupation	0.570	0.575	0.005	0.526	0.528	0.002	0.619	0.629	0.010
Single person	0.216	0.223	0.006	0.170	0.170	-0.001	0.267	0.283	0.016
Two adults - Partner NE	0.167	0.176	0.009	0.159	0.167	0.008	0.175	0.187	0.012
Two adults - Partner Emp	0.259	0.265	0.006	0.276	0.288	0.013	0.241	0.239	-0.002
3+ members - Partner NE	0.098	0.094	-0.004	0.122	0.117	-0.005	0.071	0.067	-0.003
3+ members - Partner Emp	0.177	0.161	-0.016**	0.224	0.205	-0.019*	0.125	0.111	-0.015*
Other household type	0.083	0.081	-0.002	0.049	0.053	0.005	0.121	0.113	-0.008
Home ownership	0.761	0.758	-0.003	0.773	0.773	-0.001	0.747	0.741	-0.006
Log(Household income)	10.45	10.49	0.041***	10.48	10.531	0.048***	10.41	10.45	0.031*
Observations	20,306	20,499		10,412	10,544		9,894	9,955	

*Note: The number of observations for all the variables in the whole sample is 40,807. The number of observations for the male (female) sample is 20,957 (19,850). *** p<0.01, ** p<0.05, * p<0.10. See Table A1 for the definition of the explanatory variables. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Women make up 47% of our sample. The majority of individuals in the sample (67.3%) are between 59 and 62 years old, followed by 21% aged 63 or 64. A smaller group (12%) consists of individuals aged between 65 and 69.

We classify education into three levels—low, mid, and high—based on the self-reported highest level attained. The largest group has completed upper secondary education (44%), followed by those with a university degree (36%), and the smallest

[6] Descriptive statistics for different geographic areas are provided in Table A3 in the Appendix. As observed in Table 1, differences in age groups are significant at the 5% level across all three regions. Additionally, slight differences are noted in mid-skilled occupations within Mediterranean countries and in household types within Eastern European countries.

group comprises individuals with lower secondary education or less (20%). A similar distribution of education levels is observed among men and women in both 2019 and 2020.

Regarding the distribution by skill level,[7] most older workers are high-skilled (43%), with the proportion of mid-skilled and low-skilled workers being similar (around 28% each). There are notable gender differences in the distribution by skill level, except for low-skilled occupations. The share of women in mid-skilled jobs is higher than that of men (36% versus 20%), while the opposite is true for low-skilled jobs. In our sample, 57% of workers are employed in digital occupations,[8] with a higher proportion of women (62%) in digital jobs compared to men (53%). This aligns with existing literature showing that women are more likely to work in jobs offering greater flexibility.

As a worker's partner's labor market status can influence retirement decisions, we differentiate households by partner employment status: couples with a working partner (27%), couples with a non-working partner (17%), and households with more than three members (27%), regardless of the partner's employment status. Single individuals make up about 22% of the sample, with a higher proportion of single women (27%) compared to single men (17%).

Given prior evidence suggesting that wealth affects retirement timing (Bloemen, 2011), we also control for homeownership. A majority of older workers in our sample own the house in which they live (76%).

Occupation type (digital vs. non-digital) is a key variable in our study. Table A6 in the appendix shows the determinants of performing a digital occupation across all countries and by geographic area. For all countries, the factors that increase the likelihood of performing a digital occupation include: being a woman, being a younger older worker, having a university degree, working in a high-skilled occupation, and owning a home.

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[7] High-skill occupations include managers, professionals, and technicians/associate professionals. Mid-skill occupations consist of clerical support workers, service and sales workers, and skilled agricultural, forestry, and fishery workers. Low-skill occupations encompass craft-related trades workers, plant and machine operators/assemblers, and elementary occupations.

[8] The largest proportion of workers in digital occupations are teaching professionals, whereas the majority of workers in non-digital occupations are cleaners and helpers. According to Solem et al. (2024), during periods of complete school closures, teachers were required to significantly increase their use of digital tools and adopt new methods for teaching and communicating with students.

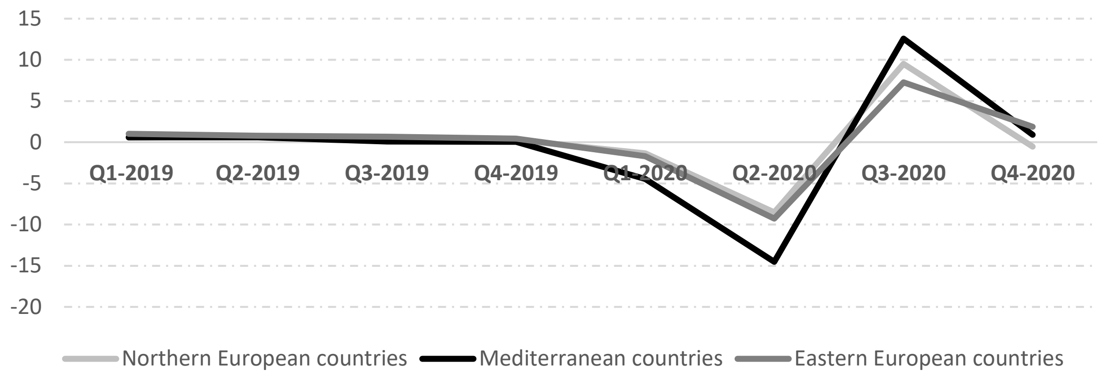
Our analysis covers the entire sample of European countries and is also conducted by geographic area. The heterogeneity in characteristics across countries, including factors such as the level of digitalization, the prevalence of WFH prior to the COVID-19 pandemic, government responses to the pandemic, welfare systems (e.g., the Scandinavian model in Nordic countries and the family-based model in Mediterranean countries), social norms, and working culture, justifies conducting separate analyses for each country. However, due to small sample sizes, we instead perform the analysis by geographic area.

We distinguish three geographic areas: Northern European countries (e.g., Denmark, Finland, France, Luxembourg, the Netherlands, Switzerland), Mediterranean countries (e.g., Cyprus, Greece, Spain, Italy, Portugal), and Eastern European countries (e.g., Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia). Table A2 in the Appendix shows the statutory pension ages by gender for all European countries considered in this analysis. Table A3 displays the distribution of countries by area, along with the number of observations per country, while Table A4 presents descriptive statistics by area.

Since the economic context and labor market conditions influence retirement decisions, we also present differences in Gross Domestic Product (GDP) growth and unemployment rates by geographic area for the period Q1-2019 to Q4-2020 in Figures 2 and 3, respectively.

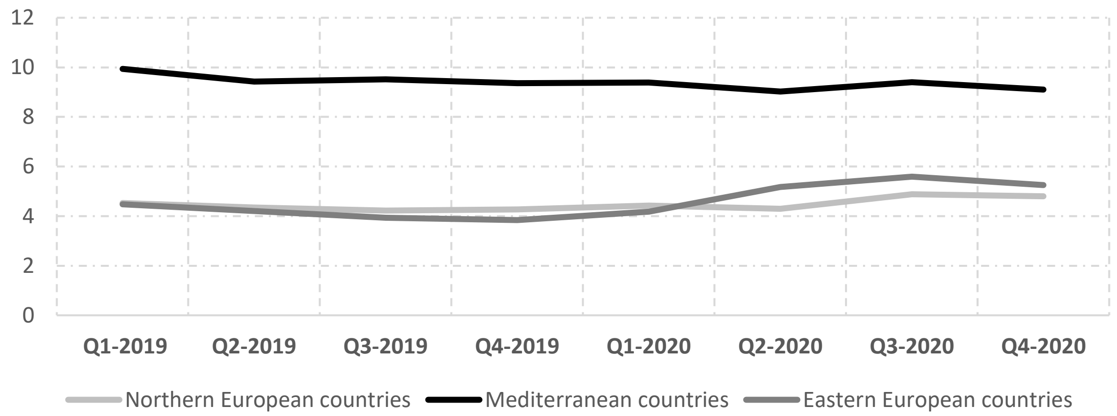
The average GDP slightly increased throughout 2019 in all geographic areas, with the strongest growth observed in Eastern European countries, followed by Northern European countries. However, with the onset of the pandemic, GDP experienced a sharp decline in the first and second quarters of 2020. The largest decline occurred in Mediterranean countries during Q2 2020, with a 14.5% decrease, followed by Eastern Europe with a 9.2% decrease and Northern Europe with an 8.52% decline.

Figure 2. Average quarterly GDP growth (previous period) by geographic area. Q1 2019 – Q4 2020. Percentage



Source: OECD (2024), Quarterly GDP (indicator). doi: 10.1787/b86d1fc8-en.

Figure 3. Average quarterly unemployment rate for all persons aged 55-64 by geographic area. Q1 2019 – Q4 2020. Percentage



Source: OECD (2024). Database: short term labour market statistics.

Despite the pronounced economic downturn caused by the sudden lockdown, the unemployment rate of individuals aged 55 to 64, shown in Figure 3, does not follow this trend. This discrepancy may stem from the number of employees leaving the labor force (e.g., through early retirement) and the number of employees who were not working but retained their employment status. Thus, the impact of COVID-19 on employment was limited, thanks to government programs designed to support employers and employees during the pandemic, such as job retention schemes and the extension of unemployment benefits.

Looking at Figure 3, unemployment rates remained relatively stable over the period from 2019 to 2020, with variations across geographic areas. In the first quarter of 2019, Mediterranean countries had the highest average unemployment rates (10%), followed by Northern European countries (4.5%) and Eastern European countries (4.4%). The unemployment rate increased slightly from the first quarter of 2020, with a more pronounced rise in Eastern European countries, where the unemployment rate reached 5.6% in Q3 2020.

The impact of the forced digitalization and WFH during COVID-19 on retirement decisions depends on the baseline level of WFH.[9] Table 2 presents the proportion of employees aged 55 to 74[10] who usually worked from home by gender and geographic area, for 2019 and 2020, along with the corresponding rate of change. This shows a substantial increase in the incidence of WFH and flexible work arrangements following the onset of COVID-19. Northern European countries had the highest prevalence of WFH, with the rate rising from 6.9% in 2019 to 15.6% in 2020. Mediterranean countries saw an increase from 3.4% in 2019 to 9.8% in 2020, while Eastern European countries reported a rise from 2% in 2019 to 4% in 2020. When comparing WFH rates by gender, women exhibited the highest share of WFH across all areas. However, the increase in WFH rates in 2020 was more pronounced for men than for women in all areas, except for Eastern Europe.

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[9] Unfortunately, our dataset does not provide individual-level data on WFH before COVID-19. However, since the share of employees who typically worked from home before the pandemic was small across all geographic areas, we do not expect this limitation to significantly affect our results.

[10] Note that the age band for the share of employees working from home, as reported in Eurostat statistics (55-74), is slightly different from the age band used in our main analysis (59-68).

Table 2. Share of employees between 55 and 74 years old usually working from home by gender and geographic area. 2019 and 2020. Percentage

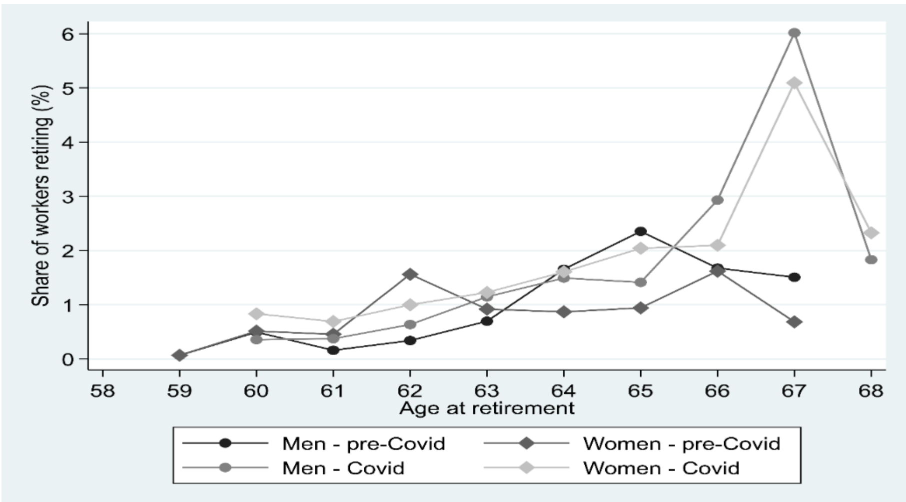
Geographic area	Men and Women			Men			Women			Gender ratio change	
	2019	2020	Rate of change	2019	2020	Rate of change	2019	2020	Rate of change	2019	2020
Northern European countries	6.91	15.56	125.12	6.39	15.12	136.65	7.47	16	114.19	14.5	5.5
Mediterranean countries	3.38	9.86	192.15	2.73	8.64	217.06	4.15	11.20	169.88	34.3	22.9
Eastern European countries	2.08	4.01	93.31	1.98	3.16	59.86	3.16	5.34	69.28	37.4	40.9

Source: Eurostat.

3.4. Exits from work into retirement

Figure 4 shows the average exit rates from work into retirement for older workers during the pre-pandemic period (March-May 2019) and the COVID-19 period (March-May 2020), broken down by age (59 to 68 years old) and gender. As expected, retirement rates generally increase with age, reaching their peak at 65 (66) years old for pre-pandemic men (women) and at 67 years old for both men and women during the COVID-19 period.

Figure 4. Average monthly exit rates from work into retirement before and during COVID-19 by age and gender



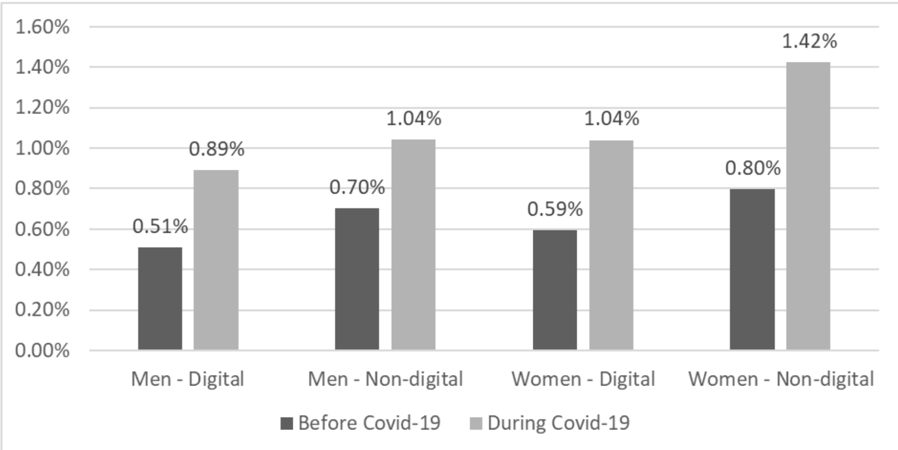
Note: The share of workers retiring at age 60 is calculated as the number of older workers retiring at age 60 divided by those of that age who have not retired yet, during the periods of March to May 2019 (pre-Covid) and March to May 2020 (Covid). Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

Retirement rates tend to be higher during the COVID-19 period compared to the pre-pandemic period, with exceptions for women at age 62 and men at age 65. The differences are statistically significant (at the 10% level) at ages 64, 65, and 67 for women, and at age 67 for men.

The highest retirement rate during the COVID-19 period is observed at age 67, with rates of 6% for men and 5.1% for women. This age also shows the largest increase in retirement rates compared to the pre-COVID-19 period. In contrast, at age 65, retirement rates decreased for men but increased for women during the COVID-19 period.

Figure 5 shows the monthly retirement hazard rates from March to May 2019 (2020) of older workers working in February 2019 (2020) by gender and digitization of the occupation.[11] Retirement rates are higher during COVID-19 in all groups, though the increase, in relative terms, is larger for women in both non-digital and digital occupations, followed by men in digital occupations. Notably, the average retirement rate per month for the whole sample is 0.63% before and 1.07% during COVID-19.

Figure 5. Exit rates from work into retirement before and during COVID by gender and digital occupation



Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

[11] Table A5 in the Appendix shows the monthly retirement rates by gender, occupation digitization, and geographic area. In all three areas, retirement rates increase for all groups, except for women in digital occupations in Eastern countries. The highest increase in retirement rates is observed among women in non-digital occupations in Mediterranean countries, followed by men in non-digital occupations in Eastern countries.

4. Methodology

To estimate the effect of the pandemic on the probability of early retirement during its initial stages, we compare the retirement transitions of older workers before (March–May 2019) and during the COVID-19 lockdown (March–May 2020) for employees working in paid jobs in February 2019 and 2020, respectively. We assume that the pandemic group would have exhibited similar behavior to the pre-pandemic group if COVID-19 had not occurred. This assumption appears reasonable, as no other factors are evident that could have caused abrupt changes in retirement behavior within the short time frame considered, apart from the gradual increase in statutory retirement ages in some countries (e.g., Spain, the Netherlands).

To examine how the rapid adoption of new technologies during the pandemic influenced retirement timing, we employ a standard difference-in-differences (DD) framework. This method compares workers in digital occupations (i.e., those more exposed to WFH during the lockdown) with workers in non-digital occupations (i.e., those minimally affected by technological changes). The identification assumption is that the pandemic's general effects (e.g., uncertainty, fear of the virus) are consistent across both groups, while the accelerated adoption of new technologies disproportionately impacts digital occupations.[12]

We model transitions from work to retirement using a discrete choice (Probit) model:

$$P\left(Y_{it} = 1 \middle| X_{it}, Y_{i,t-1} = 0\right) = \Phi(Z), \tag{1}$$

where $Y_{it} = 1$ if individual *i* is retired at month *t* and $Y_{it} = 0$ if the individual is still working. The model incorporates country and monthly fixed effects, with standard errors clustered at the individual level. Estimation is conducted using maximum likelihood. Given the non-linear nature of the model, we compute the Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement to quantify the pandemic's effect on retirement. To assess the impact of digitalization, we calculate the

[12] To ensure the validity of our identification strategy, we examine whether workers in non-digital occupations, who are less likely to WFH, are more responsive to health concerns during the COVID-19 pandemic compared to those in digital occupations. If exposure to the virus were significantly higher for those in non-digital occupations, this would compromise the validity of our approach. However, the analysis reveals no statistically significant relationship between subjective health status, digital occupation, and COVID-19 in any geographic area. Detailed estimations are available upon request.

difference in the AME of COVID-19 between workers in digital and non-digital occupations.

We estimate separate models to evaluate: (i) the general effect of the pandemic, and (ii) the influence of the sudden adoption of new technologies. Additionally, we analyze how both the pandemic and the accelerated adoption of new technologies affect the likelihood of early retirement, with particular attention to gender differences.

As outlined in Section 3, all models are estimated for the full sample of European countries and by geographic areas. As a robustness check,[13] we extend the definition of retirement to include transitions from work into either retirement or unemployment, as unemployment at older ages may serve as a pathway to retirement.

4.1. Estimating the effect of the pandemic on retirement

To evaluate the effect of the pandemic on retirement, we compare the retirement rates of older workers before (March-May 2019) and during COVID-19 (March-May 2020). We assume that the probability of transitioning from work into retirement for older workers is determined by:

$$Z_{it} = \gamma_0 \cdot T_{it} + P'_{it}\theta_{ind} + W'_{it}\vartheta_i \qquad (2)$$

where the key variable, COVID-19 dummy T_{it}, takes value 1 for the period March-May 2020 (and 0 for the pre-pandemic period), the vector P'_{it} contains individual characteristics (i.e. gender, age group, education level, skill level, and digital occupation dummy), while the vector W'_{it} includes relevant household characteristics (i.e. homeownership, household composition, and household income). To avoid endogenous problems, W'_{it} only incorporates the initial values of well-being-related variables, such as homeownership, and a set of dummies combining household size and partner occupational status.[14] This specification is referred to as Model 1.

[13] Further details on this robustness check are provided in Section 6.

[14] We also tested the inclusion of the number of rooms available to the household in their residence. Since this variable proved statistically insignificant across all models, it was excluded from the primary analysis. Further details on this sensitivity test are available upon request.

As part of the sensitivity analysis, we attempted to include additional covariates in Model 1, such as urbanization degree (urban, intermediate, rural) and subjective health status (very good, good, fair, bad, or very bad). However, including these variables reduced the sample size by 12.9% and 13.3%, respectively. Despite this reduction, the results remained consistent with those presented in Section 5. Therefore, we opted to exclude these covariates from the main model specification to preserve the maximum sample size.[15]

To investigate how the effect of the pandemic on retirement decisions varies by gender among older workers, we extend the model described in equation (2) as follows:

$$Z_{it} = \gamma_0 \cdot T_{it} + \alpha_0 \cdot T_{it} \cdot female + P'_{it}\theta_{ind} + W'_{it}\vartheta_i \quad (3)$$

where we include an interaction term between the gender dummy $female$ and the COVID-19 dummy T_{it} to capture gender-specific effects of the pandemic. The dummy $female$ is already included in the vector P'_{it}. We label this model specification as Model 2 henceforth.

To test the reliability of the estimated COVID-19 effect on retirement behaviors, we perform a placebo test, replicating the analysis one year before the pandemic. Specifically, we estimate the retirement hazards for comparable groups of older workers, considering March-May 2018 as the pre-treatment period and March-May 2019 as the post-treatment period. Estimated marginal effects of COVID-19 on retirement by geographic area and gender are presented in Table B1 in Appendix B. The treatment effect is not significant in any of these estimations, indicating that our results are likely driven by the pandemic shock.

[15] The literature suggests that the economic sector of activity may influence the likelihood of remote work. For example, Eichhorst et al. (2020) note that telework is more prevalent in the information and communication sector and in financial and insurance activities, whereas it is less common in industries such as hospitality, construction, transport, and food services. Unfortunately, our dataset does not allow us to control for sectoral differences due to a high proportion of missing observations in this variable (approximately 19% of the total sample). Similarly, we are unable to identify jobs classified as essential during the pandemic.

4.2. Estimating the effect of sudden adoption of new technologies on retirement

To examine the impact of the sudden adoption of new technologies during COVID-19 on retirement decisions, we extend the model in equation (2) as follows:

$$Z_{it} = \gamma_0 \cdot T_{it} + \beta_0 \cdot D_{it} \cdot T_{it} + P'_{it}\theta_{ind} + W'_{it}\vartheta_i, \qquad (4)$$

where we add an interaction term between the COVID-19 dummy (post-event dummy) T_{it} and the digital occupation dummy D_{it} (treatment), representing the Difference-in-Differences (DD) term. The dummy D_{it} is already included in the vector P'_{it}. This specification is referred to as Model 3.

To investigate whether being in a digital occupation during the pandemic had differential effects on retirement decisions by gender, we extend the model further:

$$Z_{it} = \gamma_0 \cdot T_{it} + \alpha_0 \cdot T_{it} \cdot female + \beta_0 \cdot D_{it} \cdot T_{it} + \delta_0 \cdot female \cdot D_{it} + \varphi_0 \cdot female \cdot D_{it} \cdot T_{it} + P'_{it}\theta_{ind} + W'_{it}\vartheta_i, \qquad (5)$$

where the interaction term $T_{it} \cdot female$ captures characteristics of women during the pandemic, $D_{it} \cdot T_{it}$ captures the DD estimate of the treatment effect on male workers, $female \cdot D_{it}$ captures time-invariant characteristics of female workers in digital occupations, while the key coefficient φ_0 identifies the effect of the triple interaction term $female \cdot D_{it} \cdot T_{it}$ representing the difference between men and women in the treatment effect. To be noted, the dummy $female$ and the dummy D_{it} are already included in the vector P'_{it}. Thus, the DD estimate of the treatment effect on female workers is $\beta_0 + \varphi_0$. This specification is referred to as Model 4.

4.2.1. Parallel trend assumption

To validate the DD approach, we verify the parallel trends assumption. This assumption posits that, in the absence of the pandemic (and the associated acceleration of digitalization), retirement decisions for workers in digital and non-digital occupations would have followed similar trends over time.

Since the counterfactual scenario is unobservable, we assess whether the two groups displayed similar retirement trends before the pandemic. Using data from the EU-SILC cross-sectional datasets (2018–2022), we estimate average retirement rates for digital and non-digital occupations during March-May of 2017, 2018, 2019, 2020, and 2021. After applying the same sample restrictions as in the main analysis, we classify occupations as "digital" if their digital index exceeds 50.

Our graphical analysis, presented by geographic area in Figures B1-B3 (Appendix B), demonstrates strong evidence of parallel trends in retirement rates between digital and non-digital occupations prior to the pandemic. This supports the validity of the parallel trends assumption, ensuring causal inference. Therefore, any observed divergence in retirement decisions after the pandemic can confidently be attributed to accelerated digitalization rather than pre-existing differences between the groups.

5. Estimation Results

5.1. Effect of COVID-19 on exits from work into retirement

To assess the impact of COVID-19 on the transitions from work into retirement, we estimate Model 1. The marginal effects of COVID-19 on these transitions are presented in Table 3.

Table 3. Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement for the whole sample of older workers. Model 1

	Model 1
COVID-19	0.0037***
	(0.0009)
Observations	121,417
Pseudo R-squared	0.089
Log Likelihood	-3,485,000

*Note: Model 1 includes controls listed in Section 4 and described in Table A1. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Full estimates are presented in Table A7. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

After accounting for worker heterogeneity, the positive coefficient of the COVID-19 dummy and its statistical significance confirm that during the COVID-19 lockdown, the probability of early retirement in European countries increased by 0.4 percentage points per month. While this magnitude may seem modest, it is significant when considering that the average monthly probability of exiting work into retirement was 0.63% in the pre-pandemic period. This implies that the number of older workers retiring during the COVID-19 outbreak rose by two-thirds compared to the same period in the previous year. These findings align with the unusually high employment exit rates for workers over 65 observed in the U.S. during the pandemic (Forsythe et al., 2022).

5.1.1. Effect of COVID-19 on exits from work into retirement by geographic area

To examine whether the pandemic's impact on retirement varied by geographic area, we estimate Model 1 separately for Northern European countries, Mediterranean countries, and Eastern European countries. The average marginal effects are presented in Table 4.

Table 4. Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement by geographic area. Model 1

	Northern countries	Mediterranean countries	Eastern countries
COVID-19	0.0028**	0.0058***	0.0029**
	(0.0012)	(0.0016)	(0.0015)
Observations	49,857	27,975	43,585
Pseudo R-squared	0.114	0.072	0.098
Log Likelihood	-1,881,000	-806,913	-748,064

*Note: Model 1 includes controls listed in Section 4 and described in Table A1. According to Wald tests, AME in Mediterranean countries is statistically different at 99% level of significance with respect to the other two geographic areas (no significant differences between Northern and Eastern countries). SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Full estimates are presented in Table A7.*

Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

The positive and significant AMEs of the COVID-19 dummy in Model 1 for all three geographic areas indicate that the probability of retiring during the pandemic crisis was higher than before. However, the relative increase in this probability was significantly more pronounced in Mediterranean countries (a monthly increase of 0.6 percentage points) compared to Northern and Eastern European countries (both showing a monthly increase of 0.3 percentage points). This finding corresponds with the significant GDP declines observed in Mediterranean countries during the first and second quarters of 2020 (see Figure 2).

5.1.2. *Effect of COVID-19 on exits from work into retirement by gender and geographic area*

To explore whether the pandemic's impact on the labor supply of older workers varies by gender, we estimate Model 2, adding an interaction term between the COVID-19 dummy and the female dummy to Model 1. The results are displayed in Table 5.

For the entire sample, the AME of the COVID-19 dummy is significantly positive for both men and women (at least at the 5% level). The probability of exiting employment into retirement increased more for women (by 0.5 percentage points) than for men (by 0.3 percentage points) during the COVID-19 lockdown, though this gender difference is statistically insignificant. These findings align with Brugiavini et al. (2022), who reported that women aged 50 and older were more adversely affected by the pandemic than men, attributing the disparity to the nature of women’s occupations.

Older women in Mediterranean and Eastern European countries experienced the largest and most significant increases in retirement rates during the initial phase of the pandemic crisis, with relative increases of 0.8 and 0.7 percentage points, respectively. In contrast, women in Northern European countries appeared unaffected by the COVID-19 crisis.

For men, the pandemic's effect on retirement was negligible in Eastern European countries and small but significant (at least at the 10% level) in Northern (0.3 percentage points) and Mediterranean countries (0.4 percentage points).

Gender differences in AMEs, where women exhibited larger increases in retirement during COVID-19, were observed in all geographic areas except Northern countries. However, this gender gap was statistically significant only in Eastern European countries.

Table 5. Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement by gender and geographic area. Model 2

	All countries	Northern countries	Mediterranean countries	Eastern countries
Women	0.0046***	0.0023	0.0077***	0.0066**
	(0.0013)	(0.0019)	(0.0022)	(0.0028)
Men	0.0028***	0.0032**	0.0039*	0.0005
	(0.0010)	(0.0015)	(0.0020)	(0.0016)
Difference	0.0018	-0.0009	0.0038	0.0062**
(Women-Men)	(0.002)	(0.002)	(0.003)	(0.003)
chi-2	1.17	0.15	1.60	3.88
p>Chi2	0.28	0.70	0.21	0.05
Observations	121,417	49,857	27,975	43,585

*Note: Model 2 includes controls listed in Section 4 and described in Table A1, as well as the interaction between COVID-19 and female dummy. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Full estimates are presented in Table A8. Source: Own elaborations from EU-SILC 2020 and EU-SILC 2021 data.*

As a sensitivity check, we incorporated a key variable related to the impact of COVID-19—monthly deaths per million inhabitants by country (sourced from Our World in Data)—into Model 1 and Model 2.[16] The inclusion of this variable had a negligible impact on the estimates of the COVID-19 effects.

5.2. *Effects of digitalization on the transition from work into retirement by geographic area*

To address the main research question, "Are Older Employees in Digital Occupations Working Longer during the Pandemic?", we extended Model 1 by introducing a difference-in-differences (DiD) coefficient. This was achieved by interacting the digital occupation dummy with the COVID-19 dummy. The COVID-19 dummy represents the lockdown period, characterized by accelerated digitalization and the transition to remote work (WFH), particularly for digital occupations. Since both digital and non-digital occupations were affected by the pandemic, the difference in the impact of

[16] According to *Our World in Data*, the Northern European region recorded the highest proportion of deaths during the pandemic.

COVID-19 on retirement between these groups offers insights into the effect of digitalization on retirement decisions.

Table 6 presents the AMEs of COVID-19 on the transition from work into retirement, comparing digital and non-digital occupations by geographic area.[17] The overall difference between digital and non-digital occupations is statistically insignificant across all countries (first column in Table 6). This result likely stems from opposing trends observed in different regions and the lack of statistical significance in Northern European countries. In Mediterranean countries, workers in digital occupations were 0.8 percentage points more likely to retire during the lockdown than those in non-digital occupations. In Eastern European countries, workers in digital occupations were 0.5 percentage points less likely to retire compared to their non-digital counterparts. In Northern European countries, the probability of retirement increased more for workers in non-digital occupations than for those in digital occupations, but this difference was statistically insignificant. These findings suggest that digitalization and remote work contributed to increased retirement rates in Mediterranean countries while decreasing retirement rates in Eastern European countries.

Given the possibility that workers in digital occupations differ systematically from those in non-digital roles (e.g., in education level or other factors influencing retirement decisions), we estimated the same model, including covariates that correlate with the likelihood of working in a digital occupation (see Table A6) and their interaction with the COVID-19 dummy.[18] The primary results remain consistent with those in Table 6. Additional details are available upon request.

[17] For robustness, we re-estimated Model 3 using a linear regression approach. The resulting DiD coefficient closely aligns with the estimated AME difference between digital and non-digital occupations. Results are available upon request.

[18] Table A6 confirms that the covariates included in the main analysis are significant determinants of the likelihood of performing a digital occupation among older workers. This ensures that potential selection bias is adequately addressed.

Table 6. Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement over digital occupation by geographic area. Model 3

	All countries	Northern countries	Mediterranean countries	Eastern countries
Digital occupation=1	0.0035***	0.0016	0.0089***	-0.0000
	(0.0011)	(0.0014)	(0.0021)	(0.0018)
Digital occupation=0	0.0039***	0.0046**	0.0012	0.0055**
	(0.0013)	(0.0022)	(0.0021)	(0.0022)
Difference	-0.0004	-0.0030	0.0077***	-0.0055**
(Digital oc. vs Non-Digital oc.)	(0.002)	(0.003)	(0.003)	(0.003)
chi-2	0.05	1.32	7.04	3.99
p>Chi2	0.83	0.25	0.01	0.05
Observations	121,417	49,857	27,975	43,585

*Note: Model 3 includes controls listed in Section 4 and described in Table A1, as well as the interaction between COVID-19 and digital occupation. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Full estimates are presented in Table A9. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

5.2.1. Effects of digitalization on the transition from work into retirement by gender and geographic area

To examine whether the effect of digitalization on the transition from work into retirement varies by gender, we estimate the triple interaction model described in Section 4 (Model 4) for the entire sample as well as by geographic area. Table 7 presents the AMEs of COVID-19 on the transition from work into retirement for workers in digital and non-digital occupations, along with the differences in these effects, disaggregated by gender and geographic area, as derived from the Model 4 estimation.

Table 7. Average Marginal Effects (AME) of COVID-19 on transitions from work to retirement over digital occupation by gender and geographic area. Model 4

	All countries		Northern countries		Mediterranean countries		Eastern countries	
	Men	Women	Men	Women	Men	Women	Men	Women
Digital occupation=1	0.0032**	0.0038**	0.0033*	0.0000	0.0053**	0.0124***	-0.0020	0.0018
	(0.0014)	(0.0016)	(0.0018)	(0.0022)	(0.0027)	(0.0032)	(0.0024)	(0.0025)
Digital occupation=0	0.0024	0.0060***	0.0030	0.0064*	0.0023	-0.0002	0.0019	0.0144**
	(0.0016)	(0.0023)	(0.0027)	(0.0035)	(0.0030)	(0.0027)	(0.0020)	(0.0056)
Difference	0.0007	-0.0019	0.0003	-0.0064	0.0029	0.0128***	-0.0038	-0.0130**
(Digital vs non-digital)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.006)
chi-2	0.10	0.47	0.00	2.28	0.49	9.59	1.56	4.31
p>Chi2	0.75	0.49	0.98	0.13	0.48	0.00	0.21	0.04
Observations	121,417	121,417	49,857	49,857	27,975	27,975	43,585	43,585

*Note: Model 4 includes controls listed in Section 4 and described in Table A1, as well as a full set of interaction terms between COVID-19, gender dummy, and digital occupation. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Full estimates for 'All countries' and by geographic area are presented in Table A10. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

For all countries, we observe asymmetric but statistically insignificant differences in retirement transitions between men and women in digital occupations. Women in digital occupations are 0.2 percentage points less likely to exit from employment to retirement compared to those in non-digital occupations. Conversely, men in digital occupations are 0.07 percentage points more likely to retire than their counterparts in non-digital roles.

However, distinguishing by geographic areas, men and women respond similarly within each area except in Northern European countries. In the former regions, the effects are larger and only statistically significant for women, suggesting that women's behaviour has driven the effects found in Mediterranean and Eastern European countries, as shown in Table 6. While digitalization increases the retirement probability of women in Mediterranean countries, it reduces the retirement likelihood of older female workers in Eastern European countries.

The significant increase in female retirement rates in Mediterranean countries during the pandemic crisis, partly linked to digitalization, may be due to added pressures from both paid and unpaid work while working from home. This explanation is supported by an extended model (not shown) that incorporates an interaction between the treatment and part-time dummy, revealing that the effect is predominantly driven by full-time female workers. In contrast, part-time female workers seem less affected, likely because part-time employment allows them greater flexibility to reconcile work and family responsibilities.

This pressure can be explained by the unequal division of caregiving and other informal/unpaid tasks[19] at home between men and women, especially in certain countries like Italy (Del Boca et al., 2020; Brugiavini et al., 2022), where traditional gender roles are prevalent, and social norms prioritize family responsibilities over paid work. Furthermore, difficulties in adapting to new technologies may exacerbate these challenges, creating further barriers to participation in the workforce.

However, digitalization decreases female retirement rates in Eastern European countries during the first stage of COVID-19. In these countries, greater gender equality in unpaid work exists, allowing women to better manage family and work responsibilities during COVID-19.

In Northern European countries, the retirement of women in digital occupations seems to be unaffected by COVID-19, while it increases the retirement of those in non-digital occupations. The non-response among women in digital occupations could be attributed to the higher prevalence of part-time work among women,[20] allowing them better work-family conciliation, as well as their prior familiarity with WFH arrangements before COVID-19, which might imply a smoother transition to WFH.

Therefore, for Northern and Eastern Europe, the shift to WFH seems to prevail with positive aspects, such as increased flexibility and savings in time and money spent on commuting.

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[19] According to the Time Use Survey 2010 from Eurostat (for individuals between 45 and 64 years old), participation rates in household and family care are higher for women than for men. The largest difference is observed in Mediterranean countries (22 percent), followed by Northern European countries (9.5 percent) and Eastern European countries (8.7 percent).

[20] According to "*The Life of Women and Men in Europe – A Statistical Portrait*" (2020 edition, with data referring to 2019 from Eurostat), the highest shares of women working part-time are in Northern countries: the Netherlands (75%), Austria and Germany (both 47%), and Belgium (41%). The lowest shares of women in part-time employment are in Eastern countries: Bulgaria (2%), Romania, Slovakia, Croatia, and Hungary (between 6% and 7%). Unfortunately, we cannot run the analysis distinguishing full-time and part-time work due to the limited number of observations.

6. Sensitivity analysis

We investigate whether the effects of COVID-19 and accelerated digitalization on retirement decisions are sensitive to the definition of retirement and to the length of the observation window.

6.1. Sensitivity to the definition of retirement

In our benchmark specification, retirement is considered as a strict labour market state self-reported by individuals at the moment of the interview. However, as unemployment at older ages is very often used as a bridge to retirement, we replicate our main analysis by adopting a broader definition of the transition from work into retirement, which also includes exits from work into unemployment. Tables B2 and B3 in the Appendix present estimates of the previous models using this broader definition of retirement.

As expected, using the broader definition of retirement (Table B2), the global effects of COVID-19 on retirement, as well as effects by gender and by geographic area, are qualitatively similar to those found using the benchmark definition of retirement in Tables 3–4, though the size of the coefficients tends to be larger. Comparing the estimations in Table 5 and Table B2, we observe that, after including unemployment in the definition of retirement, the effect of COVID-19 on retirement becomes more pronounced in size and statistically more significant for men and women living in Northern Europe and Mediterranean countries, while it does not affect either men or women in Eastern countries. This result suggests that unemployment plays a role in all geographic areas except in Eastern countries, where unemployment benefits are less generous than in other areas. This might make retirement or continuing to work more attractive than taking up unemployment benefits.

Conversely, when including unemployment cases among retirement ones, the positive effect of performing a digital occupation on retirement among women living in Mediterranean countries is no longer significant in Table B3, whereas the negative effect among women in Northern European countries becomes significant. In both cases, this divergence may be explained by the fact that older women performing non-digital occupations were forced more frequently into unemployment in these countries. As in the case of Table B2, Table B3 does not reveal any relevant change in estimation results for Eastern countries compared to those reported in Tables 6 and 7.

6.2. Sensitivity to the observation window

In our main analysis, the observation window for each group is very narrow (March–May 2019 and 2020, respectively) to better capture the response to the mass move to WFH during the first stage of the pandemic and to guarantee a clear identification strategy. However, to test the long-term responses, we extend our observation window to the entire 2020 period (March–December 2020).

Results of this sensitivity analysis, presented in Table B4, overall confirm the findings in Tables 3–5 regarding the positive effect of the pandemic on the probability of retiring. However, we observe that the short-term effects (March–May) of COVID-19 on retirement are stronger than long-term effects (March–December), particularly in Mediterranean countries. An exception is found in Northern countries, where long-term effects are slightly more pronounced.

Unfortunately, testing the long-term effects of accelerated digitalization is not feasible, as WFH is not guaranteed beyond the lockdown period, and we cannot identify individuals who continued WFH.

7. Conclusions

In this paper, we investigate how the pandemic and the transition of many workers to WFH, resulting in sudden digitalization, have affected the retirement age. We assess the effects of digitalization on retirement by comparing the retirement behaviour of older workers in digital jobs (with a higher potential for WFH) and those in non-digital jobs before and during the first COVID-19 lockdown.

During the first COVID-19 lockdown (March–May 2020), the number of older workers in European countries retiring earlier increased by two-thirds compared to the same period in the previous year (March–May 2019). The estimations suggest that the increase in retirement during the lockdown is driven mainly by women in Mediterranean and Eastern European countries. Conversely, male workers are less affected in Mediterranean and Northern countries or not affected at all in Eastern countries.

The overall effect of digitalization on retirement is null and not significant when looking at the entire sample of European countries. Nonetheless, this result is driven by the opposite effects found in Mediterranean and Eastern European countries and the negative but insignificant effect in Northern European countries.

Men and women respond similarly within each area, but the effects are larger and only statistically significant for women. More specifically, in Mediterranean countries, digitalization increases the likelihood of retirement for women but not for men. This may be related to the work-life balance challenges faced by women in societies with an unequal division of caregiving and other informal/unpaid tasks, which were intensified during the pandemic due to increased time spent at home (Corsi and Ilkkaracan, 2023) and the lack of external help. In addition, challenges in adapting to new technologies may also play a role. As a consequence, women could have chosen retirement to manage unpaid work and comply with the gendered caregiving norms typical in Mediterranean welfare systems.

In contrast, in Northern and Eastern European countries, greater gender equality in unpaid work exists, allowing women to better manage family and work responsibilities. In both Eastern and, to a lesser extent, Northern Europe, female workers tend to postpone retirement when moved to WFH. The lower response in Northern Europe could be attributed to the higher prevalence of part-time work among women (important for reconciling work and family life), as well as their prior familiarity with WFH arrangements before COVID-19, which implied a smoother transition to WFH.

The null global effects seem to hide the different effects of COVID-19 and digitalization on retirement by geographic area and gender, underscoring the necessity of conducting a more disaggregated analysis. Indeed, future research could benefit from further exploration in this direction, such as examining specific countries and exploring the multitude of factors interacting with digitalization and WFH (for instance, commuting time) that influence retirement decisions. Unfortunately, the limited number of observations and variables in EU-SILC does not allow for such detailed analysis, and richer datasets would be required.

This study also provides two interesting policy implications. First, differences in retirement behaviour between workers in digital and non-digital occupations are in line with the ‘new divide’ in the labour market based on jobs having or not having the possibility to work remotely. Although the ‘new normal’ way of working today may not be as critical as expected during the initial stages of the outbreak (Bonacini et al., 2021), the use of WFH practices—at least partial ones—is still widespread in many companies post-COVID-19, which could emphasize existing differences. The policy relevance of this justifies the need for further research using a longer period and a different context (without a pandemic crisis) for analysis.

Second, the asymmetric effects of digitalization on retirement by gender risk exacerbating the already existing gender gaps in labour market outcomes, such as pension adequacy (Bettio et al., 2013). If older women performing digital occupations, especially those living in Mediterranean countries, systematically begin to retire earlier, this would indeed determine a reduction of their future pension income and further increase the gender gap in pensions. If so, future policy measures aiming to reduce this potentially increasing gender gap would become more necessary than ever.

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Appendix A – Additional statistics and analyses

Table A1. Explanatory variables

Variable	Definition
Female	1 if female
Age	59-60;61-62;63-64;65-68
Education level:	
Low education level	Lower secondary school or less
Mid education level	Upper secondary school
High education level	University degree
Level of skills:	
High skill level	Managers, professionals, technicians and associate professionals.
Mid skill level	Clerical support workers, services and sales workers, skilled agricultural, forestry, and fishery workers
Low skill level	Craft and related trade workers, plant and machine operators and assemblers, elementary occupations
Occupation characteristics:	
Digital occupation	Variable constructed by collapsing the index from Cirillo et al. (2021) 4-digit ISCO to 2-digit ISCO. Takes value 1 if the digitalization index (ranging between 0 and 100) is higher than 50
Household composition:	
Single person	The individual is not married and living alone
Two adults – Partner NE	The individual is living with a non-employed partner
Two adults – Partner Emp	The individual is living with an employed partner (labour income greater than zero)
3+ members – Partner NE	The individual is living in a household with more than three members and the partner is non-employed
3+ members – Partner Emp	The individual is living in a household with more than three members and the partner is employed
Other household type	
Well-being characteristics:	
Home ownership	The individual owns the house where he/she lives
Log (Household income)	Household income is the total income of a household, after tax and other deductions, that is available for spending or saving, divided by the number of household members converted into equivalent adults. Household members are equalised through the OECD modified equivalence scale

Table A2. Statutory pension ages by gender

		Statutory Pension age (as of 2020)	
		Men	Women
Belgium	BE	65 years	65 years
Bulgaria	BG	66 years 6 months	66 years 6 months
Czechia	CZ	63 years 8 months	63 years 8 months
Denmark	DK	66 years 6 months	66 years 6 months
Germany	DE	65 years 8 months	65 years 8 months
Estonia	EE	63 years 6 months	63 years 6 months
Ireland	IE	66 years	66 years
Greece	EL	67 years	67 years
Spain	ES	65 years 10 months	65 years 10 months
France	FR	66 years 7 months	66 years 7 months
Croatia	HR	65 years	61 years 9 months
Italy	IT	67 years	67 years
Cyprus	CY	65 years	65 years
Latvia	LV	63 years 9 months	63 years 9 months
Lithuania	LT	64 years	63 years
Luxembourg	LU	65 years	65 years
Hungary	HU	64 years 6 months	64 years 6 months
Netherlands	NL	66 years 4 months	66 years 4 months
Austria	AT	65 years	60 years
Poland	PL	65 years	60 years
Portugal	PT	66 years 5 months	66 years 5 months
Romania	RO	65 years	61 years 3-5 months
Slovenia	SI	65 years	65 years
Finland	FI	65 years	65 years
Sweden	SE	65 years	65 years
Switzerland	CH	65 years	64 years

Source: Extending working life: what do workers want? Eurofound, 2017 and the Finnish Centre for Pensions (https://www.etk.fi/en/).

Table A3. Distribution of countries by area. Number of observations per country

Country	Country code	Northern Europe	Mediterranean Europe	Eastern Europe	Total
Austria	AT	1,931	0	0	1,931
Belgium	BE	2,660	0	0	2,660
Switzerland	CH	5,232	0	0	5,232
Germany	DE	15,352	0	0	15,352
Denmark	DK	3,932	0	0	3,932
Finland	FI	3,030	0	0	3,030
France	FR	4,787	0	0	4,787
Ireland	IE	2,260	0	0	2,260
Luxembourg	LU	925	0	0	925
Netherlands	NL	5,959	0	0	5,959
Sweden	SE	3,789	0	0	3,789
Cyprus	CY	0	2,518	0	2,518
Greece	EL	0	2,569	0	2,569
Spain	ES	0	7,869	0	7,869
Italy	IT	0	7,522	0	7,522
Portugal	PT	0	7,497	0	7,497
Bulgaria	BG	0	0	5,014	5,014
Czechia	CZ	0	0	4,561	4,561
Estonia	EE	0	0	5,007	5,007
Croatia	HR	0	0	3,102	3,102
Hungary	HU	0	0	3,797	3,797
Lithuania	LT	0	0	4,697	4,697
Latvia	LV	0	0	5,118	5,118
Poland	PL	0	0	7,080	7,080
Romania	RO	0	0	2,175	2,175
Slovenia	SI	0	0	3,034	3,034
Total		49,857	27,975	43,585	121,417

Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

Table A4. Descriptive statistics by geographic area

Variable	Northern European countries			Mediterranean countries			Eastern European countries		
	February 2019	February 2020	Mean difference	February 2019	February 2020	Mean difference	February 2019	February 2020	Mean difference
Women	0.503	0.488	-0.015	0.461	0.472	0.010	0.426	0.401	-0.024*
Aged 59-60	0.436	0.252	-0.184***	0.402	0.226	-0.176***	0.390	0.231	-0.159***
Aged 61-62	0.320	0.389	0.069***	0.275	0.370	0.095***	0.286	0.347	0.061***
Aged 63-64	0.174	0.240	0.066***	0.192	0.220	0.027***	0.202	0.245	0.043***
Aged 65-68	0.070	0.119	0.048***	0.130	0.184	0.054***	0.122	0.177	0.055***
Lower secondary or less	0.169	0.162	-0.007	0.379	0.355	-0.024	0.075	0.070	-0.005
Upper secondary	0.446	0.436	-0.010	0.313	0.316	0.003	0.581	0.589	0.008
University degree	0.385	0.402	0.017	0.308	0.329	0.021	0.344	0.341	-0.003
High skill level	0.456	0.465	0.009	0.411	0.444	0.033*	0.369	0.375	0.006
Mid skill level	0.292	0.283	-0.009	0.311	0.277	-0.034**	0.214	0.215	0.002
Low skill level	0.252	0.252	0.000	0.278	0.279	0.001	0.417	0.409	-0.008
Digital occupation	0.617	0.609	-0.008	0.575	0.590	0.016	0.452	0.453	0.001
Single person	0.265	0.258	-0.007	0.157	0.173	0.017	0.176	0.187	0.011
Two adults - Partner NE	0.180	0.193	0.013	0.156	0.150	-0.006	0.148	0.164	0.016**
Two adults - Partner Emp	0.329	0.334	0.005	0.146	0.141	-0.005	0.235	0.239	0.004
3+ members - Partner NE	0.050	0.047	-0.004	0.168	0.165	-0.003	0.122	0.133	0.011
3+ members - Partner Emp	0.118	0.117	0.000	0.258	0.235	-0.023	0.217	0.185	-0.032***
Other household type	0.058	0.051	-0.007	0.115	0.136	0.021	0.102	0.092	-0.010
Home ownership	0.674	0.677	0.002	0.820	0.820	0.000	0.894	0.910	0.015*
Log(Household income)	10.74	10.75	0.011	10.51	10.529	0.014	9.67	9.68	0.012
Observations	7,835	8,918		4,689	4,695		7,782	6,886	

*Note: The number of observations for all the variables in Northern European countries is 16,753. The number of observations for all the variables in Mediterranean countries is 9,384. The number of observations for all the variables in Eastern European countries is 14,670. *** p<0.01, ** p<0.05, * p<0.10. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table A5. Exit rates from work into retirement before and during COVID by gender, area, and type of occupation (Digital/Non-Digital)

Gender	Digital occupation	Northern countries		Mediterranean countries		Eastern countries	
		Covid period		Covid period		Covid period	
		No	Yes	No	Yes	No	Yes
Man	Yes	0.53%	0.91%	0.38%	1.01%	0.70%	0.56%
Man	No	0.80%	1.13%	0.62%	0.95%	0.65%	0.99%
Woman	Yes	0.76%	0.82%	0.13%	1.46%	0.76%	1.15%
Woman	No	0.95%	1.50%	0.43%	0.49%	0.90%	2.63%
Man	Total	0.64%	1.00%	0.49%	0.98%	0.67%	0.84%
Woman	Total	0.83%	1.07%	0.25%	1.10%	0.82%	1.73%
Total		0.73%	0.73%	0.38%	1.04%	0.73%	1.20%

Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

Table A6. Estimation results of the probit model (performing a digital occupation), for the whole sample and by geographic area

Y = Digital occupation	All countries	Northern countries	Mediterranean countries	Eastern countries
Woman	0.013**	0.008	0.012	0.027***
	(0.005)	(0.008)	(0.010)	(0.006)
Aged 61-62	-0.005	-0.011	0.001	0.002
	(0.006)	(0.008)	(0.013)	(0.008)
Aged 63-64	0.007	-0.001	0.019	0.007
	(0.007)	(0.010)	(0.015)	(0.010)
Aged 65-68	-0.020***	-0.037***	-0.002	-0.013
	(0.008)	(0.011)	(0.015)	(0.010)
Upper secondary	0.071***	0.036***	0.122***	0.090***
	(0.007)	(0.009)	(0.015)	(0.013)
University degree	0.105***	0.057***	0.160***	0.159***
	(0.009)	(0.012)	(0.019)	(0.020)
Mid skill level	-0.500***	-0.489***	-0.421***	-0.654***
	(0.009)	(0.012)	(0.018)	(0.015)
Low skill level	-0.899***	-0.920***	-0.863***	-0.887***
	(0.006)	(0.007)	(0.016)	(0.009)
Two adults - Partner NE	-0.015*	-0.021*	-0.007	-0.001
	(0.009)	(0.013)	(0.016)	(0.010)
Two adults - Partner Emp	0.004	0.009	0.002	-0.009
	(0.006)	(0.008)	(0.015)	(0.010)
3+ members - Partner NE	-0.005	0.028	-0.019	-0.011
	(0.010)	(0.020)	(0.016)	(0.014)
3+ members - Partner Emp	0.007	-0.005	0.021	-0.004
	(0.009)	(0.014)	(0.017)	(0.011)
Other household type	-0.019*	-0.017	-0.025	-0.013
	(0.010)	(0.017)	(0.018)	(0.012)
Home ownership	0.033***	0.023***	0.060***	0.029**
	(0.006)	(0.008)	(0.013)	(0.012)
COVID-19	-0.008**	-0.012**	-0.001	-0.003
	(0.004)	(0.006)	(0.009)	(0.006)
Country fixed effects	Yes	Yes	Yes	Yes
Observations	121,417	49,857	27,975	43,585
Pseudo R-squared	0.613	0.601	0.607	0.663
Log Likelihood	-20,900,000	-11,200,000	-5,707,000	-3,637,000

*Note: SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table A7. Estimation results of the probit model (transitions from work into retirement), for the whole sample and by geographic area (Model 1)

	Model 1			
	Whole sample	Northern countries	Mediterranean countries	Eastern countries
COVID-19	0.0037***	0.0028**	0.0058***	0.0029**
	(0.0009)	(0.0012)	(0.0016)	(0.0015)
Woman	0.0015*	0.0007	-0.0009	0.0064***
	(0.0009)	(0.0014)	(0.0015)	(0.0016)
Digital occupation	-0.0002	0.0002	0.0014	-0.0029
	(0.0013)	(0.0018)	(0.0023)	(0.0022)
Aged 61-62	0.0021**	0.0024*	0.0013	0.0022*
	(0.0009)	(0.0013)	(0.0016)	(0.0013)
Aged 63-64	0.0085***	0.0116***	0.0039**	0.0087***
	(0.0011)	(0.0019)	(0.0017)	(0.0016)
Aged 65-68	0.0178***	0.0185***	0.0145***	0.0205***
	(0.0019)	(0.0028)	(0.0031)	(0.0031)
Upper secondary	0.0002	0.0012	-0.0019	-0.0025
	(0.0012)	(0.0018)	(0.0019)	(0.0031)
University degree	-0.0023*	-0.0018	-0.0034*	-0.0039
	(0.0013)	(0.0019)	(0.0019)	(0.0035)
Mid skill level	0.0028**	0.0043**	0.0005	0.0035
	(0.0013)	(0.0018)	(0.0024)	(0.0022)
Low skill level	0.0013	0.0032	-0.0002	0.0006
	(0.0016)	(0.0024)	(0.0030)	(0.0026)
Two adults - Partner NE	0.0035**	0.0048**	0.0025	0.0009
	(0.0014)	(0.0021)	(0.0024)	(0.0021)
Two adults - Partner Emp	-0.0001	-0.0001	0.0026	-0.0030*
	(0.0011)	(0.0015)	(0.0023)	(0.0017)
3+ members - Partner NE	-0.0001	0.0025	-0.0005	0.0001
	(0.0020)	(0.0052)	(0.0020)	(0.0033)
3+ members - Partner Emp	-0.0023*	-0.0061***	0.0027	-0.0028
	(0.0013)	(0.0014)	(0.0025)	(0.0025)
Other household type	-0.0008	-0.0052***	0.0052	-0.0030
	(0.0017)	(0.0020)	(0.0034)	(0.0024)
Home ownership	0.0036***	0.0049***	0.0021	0.0008
	(0.0011)	(0.0014)	(0.0023)	(0.0025)
Month fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	121,417	49,857	27,975	43,585
Pseudo R-squared	0.089	0.114	0.072	0.098
Log Likelihood	-3,485,000	-1,881,000	-806,913	-748,064

*Note: Model 1 includes controls listed in Section 4 and described in Table A1. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table A8. Estimation results of the probit model (transitions from work into retirement), for the whole sample and by geographic area (Model 2)

	Model 2			
	Whole sample	Northern countries	Mediterranean countries	Eastern countries
COVID-19	0.0030***	0.0035**	0.0038*	0.0006
	(0.0011)	(0.0017)	(0.0020)	(0.0019)
Woman	0.0008	0.0015	-0.0041	0.0040*
	(0.0014)	(0.0022)	(0.0028)	(0.0021)
Woman*COVID-19	0.0013	-0.0014	0.0050	0.0046
	(0.0017)	(0.0025)	(0.0032)	(0.0028)
Digital occupation	-0.0002	0.0002	0.0013	-0.0029
	(0.0013)	(0.0018)	(0.0023)	(0.0022)
Aged 61-62	0.0021**	0.0024*	0.0013	0.0022*
	(0.0009)	(0.0013)	(0.0016)	(0.0013)
Aged 63-64	0.0085***	0.0116***	0.0038**	0.0087***
	(0.0011)	(0.0019)	(0.0017)	(0.0016)
Aged 65-68	0.0178***	0.0184***	0.0146***	0.0204***
	(0.0019)	(0.0028)	(0.0031)	(0.0031)
Upper secondary	0.0002	0.0012	-0.0019	-0.0026
	(0.0012)	(0.0018)	(0.0019)	(0.0031)
University degree	-0.0023*	-0.0018	-0.0034*	-0.0040
	(0.0013)	(0.0019)	(0.0019)	(0.0035)
Mid skill level	0.0028**	0.0043**	0.0005	0.0035
	(0.0013)	(0.0018)	(0.0023)	(0.0022)
Low skill level	0.0013	0.0032	-0.0002	0.0006
	(0.0016)	(0.0024)	(0.0030)	(0.0026)
Two adults - Partner NE	0.0035**	0.0048**	0.0025	0.0010
	(0.0014)	(0.0021)	(0.0023)	(0.0021)
Two adults - Partner Emp	-0.0000	-0.0001	0.0026	-0.0030*
	(0.0011)	(0.0015)	(0.0023)	(0.0017)
3+ members - Partner NE	-0.0001	0.0025	-0.0005	0.0002
	(0.0020)	(0.0052)	(0.0019)	(0.0033)
3+ members - Partner Emp	-0.0023*	-0.0061***	0.0027	-0.0028
	(0.0013)	(0.0014)	(0.0025)	(0.0025)
Other household type	-0.0007	-0.0053***	0.0051	-0.0030
	(0.0017)	(0.0020)	(0.0034)	(0.0024)
Home ownership	0.0036***	0.0049***	0.0020	0.0009
	(0.0011)	(0.0014)	(0.0023)	(0.0025)
Month fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	121,417	49,857	27,975	43,585
Pseudo R-squared	0.089	0.114	0.075	0.100
Log Likelihood	-3,485,000	-1,881,000	-804,777	-746,907

*Note: Model 2 includes controls listed in Section 4 and described in Table A1, as well as the interaction between COVID-19 and gender dummy. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.*

Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

Table A9. Estimation results of the probit model (transitions from work into retirement), for the whole sample and by geographic area (Model 3)

	Model 3			
	All countries	Northern countries	Mediterranean countries	Eastern countries
COVID-19	0.0034***	0.0039**	0.0013	0.0050**
	(0.0012)	(0.0019)	(0.0022)	(0.0020)
Woman	0.0015*	0.0007	-0.0010	0.0064***
	(0.0009)	(0.0014)	(0.0015)	(0.0016)
Digital occupation	-0.0004	0.0013	-0.0035	-0.0003
	(0.0017)	(0.0025)	(0.0032)	(0.0025)
Digital*COVID-19	0.0004	-0.0020	0.0080**	-0.0050*
	(0.0017)	(0.0026)	(0.0032)	(0.0028)
Aged 61-62	0.0021**	0.0024*	0.0012	0.0022*
	(0.0009)	(0.0013)	(0.0016)	(0.0013)
Aged 63-64	0.0085***	0.0117***	0.0039**	0.0086***
	(0.0011)	(0.0019)	(0.0017)	(0.0016)
Aged 65-68	0.0178***	0.0184***	0.0144***	0.0204***
	(0.0019)	(0.0028)	(0.0031)	(0.0031)
Upper secondary	0.0002	0.0011	-0.0017	-0.0024
	(0.0012)	(0.0018)	(0.0019)	(0.0030)
University degree	-0.0023*	-0.0019	-0.0033*	-0.0038
	(0.0013)	(0.0019)	(0.0019)	(0.0035)
Mid skill level	0.0028**	0.0043**	0.0008	0.0035
	(0.0013)	(0.0018)	(0.0024)	(0.0022)
Low skill level	0.0013	0.0032	0.0002	0.0007
	(0.0016)	(0.0024)	(0.0030)	(0.0026)
Two adults - Partner NE	0.0035**	0.0049**	0.0025	0.0009
	(0.0014)	(0.0021)	(0.0023)	(0.0021)
Two adults - Partner Emp	-0.0001	-0.0001	0.0026	-0.0031*
	(0.0011)	(0.0015)	(0.0023)	(0.0017)
3+ members - Partner NE	-0.0001	0.0025	-0.0004	-0.0000
	(0.0020)	(0.0052)	(0.0020)	(0.0033)
3+ members - Partner Emp	-0.0023*	-0.0061***	0.0025	-0.0029
	(0.0013)	(0.0014)	(0.0024)	(0.0025)
Other household type	-0.0008	-0.0052***	0.0053	-0.0031
	(0.0017)	(0.0020)	(0.0034)	(0.0024)
Home ownership	0.0036***	0.0049***	0.0020	0.0008
	(0.0011)	(0.0014)	(0.0022)	(0.0025)
Month fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	121,417	49,857	27,975	43,585
Pseudo R-squared	0.089	0.114	0.079	0.100
Log Likelihood	-3,485,000	-1,880,000	-801,273	-746,789

*Note: Model 3 includes controls listed in Section 4 and described in Table A1, as well as the interaction between COVID-19 and digital occupation. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.*

Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.

Table A10. Estimation results of the probit model (transitions from work into retirement), for the whole sample and by geographic area (Model 4)

	Model 4			
	All countries	Northern countries	Mediterranean countries	Eastern countries
COVID-19	0.0023	0.0028	0.0021	0.0022
	(0.0016)	(0.0026)	(0.0027)	(0.0023)
Woman	0.0000	-0.0009	-0.0026	0.0039
	(0.0021)	(0.0033)	(0.0037)	(0.0026)
Digital occupation	-0.0011	-0.0010	-0.0024	0.0013
	(0.0021)	(0.0033)	(0.0035)	(0.0030)
Woman*COVID-19	0.0024	0.0019	-0.0023	0.0066*
	(0.0025)	(0.0038)	(0.0046)	(0.0038)
Digital*COVID-19	0.0015	0.0013	0.0033	-0.0051
	(0.0022)	(0.0034)	(0.0038)	(0.0042)
Woman*Digital	0.0015	0.0042	-0.0037	-0.0016
	(0.0028)	(0.0042)	(0.0050)	(0.0039)
Woman*Digital*COVID-19	-0.0023	-0.0060	0.0116*	-0.0020
	(0.0034)	(0.0050)	(0.0066)	(0.0056)
Aged 61-62	0.0021**	0.0024*	0.0011	0.0022*
	(0.0009)	(0.0013)	(0.0015)	(0.0013)
Aged 63-64	0.0085***	0.0117***	0.0037**	0.0086***
	(0.0011)	(0.0019)	(0.0017)	(0.0016)
Aged 65-68	0.0179***	0.0185***	0.0149***	0.0202***
	(0.0019)	(0.0028)	(0.0032)	(0.0031)
Upper secondary	0.0002	0.0010	-0.0018	-0.0023
	(0.0012)	(0.0018)	(0.0019)	(0.0031)
University degree	-0.0023*	-0.0020	-0.0035*	-0.0037
	(0.0013)	(0.0019)	(0.0019)	(0.0035)
Mid skill level	0.0028**	0.0042**	0.0006	0.0035
	(0.0013)	(0.0018)	(0.0024)	(0.0022)
Low skill level	0.0013	0.0031	-0.0003	0.0008
	(0.0016)	(0.0024)	(0.0029)	(0.0025)
Two adults - Partner NE	0.0035**	0.0049**	0.0025	0.0009
	(0.0014)	(0.0021)	(0.0024)	(0.0021)
Two adults - Partner Emp	-0.0000	-0.0001	0.0024	-0.0032*
	(0.0011)	(0.0015)	(0.0023)	(0.0017)
3+ members - Partner NE	-0.0001	0.0024	-0.0005	-0.0001
	(0.0020)	(0.0050)	(0.0019)	(0.0032)
3+ members - Partner Emp	-0.0023*	-0.0061***	0.0026	-0.0031
	(0.0013)	(0.0014)	(0.0024)	(0.0024)
Other household type	-0.0007	-0.0052***	0.0052	-0.0033
	(0.0017)	(0.0020)	(0.0034)	(0.0024)
Home ownership	0.0036***	0.0049***	0.0018	0.0010
	(0.0011)	(0.0014)	(0.0022)	(0.0025)
Month fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	121,417	49,857	27,975	43,585
Pseudo R-squared	0.089	0.115	0.085	0.103
Log Likelihood	-3,484,000	-1,879,000	-795,845	-744,491

*Note: Model 4 includes controls listed in Section 4 and described in Table A1, as well as a full set of interaction terms between COVID-19, gender dummy, and digital occupation. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Appendix B – Robustness checks

Table B1. Average Marginal Effects of treatment on transitions from work to retirement, whole sample and by geographic area (Models 1 and 2). Placebo test

	All countries	Northern countries	Mediterranean countries	Eastern countries
Total sample	-0.0007	-0.0008	-0.0017	0.0005
	(0.0007)	(0.0012)	(0.0010)	(0.0010)
Women	0.0003	0.0011	-0.0019	0.0012
	(0.0010)	(0.0016)	(0.0013)	(0.0016)
Men	-0.0017	-0.0027	-0.0015	-0.0000
	(0.0010)	(0.0018)	(0.0015)	(0.0013)
Difference	0.0020	0.0038	-0.0004	0.0013
(Women-Men)	(0.001)	(0.002)	(0.002)	(0.002)
chi-2	1.86	2.52	0.05	0.40
p>Chi2	0.17	0.11	0.83	0.53
Observations	131,606	49,380	32,583	49,643

*Note: Model 1 includes controls listed in Section 4 and described in Table A1, while Model 2 adds to Model 1 the interaction between COVID-19 and gender dummy. Results of Model 1 are presented in the row labelled 'Total sample', while results of Model 2 are presented in the following rows. Pre-treatment group: older workers working in February 2018 and we follow their retirement decision from March to May 2018. Post-treatment group: older workers working in February 2019 and we follow their retirement decision from March to May 2019. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table B2. Average Marginal Effects of COVID-19 on the transitions from work to retirement, whole sample and by geographic area (Models 1 and 2). Alternative definition of retirement

	All countries	Northern countries	Mediterranean countries	Eastern countries
Total sample	0.0058***	0.0051***	0.0089***	0.0037**
	(0.0010)	(0.0013)	(0.0019)	(0.0016)
Women	0.0067***	0.0039*	0.0121***	0.0068**
	(0.0014)	(0.0020)	(0.0026)	(0.0028)
Men	0.0050***	0.0062***	0.0057**	0.0015
	(0.0012)	(0.0017)	(0.0027)	(0.0018)
Difference	0.0017	-0.0023	0.0064*	0.0053*
(Women-Men)	(0.002)	(0.003)	(0.004)	(0.003)
chi-2	0.82	0.79	2.81	2.71
p>Chi2	0.37	0.37	0.09	0.10
Observations	124,174	50,713	28,753	44,708

*Note: Model 1 includes controls listed in Section 4 and described in Table A1, while Model 2 adds to Model 1 the interaction between COVID-19 and gender dummy. Results of Model 1 are presented in the row labelled 'Total sample', while results of Model 2 are presented in the following rows. Analogous to Tables 3-5 but using broader definition of retirement including unemployment. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table B3. Average Marginal Effects (AME) of COVID-19 on the transitions from work to retirement over digital occupation, whole sample and by geographic area (Models 3 and 4). Alternative definition of retirement

	All countries			Northern countries		
	All	Men	Women	All	Men	Women
Digital occupation=1	0.0046***	0.0046***	0.0046***	0.0028*	0.0050***	0.0007
	(0.0011)	(0.0014)	(0.0017)	(0.0015)	(0.0019)	(0.0023)
Digital occupation=0	0.0074***	0.0055***	0.0102***	0.0088***	0.0080***	0.0097***
	(0.0016)	(0.0020)	(0.0025)	(0.0024)	(0.0031)	(0.0037)
Difference	-0.0029	-0.0011	-0.0051*	-0.0060**	-0.0037	-0.0082**
(Digital oc. vs Non-Digital oc.)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
chi-2	2.24	0.20	3.12	4.63	0.92	4.14
p>Chi2	0.13	0.66	0.08	0.03	0.34	0.04
Observations	124,174	124,174	124,174	50,713	50,713	50,713
	Mediterranean countries			Eastern countries		
	All	Men	Women	All	Men	Women
Digital occupation=1	0.0104***	0.0067**	0.0139***	0.0003	-0.0019	0.0022
	(0.0023)	(0.0029)	(0.0035)	(0.0018)	(0.0025)	(0.0025)
Digital occupation=0	0.0064**	0.0045	0.0087**	0.0066***	0.0035	0.0141**
	(0.0032)	(0.0048)	(0.0039)	(0.0024)	(0.0023)	(0.0057)
Difference	0.0040	0.0020	0.0056	-0.0063**	-0.0054	-0.0118*
(Digital oc. vs Non-Digital oc.)	(0.004)	(0.006)	(0.005)	(0.003)	(0.003)	(0.006)
chi-2	1.06	0.12	1.21	4.58	2.45	3.70
p>Chi2	0.30	0.73	0.27	0.03	0.12	0.05
Observations	28,753	28,753	28,753	44,708	44,708	44,708

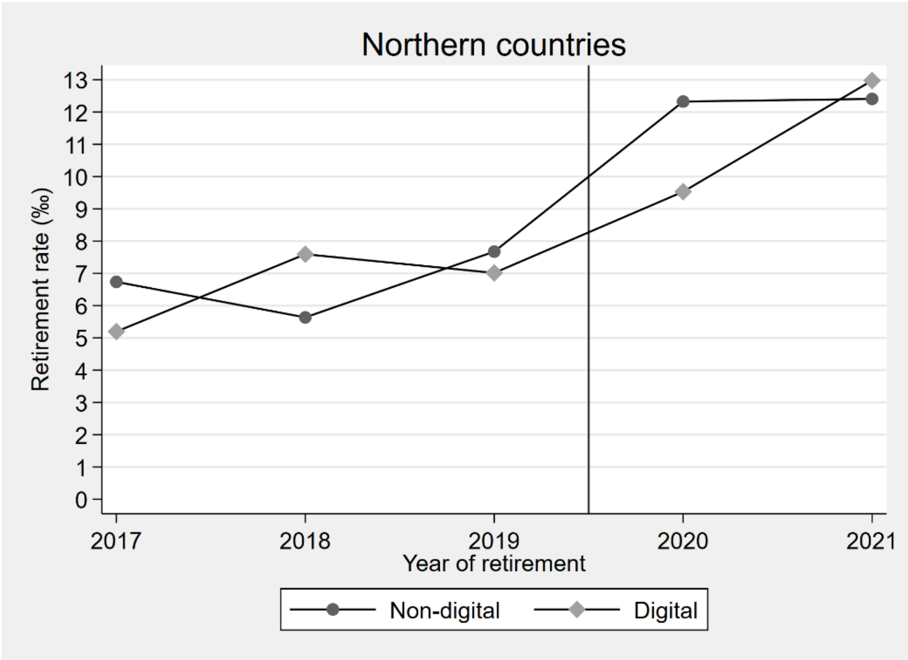
*Note: Columns 'All' present results of Model 3 while columns 'Men' and 'Women' those of Model 4. Model 3 includes controls listed in Section 4 and described in Table A1, as well as the interaction between COVID-19 and digital occupation, while Model 4 includes a full set of interaction terms between COVID-19, gender dummy, and digital occupation. Analogous to Tables 6 and 7 but using broader definition of retirement including unemployment. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Table B4. Average Marginal Effects of COVID-19 on the transitions from work to retirement, whole sample and by geographic area (Models 1 and 2). March-December 2020 period

	All countries	Northern countries	Mediterranean countries	Eastern countries
All	0.0027***	0.0031***	0.0022**	0.0023***
	(0.0005)	(0.0008)	(0.0010)	(0.0009)
Women	0.0035***	0.0026**	0.0039***	0.0060***
	(0.0008)	(0.0011)	(0.0014)	(0.0017)
Men	0.0020***	0.0037***	0.0007	-0.0000
	(0.0007)	(0.0012)	(0.0014)	(0.0010)
Difference	0.0015	-0.0011	0.0032	0.0060***
(Women-Men)	(0.001)	(0.002)	(0.002)	(0.002)
chi-2	1.99	0.49	2.68	9.90
p>Chi2	0.16	0.48	0.10	0.00
Observations	411,501	169,434	95,184	146,883

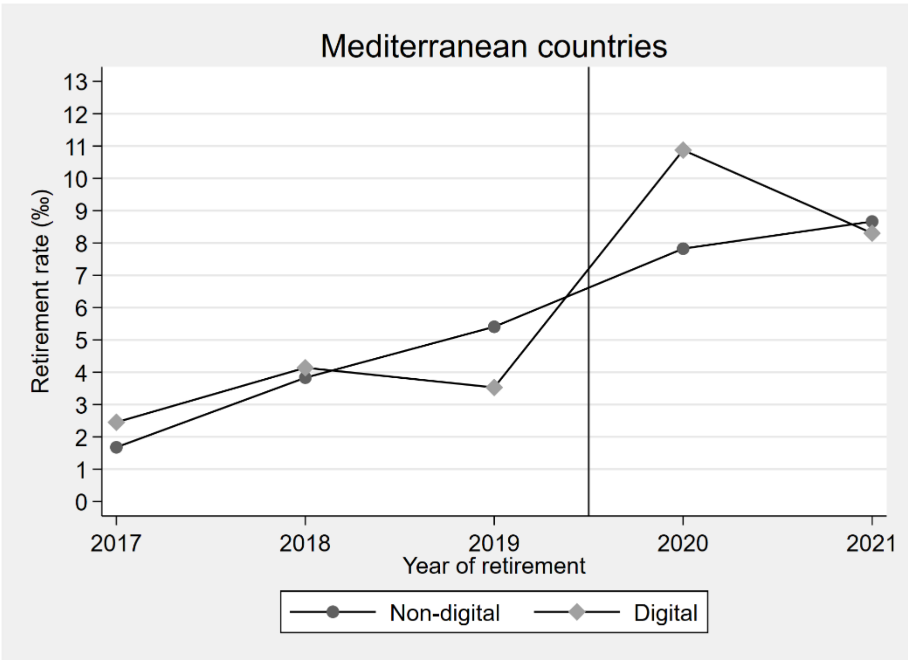
*Note: Model 1 includes controls listed in Section 4 and described in Table A1, while Model 2 adds to Model 1 the interaction between COVID-19 and gender dummy. Results of Model 1 are presented in the row labelled 'Total sample', while results of Model 2 are presented in the following rows. Analogous to Tables 3-5 but using observations for the whole 2020 period. SE in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration from EU-SILC 2020 and EU-SILC 2021 data.*

Figure B1. Average retirement rate by digital occupation and year – Northern countries



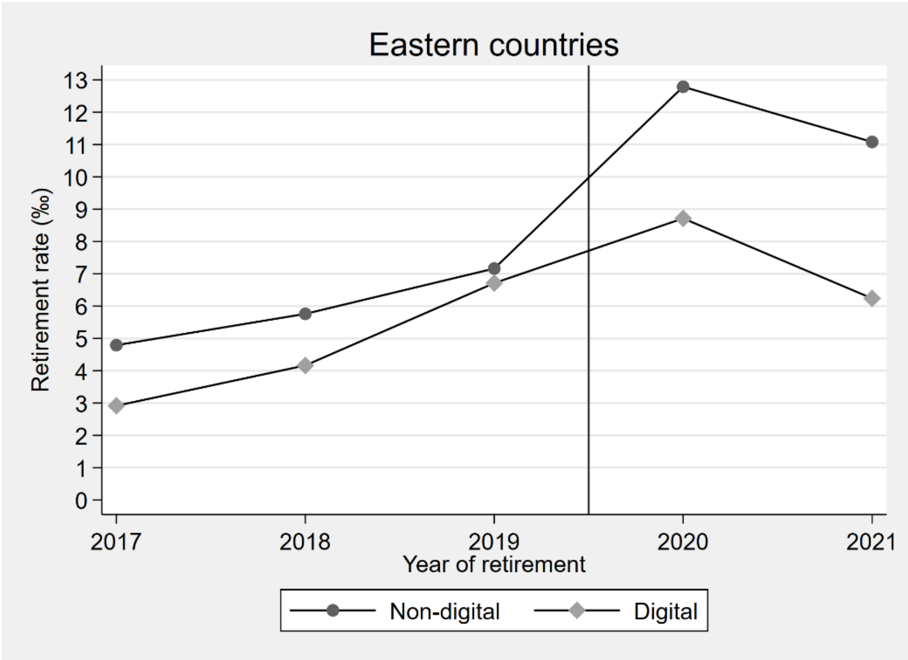
Note: Each year refers to the older workers retiring in the March-May period only. Source: Own elaboration from EU-SILC 2018-2022 data.

Figure B2. Average retirement rate by digital occupation and year – Mediterranean countries



Note: Each year refers to the older workers retiring in the March-May period only. Source: Own elaboration from EU-SILC 2018-2022 data.

Figure B3. Average retirement rate by digital occupation and year – Eastern countries



Note: Each year refers to the older workers retiring in the March-May period only. Source: Own elaboration from EU-SILC 2018-2022 data.