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Covid-19 and Working from Home: toward a "new normal"?

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Abstract

The COVID pandemic that took the world economy by surprise at the beginning of 2020 brought many drastic changes to the way individuals carry on their daily lives. One that will have long lasting effects, even after the spread of the virus is contained, is a shift towards flexible work arrangements, including remote work options. Initially implemented to comply with government imposed stay-at-home orders, many employers decided to allow remote work even after the orders were lifted. In this chapter we will review some of the metrics used in the literature to measure the potential that a specific occupation is suitable for telework. This is important because Working From Home was often the only option for businesses to remain open during the first part of the pandemic. We also review the results of the literature on two important dimensions of inequality: the gender wage gap and income inequality. Moreover, we review some evidence of the effect of WFH on worker's productivity in general and during the pandemic and on physical and mental health. We conclude with a description of what WFH may look like after the pandemic, by describing the process towards a possible "new normal" in the labour market.

Keywords: COVID-19; working from home; inequality; productivity, health.

JEL Classification: D13; D23; E24; G18; J22; M54; R3

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Introduction

The COVID pandemic that took the world economy by surprise at the beginning of 2020 brought several drastic changes to the way individuals carry on their daily lives. One that will have long lasting effects, even after the spread of the virus is contained, is a shift towards flexible work arrangements, including remote work options. Initially implemented to comply with government imposed stay-at-home orders, many employers decided to allow remote work even after the orders were lifted. This decision was not only due to health concerns, but also to accommodate workers' need for more flexible work arrangement due to closure of day-care centres and the shift of schools to remote learning. While the extent of remote work will likely subside over time, many employers have discovered that they can reduce operating costs by reducing the footprint of their office buildings. Thus, it is very likely that the new post-pandemic normal will include a higher level of remote work.

We use the term Work-From-Home (WFH) as shorthand for various situations of a job performed away from a standard common (e.g. office or factory) or changing (e.g. delivery routes or client's property- as for a plumber or landscaper) location. In this chapter, the terms WFH and telework will be used interchangeable although they capture slightly different aspects of remote work. WFH specifically refers to work that is performed at home with or without the use of Information and Communication Technologies (ITC), such as a modem or a telephone. A schoolteacher that grades at home or a customer service agent that responds to phone calls from home are both examples of job tasks performed from home. Teleworking instead refers to the use of ITC to connect to the workplace while away from the employer premises, whether that is at home or somewhere else. This difference became blurrier during the pandemic, as most work done from home involved some ITC and there was virtually no remote work performed out of one's home.

Several indexes were developed to measure the intensity of WFH. These indexes can be categorized along two dimensions. The first is whether the index is a continuous measure of the degree to which a job can be performed remotely or an indicator for whether a job can be performed entirely from home. The second is whether the index is based on occupation characteristics or direct assessments of whether occupations are WFH compatible. In any of these cases, researchers have used a variety of methods to collect the information required to construct their indexes.

In this chapter we will review some of the metrics used in the literature to measure the potential that a specific occupation is suitable for telework. This is important because WFH was often the only option for businesses to remain open during the first part of the pandemic. Thus, some occupations may have been better equipped to weather the storm created by the COVID crisis. We then review the WFH experience of several countries both before and during the pandemic. The comparison between the two time periods is difficult because WFH, while somewhat common even before the pandemic in high-income countries, was typically understood to supplement the standard workday on the employer's premises. During the pandemic, WFH became a substitute for working on the employer premises. Since the degree of teleworkability changes based on the nature of the occupation, the effects of the pandemic were not homogeneously distributed across the population. We review the results of the literature on two important dimensions of inequality: the gender wage gap and income inequality and the effect of WFH on mental and emotional health. Finally, we review some evidence of the effect of WFH on worker's productivity in general and during the pandemic and conclude with a description of what WFH may look like after the pandemic, by describing the process towards a possible "new normal" in the labour market.

I. Measurements WFH capacity.

Perhaps the most widely recognized index of WFH capacity is the Dingel and Neiman (2020) indicator that classifies occupations by whether employees in their jobs can complete their work entirely from home (from here onward we use “DN” to refer to both the index and the 2020 paper). They develop this classification using information from the United States Bureau of Labor Statistics Occupational Information Network (O*NET). The index combines information from 15 different questions across O*NET’s Work Context and Generalized Work Activities Questionnaires. If any of the fifteen conditions is true, the DN index codes that occupation is unable to be performed at home. Table 1 lists these fifteen conditions. By its construction, the DN indicator seemingly sets a high bar for WFH eligibility.

{ table 1 here }

Combining this index with occupational employment numbers from the US Bureau of Labor Statistics, DN estimate that 37 percent of US workers can entirely perform their jobs from home. While this is a sizable share of the workforce, the aggregate number masks important heterogeneities across occupation groups and geographies. DN find a wide range of WFH feasibility across broad occupation groups, ranging from 0 percent for groups such as *Food Preparation and Serving Related Occupations* to 100 percent for *Computer and Mathematical Occupations*.

We should also note the DN index was constructed specifically to analyze the impact of social distancing measures enacted during the Covid-19 pandemic. Hence the emphasis on complete WFH capability. As such, this measure may be more limited in developing an understanding of which jobs are likely to return to the office first in a hybrid WFH arrangement as the pandemic continues to wind down or which jobs will continue in a hybrid format in future. Montenegro et al. (2020) also investigate the socio-demographic divide in early labour market

responses to the U.S. COVID-19 epidemic and its policies. They find that job loss was larger in occupations that (among other tasks) cannot be performed remotely. Their *remote work index* is a composite index resulting from the average of the responses to the questions regarding i) the frequency with which respondents use electronic mail, ii) whether the job requires written letters and memos, and iii) how often they have telephone conversations².

Moving outside the US, the DN index has been applied to other countries. Using the DN index, Beland et al (2020b) estimate that 37.5 percent of Canadian jobs can be performed remotely. The remarkable similarity to the DN estimate for the United States reflects a strong correlation in the occupational distribution of jobs between the two countries. By using the DN index, differences in the aggregate share of WFH capable jobs comes from differences in the occupational shares of employment between the two countries. This assumes production technologies are at least highly similar between the two countries, such that a given occupation has the same work content and activities across both economies. While this assumption is reasonable in the Canadian context, it may not apply when estimating WFH capability in other countries. However, the lack of an O*NET type database in many countries leaves researchers looking for alternative methods of developing a WFH index.

Focusing on Europe, Palomino, Rodriguez and Sebastian (2020) investigate the capacity of individuals in European countries to work under a lockdown based on a "Lockdown Working Ability index" which measures individuals' teleworking capacity and whether their occupation is essential or closed. Their findings highlight a large heterogeneity across European countries (northern countries score much higher than southern countries) but also across gender, type of contract (permanent vs temporary; full-time vs part time), and education level. Significant variability, both across as well as within occupations and industries in the share of tasks that can be done from home is found also by Adams-Prassl et al. (2022). Globally, Garrote et al (2021)

² Such an index is also used by Kosteas and Renna (2021) who use the concentration index to estimate income-related inequality in unemployment in the US and to analyze the change in inequality between February and April of 2020.

estimates that one in every five jobs can be done remotely, but the ratio drops to one in 26 jobs for low-income countries.

There have been several efforts to compare estimates using the DN index to other measures of teleworkability. Holgerson et al (2021) use Amazon's Mechanical Turk to gather responses on whether jobs can be performed from home. Mechanical Turk is an online marketplace where jobs can be posted to freelance workers. Specifically, the authors posed the question "Can this type of job likely be performed from a home office?" followed by a brief description of the occupation in question. Using this method, they collected at least 20 responses for each of 426 occupations. Applying employment weights to each occupation, they estimate 38 percent of Norwegian jobs can be performed from home. In contrast to the O*Net surveys, the respondents in this study may not have direct experience or familiarity with the occupations they are evaluating, raising questions about the accuracy of the resulting index. In spite of this limitation, the authors find their index yields a similar result to employing the DN index, which yields an estimate of 43 percent of Norwegian jobs as being WFH compatible. Conversely, Alipour et al (2020) find that the DN index underestimates the true level of teleworkability in Germany. Using information from an employee survey on whether individuals ever WFH or believe their jobs could be performed remotely, the authors estimate that 56% percent of German jobs could be performed either partially or entirely remotely. Constructing a task-based indicator similar to the DN index using employee responses regarding work tasks, they estimate WHF capability of 34 percent.

While the DN remains the dominant index to measure WFH capability, the literature provides several alternatives. Boeri et al (2020) integrates information from O*NET on whether jobs require personal interaction with information from a survey conducted by the Italian Statistical Office and INAPP (as well as their own personal judgements) to ascertain whether these interactions need to be face-to-face or if they can be performed remotely. Using this alternative WFH index they estimate WFH capability rates ranging from 23.95 percent for Italy to 31.38 percent for the United Kingdom, with estimates for France, Germany, Spain, and Sweden falling

between the two. Barbieri et al (2021) use data from the INAPP_ICP dataset, the Italian equivalent of O*NET, to construct a continuous measure of WFH feasibility for Italian workers and estimate an overall WFH index average of 49 (on a 0-100 scale). They created a composite index that proxies for the feasibility of a remote working arrangement using responses to the following seven questions: i) importance of performing general physical activities; (ii) importance of working with computers; (iii) importance of manoeuvring vehicles, mechanical vehicles or equipment; (iv) requirement of face-to-face interactions; (v) dealing with external customers or with the public; (vi) physical proximity; (vii) time spent standing.

The indexes in Barbieri et al (2021), Boeri et al (2020), and Montenovolo et al (2020) capture different dimension of WFH potential, as evidenced by modest correlations between them. The rank correlation between the index in Barbieri et al (2021) and Boeri et al. (2020) is 0.57 (up to 0.81 using alternative indexes), while the rank correlation between the index in Barbieri et al (2021) and Montenovolo et al. (2020) is 0.55. In fact, the lists of the top 10 occupations that can be performed remotely varies according to the three categorizations. For example, both Boeri et al (2020) and Montenovolo et al. (2020) highly rank managerial jobs despite these occupations requiring interactions with administrative staff, junior managerial positions, and customers. On the other hand, Barbieri et al. (2021) favours occupations in the service sector whose tasks can be clearly done from home with little to no interaction with other people (Table 2).

{ Table 2 here }

The literature also points out that the capacity to WFH of local labour markets areas may influence the effects of *lockdown* measures. Caselli et a. (2020) show that areas with a higher proportion of professions that can be done remotely are characterised by a smaller increase in mobility after re-opening. Moreover, a positive correlation between average wages and WFH capability has been detected. The 37 percent of jobs amenable to DN's definition of WFH account

for 46 percent of wages in the US, reflecting the fact that jobs requiring greater human capital investment are more likely to be WFH compatible. Similarly, Bonacini et al. (2021) show that employees working in sectors with high WFH capacity obtain, on average, a greater annual labour income than the others (€27,300 vs €24,700). In the Italian case, economic sectors being characterized by greater shares of employees with high WFH feasibility are: Finance and Insurance; Information and Communications; Professional Services; Other Business Services (e.g. car renting, travel agencies, employment agencies); and Public Administration. Within each economic sector, occupations with a high WFH index receive a “wage premium” in most, but not in all cases. Examples of sectors in which positions with high WFH capacity earn a lower labour income include Leisure and Hospitality and Personal Services. These patterns are also reflected in the geographic distribution of WFH potential. In the US, the metropolitan areas with the highest rate of WFH tend to have large tech sectors, while for Italy WFH potential is higher in regions where public administration, insurance, and banking services are concentrated.

Outside of high-income countries, we see a variety of approaches taken to estimate WFH potential. Leone (2020) cites a telephone survey where 46 percent of Brazilian respondents indicated their jobs can be performed at home. This figure differs considerably from Leone’s estimate based on household surveys conducted by the Brazilian Institute of Geography and Statistics that 13.5 percent of Brazilian workers transitioned to WFH during the early months of the pandemic, raising questions about the reliability of the telephone survey and worker perceptions of whether their jobs are WFH compatible. This self-reported WFH compatible share is also much higher than estimates developed by Saltiel (2020) who constructs a task based WFH index using data from the Skills Toward Employability & Productivity (STEP) survey for ten low and middle-income countries, with estimates ranging from 5.5 percent for Ghana to 23 percent for the Yunan Province in China. By using data from the countries examined, the authors are not assuming US production methods, as implicitly occurs when applying the O*NET data. Gottlieb et al use the STEP survey to construct a WFH index based on 5 work characteristics and apply this index to

develop WFH share estimates for the following low-income countries: Armenia, Bolivia, China (Yunnan Province), Colombia, Georgia, Ghana, Kenya, Laos, Macedonia and Vietnam. They find 9.8 percent of jobs in this group of countries are amenable to WFH. They also construct WFH share estimates using the DN index and find the latter overstates the WFH capability compared with their measure. Using the same methodology and data from the STEP surveys for Bolivia and Columbia, Delaporte et al (2021) provide WFH estimates for 20 Latin American and Caribbean Countries, ranging from a low of 7.5 percent for Nicaragua to a high of 15.8 percent for Barbados. For comparison, the authors use the DN index and find that it yields higher rates of WFH for these countries compared with their measure.

Finally, we note a couple of papers that introduce the importance of accounting for infrastructure requirements, specifically home internet access, when estimating the share of jobs that can be performed from home. Hatayama et al (2020) provide WFH capability estimates for 53 countries using an index constructed from three task indexes: 1) physical/manual intensity, 2) face-to-face intensity, and 3) low ICT use at work. They also construct an adjusted WFH capability index by including information on whether the individual has an internet connection at home. Interestingly, when controlling for internet access, the study finds the US has a lower rate of WFH amenability than most OECD countries. The authors also show that accounting for internet accessibility leads to substantially lower estimates of WFH capability. It is important to account not just for whether a job can be performed remotely, but whether the infrastructure exists for workers to perform these jobs from home. This finding is corroborated by Sanchez et al (2021) who show that 90 percent of WFH compatible jobs in the US require home internet access and accounting for internet access decreases the estimated WFH compatible share of jobs across 107 countries from 23.9 to 18.7 percent.

II. WFH experience before and during the pandemic

WFH before the pandemic

The incidence of individuals working from home (at least one day per week) was steadily increasing in the years preceding the pandemic but remained low. In the 80's, less than 1 percent of all workers in the US primarily worked from home (Mateyka, Rapino, and Landivar, 2012). With the intensification of ICT in the first two decades of the 21st century, more and more individuals started working from home, although this was done mostly on an occasional basis. However, the incidence of telecommuting before the pandemic varied dramatically across countries, between sectors within a country, and even within the same sector according to the managerial style of the company.

In the U.S., most telecommuters did not work full-time from home. More than 1 in 5 respondents to the American Time Use Survey in 2019 reported doing some work from home. Doing some work at home, however, is not the same as WFH. In WFH, home becomes an alternative to working on the employer premises. Most telecommuting activity before the pandemic represented a continuation of a full day of work in the office which included checking work email or taking some work home. Only 5.7 percent of respondents to the American Community Survey (ACS) reported their home as principle workplace in 2019 up from 4.3 in 2010 (figure 1). This estimate is derived from the response rate to a question on how workers commute from home. Respondents were classified as working from home if they reported “worked at home” in response to that question and covers the commuting method used on most workdays.

{ figure 1 here }

Individuals engaging in WFH have done so inconsistently. Therefore, the rate of WFH over a longer period of time is higher than the annual rate. Using ACS data from the 2014-2018, Beland et al (2020a) estimate that 10.5 percent of US workers worked from home prior to the pandemic. While their measure of the actual rate of WFH in the US is far lower than the DN estimate of the share of workers who could WFH, it still may overstate the share of workers who always WFH by

including workers on a hybrid model where they go to the office one or two days a week or one week every month. In fact, full-time workers average about 8 hour per day at the workplace, but less than 4 hours per day from home.³

The rate of working from home varied dramatically from country to country. Some of these differences may be related to the degree of ICT technology availability in the country but also differences in work culture. For example, only 13% of employers in Spain were keen to offer the possibility to work from home to their employees (Eurofound and the International Labour Office, 2017). In contrast, Swedish managers were more inclined to let their employees work from home (Vihelmsen and Thulin, 2016). Not surprisingly, Sweden has a WFH rate higher than the average in Europe, while Spain's WFH rate is below the European average (figure 2). Other European countries with high WFH rates include Denmark, France, Finland, Netherlands, Norway, and Belgium. The WFH rate in these country was higher than 12%. On the other end of the spectrum, Germany, Bulgaria, Cyprus, Italy, Slovakia had WFH rates below 4%.

{figure 2 here}

Telecommuting was more prevalent among selected occupations. According to Bloom and Van Reenen (2007), more than 40% of managers in Germany and the UK occasionally worked from home, and not trivial shares of managers workers from home in middle- and low-income countries as well. On the lower end of the wage spectrum, telecommuting was common among workers in call centers (Bloom et al, 2015). However, there was a lot of heterogeneity in the adoption rate of telecommuting practices even among firms within the same industry. This had to do with a well-documented variety of managerial styles, with some firms being more open than others to include telecommuting among their work-flexibility options. (Bloom, Kretschmer, and Van Reenen, 2009)

Take-up rates added an additional layer of heterogeneity to the prevalence of WFH. According to a survey by the International Foundation of Employee Benefit Plans, 75% of US employers listed

³ <https://www.bls.gov/news.release/atus.t04.htm> accessed on 9/14/2021

remote working as one of their flexible work arrangements in 2017.⁴ Yet, only 23% of U.S. workers reported some WFH that year according to the American Time Use Survey. In Germany, a survey of ICT companies indicates that 57% of them offered the possibility to WFH in 2013, but only 12% of workers took advantage of this opportunity (TNS Infratest and ZEW, 2014). These low take-up rates led to a line of research, mostly outside economics, which focused on the determinants of the decision to work remotely. Most studies point to married women having a higher probability of telecommuting (Popuri, 2003; Brenke, 2014) especially when looking at individuals working full-time from home (Sarbu, 2015). The presence of children in the household increased the probability of telecommuting (Sarbu, 2015, Popuri 2003; Brenke, 2014). Commuting time (Peters 2004) is correlated with a higher incidence of working from home while the need to interact with colleagues and teamwork (Popuri 2003) decreased the probability of working remotely. Age and tenure have mixed impacts on the decision to telecommute (De Graaff, 2003; Popuri, 2004). Finally, education was found to be a key determinant of working remotely (De Graaff, 2003, Popuri, 2003; and Noonan, 2012) due at least in part to more educated employees being more likely to have the option to work remotely.

WFH during the pandemic

The pandemic abruptly accelerated the rate of adoption of WFH. In Table 3 we provide estimates for the share of US workers who shifted to full time work as a result of the pandemic. The estimates are constructed using the United States' monthly Current Population Surveys from May 2020 through September 2021. Specifically, respondents were asked "*At any time in the LAST 4 WEEKS, did you telework or work at home for pay BECAUSE OF THE CORONAVIRUS PANDEMIC?*" (Flood et al 2021). As a result, the estimates provided in Table 3 represent the added share of remote work, not the total share who are working from home. We present estimates for the

⁴ <https://www.ifebp.org/bookstore/flexible-work-arrangements/Pages/flexible-work-arrangements-2017.aspx>

following categories: all workers, full vs part-time, between 18 and 64 years of age, male vs female, black, Hispanic, and non-Hispanic whites. All estimates are constructed using population weights.

{Table 3 here}

For the full sample, we observe 35.5 percent of US workers in May 2020 were working from home as a result of COVID. This share declines to 13.2 percent in September 2021. It is unclear whether the share of workers who telecommuted at least on some days declined by this amount or whether some respondents view their continued telecommuting as due to labour practice rather than the ongoing pandemic. While the overall trend is sharply downward, we do observe an increase in the share of workers shifting to WFH due to the pandemic in December 2020, coinciding with a rise in case counts in the US. We also see that part-time workers have higher rates of COVID induced WFH relative to full-time workers and non-Hispanic white Americans have higher rates than black or Hispanic Americans. Women also report higher WFH rates relative to men, but some of this difference may be due to a higher fraction of women exiting the labour force, especially those previously employed in jobs that did not afford them the opportunity to WFH.

The 35.5 percent number is remarkable given that it only represents those who are working from home some of the time due to the pandemic and is close to the 37 percent of US jobs estimated by DN as being amenable to complete WFH. Adding the 10.5 percent of US workers estimated to be working primarily from home prior to the pandemic (Beland et al, 2020) yields a total share of the US workers who telecommuted at least once during the previous month of 46 percent. Beland et al (2020)'s finding, combined with Hensvik et al (2020) 's estimate of 15 percent of work hours performed remotely prior to the pandemic, indicates the share of hours worked remotely might exceed the share of workers who WFH. By either metric, share of hours or share of workers, roughly half of employment during the early months of the pandemic included WFH. What do we make of these combined WFH estimates? First, these estimates include workers in hybrid on-premise and WFH arrangements; the share of workers who fully WFH during the early stages of the pandemic was likely much lower. Second, the share of workers who completely or

partially WFH during that time was likely higher than 50 percent as the Beland et al (2020) estimates did not capture those who WFH less often than they commuted to work (e.g. two days at home and three days in the office each week). Finally, the significant decline in the share of workers who reported working from home at least once in the previous month due to the pandemic supports the narrative that firms were making a short-term trade-off early in the pandemic between (at least perceived) worker productivity and safety.

Using the April & May Google Consumer Surveys, Brynjolfsson et al (2020) find that 35 percent of US workers who were employed prior to Covid-19 switched to remote work during the pandemic, while another 15 percent of US workers already WFH prior to the pandemic. Their estimate of the percent of workers switching to remote work is in line with our estimates presented in Table 3 for the same time period. The latter estimate is considerably higher than Beland et al (2020). It is unclear whether the differences in these two estimates are due to differences in question wording or sample construction as other statistics presented by Brynjolfsson et al (2020) differ from the official Bureau of Labor Statistics estimates.

The estimates presented above are based on household/worker surveys, which is the norm in this literature. Breaking with this tendency, Bartik et al (2020) use employer surveys to estimate rates of WFH for the United States during the pandemic. Defining remote work as 2 or more days per week WFH, they find that 45 percent of firms in a survey of small business leaders report having any workers operating remotely, while in a small sample of business economists, half of firms have at least 40 percent of their employees working remotely. In both samples, respondents reported a belief that a significant minority of workers (40 and 36 percent, respectively) will be able to continue to WFH post pandemic.

Outside of the United States, we observe actual WFH rates that match the general patterns of WFH capability predictions. In general, higher income countries have higher rates of actual WFH during the pandemic. We also observe similar patterns outside the US in which workers are working from home as we observe in the United States. In order to test their WFH capacity

measure, Alipour et al (2020) use an employer survey to estimate the share of firms by industry that intend to “rely more heavily on working from home” in response to the pandemic. They find similar patterns to the US and other developed countries.

Okubo (2020) estimates the WFH rate in Japan rose from 6 percent in January of 2020 to 17 percent in June of 2020. This 11-percentage point increase is far more modest than the roughly 31 percent US workers who reported WFH due to the pandemic in that same month and much lower than what is observed in many high-income European countries. The author points to Japan’s lower rate of Covid cases, its “soft” lockdown approach to the pandemic, and its unique corporate culture as reasons for why Japan had a lower WFH rate compared with these countries during the early months of the pandemic. Part of the difference may also be attributable to their narrower definition of telework. Okubo (2020) reports similar occupational patterns in WFH as in the US workforce along with a similar urban-rural divide. They also find a much lower rate of WFH in small and medium-sized firms compared with larger ones.

Gottlieb et al (2021) estimate 13.3 percent of Brazilian workers started working from home in the second quarter of 2020 while 10.6 percent of Costa Rican workers worked WFH during that same period. These figures are remarkably close to the 14.8 percent of Brazilian jobs and 13.8 percent of Costan Rican jobs estimated by Delaporte et al (2020) that are WFH compatible. In both countries the authors show a positive correlation between rates of WFH and higher paying occupations. They also find women are far more likely to WFH than are men.

III: The impact of WFH on the labour market

The WFH and the gender wage gap

A source of concern is whether WFH will penalize women in the labour market even more or facilitate the Gender Wage Gap (GWG) convergence. Arguments can be made for either cases. If teleworkers enjoy a wage premium (due to their characteristics, more often highly educated, skilled) and women are less likely to work on jobs that are suitable to be performed remotely, an expansion

in the relative number of these jobs (or an increase in the premium over time) will worsen the existing GWG. Conversely, if women did not apply to some high paying positions because they were not compatible with their traditional roles in the household, as these positions become telecommutable they become more appealing to women and WFH can help to close the GWG. In line with the latter point, Goldin (2015) suggests that the American GWG is due in part to a lack of flexibility in work arrangements, particularly in sectors with a higher WFH attitude. Similarly, Bertrand (2018) show that, since GWGs are mainly driven by rewards for long hours and working non-ordinary hours, an increase in time flexibility may decrease the GWG.

A few articles have evaluated the effect of WFH on the GWG without a clear consensus whether the former increases or decreases the latter (Leslie et al., 2012). Sullivan and Lewis (2001) indicate that WFH exacerbates gender inequalities since it reinforces women's responsibility for childcare and domestic responsibilities. Similarly, a positive association between the number of teleworking days and the GWG was found in the UK and the US (Smithson et al., 2004; Pabilonia and Vernon, 2020). In contrast, Weeden (2005) shows that flexible work arrangements do not affect the GWG in the US. While WFH is associated with a positive wage premium for both men and women, these premiums are similar across the two demographics, thus they do not affect the overall gap (Gariety and Shaer, 2007). Arntz et al. (2019) show that in Germany, WFH is associated with a reduction in the gender gap in terms of monthly earnings (because contractual hours increase more among mothers), but, on the one other hand, with an increase in the standard GWG because it is associated with higher hourly wages for fathers but not for mothers, unless the latter change employers.

The COVID-19 experience added an extra level of complexity to the issue of gender inequality. Women were impacted more greatly than men by the pandemic. Women were more likely to work from home than men, either by mandate or as a personal choice following the closure of schools and day-care centres in many countries. In fact, the increased burden of childcare fell disproportionately more on women (Alon et al., 2020b). Real-time data on daily lives in the UK

confirm that, irrespective of their employment status, women WFH have undertaken more childcare than men during the pandemic (Sevilla and Smith, 2020). Similarly, in Italy and in the US most additional housework and childcare associated with the COVID-19 situation has fallen on women (Del Boca et al., 2020, Zamarro and Prados, 2021).⁵ Çoban (2021) found that having children at home makes WFH more preferable for women than for men because they are able to spend more time on childcare and other household production, revealing that the rapid spread of WFH exacerbates gender inequality in domestic work, thereby increasing work-life imbalances for women.

Moreover, women were more likely to lose their jobs due to the pandemic (Adams-Prassl et al., 2020a; Farré et al., 2020) and they were more concerned about the pandemic having a negative impact on their careers, compared to men (Baert et al., 2020b). The share of female workers is larger in sectors with a higher risk of COVID-19 contagion (Bertocchi, 2020) and those affected by lockdown measures (Hupkau and Petrongolo, 2020). Adams (2020) shows a positive association between female participation in the labour market and female exposure to the risk of contagion, while Besart and Gaurav (2020) emphasize that a larger share of female employment is found in occupations that are intensive in terms of face-to-face interactions. Adams-Prassl et al., (2020b) show that women are more likely to be in jobs where fewer tasks can be performed remotely.

The early indication is that some of the WFH initiated by the pandemic is going to become permanent. It is unlikely that economies will return to their pre-pandemic *modus operandi*. How much of the COVID induced WFH will become permanent and its potential impact on the GWG remains an open question. Employing an unconditional quantile regression within Oaxaca–Blinder type decomposition, Bonacini et al. (2021b) estimate whether and to what extent a permanent increase in the incidence of WFH can influence the GWG at the mean and along the whole wage distribution. Specifically, using pre-pandemic data, they predict that the current pandemic may have increased the overall GWG, since the gap is greater for females working in an occupation with a

⁵ Thomason and Macias-Alonso (2020) argue that caregiving, where women are over-represented, is relevant work as well as underpaid.

high level of WFH propensity. They argue that the large-scale and (probably) persistent diffusion of remote working practices implemented during the current pandemic could exacerbate the GWG in the medium-to-long run. On the contrary, using a randomized experiment among Italian workers during the pandemic, Angelici and Profeta (2020) predict that the flexibility of WFH can reduce gender inequalities.

WFH, wage premiums, and income inequality

Before the 2000's, employers generally did not view WFH favorably and WFH was associated with a wage penalty (Oettinger, 2011). As ICT technologies improved and WFH slowly became a more widespread flexible working condition, this penalty disappeared turning into a wage premium. In fact, Pignini and Staffolani (2019) conclude that teleworkers benefit from a wage premium between 2.7 and 8% depending on gender and the job position. It is natural to wonder how the mass mandated WFH policies during the pandemic have affected wages and ultimately inequality. So far, the literature has been unable to comprehensively investigate this issue due to the lack of timely and reliable data. Typically, nationally representative datasets on population incomes and living conditions are available with a considerable lag (Gallo and Raitano, 2020). Information on labour earnings from 2020 has become available only recently. To overcome this limitation, some researchers have resorted to ad-hoc surveys (Adams-Prassl et al., 2020; Galasso, 2020) or even data from bank records (Aspachs et al., 2020). However, these types of studies are not representative of the entire population, and thus cannot provide reliable estimates of changes in the income distribution during the pandemic. Some notable exceptions are a few of studies based on the UK Household Longitudinal Study COVID-19 Supplement (Benzeval et al., 2020; Witteveen, 2020) and some studies based on US's Bureau of Labor Statistics datasets (Berman, 2020; Cortes and Forsythe, 2020). Overall, these studies conclude that individuals at the top of the income distribution experience a smaller contraction in earnings than those at the bottom.

The ability of individuals at the top of the income distribution to remotely work from home was a significant contributor to increased inequality during the pandemic. In fact, Bonacini et al (2021a) show that a positive shift in WFH capacity in Italy would lead to an increase in average labour income, but this potential benefit would not be equally distributed among all workers. Specifically, an increase in the capacity to work remotely would favor older, highly educated, and higher paid workers. Thus, the authors suggest that the crisis may exacerbate pre-existing inequalities in the labour market, without adequate policies to counterbalance the effect of permanent increases in WFH. Therefore, the authors suggest that policies aimed at reducing inequality, such as income support measures (in the short run) and human capital interventions (in the long run), may become even more important in the future.

As previously noted, Palomino et al. (2020) estimated the ability of individuals to work under a lockdown based on a Lockdown Working Ability index, which combines teleworking capacity and essential occupation designation, for 29 European countries. Under their four different scenarios, the headcount poverty index increases on average between 4.9 and 9.4 percentage points and the Gini coefficient rises on average between 3.5% and 7.3% as a result of the pandemic. Similarly, Delaporte and Pena (2021) look at the distributional outcomes of social distancing policies imposed during the pandemic in the Latin America and Caribbean region. They find that both poverty and labour income inequality have increased, and the majority of the income losses can be ascribed to the sectoral and occupational structure of the economies. Adams-Prassl et al. (2020) explore the inequality in job and income losses based on occupation and individual characteristics for the US and the UK. Their findings show that workers unable to work remotely are more likely to lose their job and that younger and less educated workers have a higher probability of experiencing a decrease in labour income.

Looking at the Turkish labour market, Duman (2020) concludes that rising wage inequality during the COVID-19 crisis can be traced back to supply shocks from government-imposed confinement policies. However, Aina et al. (2021) conclude that although these distributional

effects have been more pronounced among those in the lowest quantiles of the labour income distribution, WFH has mitigated these negative effects. Indeed, on average, workers who have been able to work remotely have received a wage premium, and this is especially true for those at the bottom of the distribution. Moreover, when the authors derive a WFH capacity index to test the potential long-lasting effects of working remotely, they find that the index underestimates the positive advantage of WFH for workers at the bottom of the wage distribution. The relative advantage of workers at the lowest quantiles, therefore, is likely to decline in the long term, suggesting that WFH benefited this group of workers only during the emergency.

In contrast, Irlacher and Koch (2021) concluded that high-wage earners benefitted the most during the pandemic in Germany. Using the latest wave of the German Qualifications and Career Survey, they found a wage premium of more than 10 percent associated with jobs amenable to WFH that remained significant after accounting for a large number of controls. However, these gains are concentrated among high-income workers. Almost 80% of workers in the top decile of the wage distribution can work remotely, compared to only 13% in the lowest decile. The authors also investigate regional disparities in WFH capacity in Germany and show that districts with a low share of WFH jobs also have a lower average income. More specifically, they point out that the new federal states of the former German Democratic Republic exhibit a low share of WFH jobs.

WFH and worker's productivity during a pandemic

Before the restrictions imposed by the lockdown, many employers resisted WFH arrangements out of concern that unsupervised employees may shirk during working hours. Even without shirking, WFH may still have a negative impact on productivity if face-to-face interactions are believed to be essential for daily business. However, arguments can be found for why productivity may go up when working from home. A reduction in commuting time, the need to take fewer breaks, and being in a quieter environment can all boost worker's productivity. Thus, the type of task performed

on one's job may determine whether productivity increases or decreases when working from home. In fact, Dutcher (2012) find that telecommuting has a positive effect on productivity of creative tasks but a negative effect on productivity of dull tasks. An important factor to consider, however, is whether the worker's tasks involve some teamwork activity. In that situation, co-workers are negatively affected by telecommuting colleagues and the team performance declines as more and more team members work from home (van der Lippe and Lippenyi, 2019).

There are only a few experimental studies of the impact of WFH on worker productivity before the pandemic. A notable exception is Bloom et al (2015) based on the call center of a large Chinese travel agency. Using a randomized designed, they conclude that workers who were assigned to WFH were 13% more productive than individuals assigned to work from the employer's premises. Seventy percent of this increase was due to the fact that individuals who WFH worked longer. The remaining 30 percent represents an increase in the number of calls per minute. There is, however, a lot of ex-ante uncertainty about the benefits of WFH, not only from the point of view of the employer, but also for the workers. In fact, when the Chinese travel agency decided to make the WFH option permanent after the positive results of the experiment, about half of the individuals who had previously selected to work from home decided to return to the office. For many individuals, working for home initially held appeal but it quickly wore off. Loneliness was the most cited concern among those working remotely. Firm productivity increased by 22% after the reallocation of workers following the initial experiment.

Mental health concerns complicate any evaluation of the natural experiment in WFH created by the pandemic, as increased feelings of isolation are one potential downside of WFH. Thus, poor mental health may have counter-acted the positive effect of WFH on productivity. In fact, the decline in work productivity during the pandemic was strongly correlated with a decline in mental well-being (Etheridge and Wang, 2020). Comparing subjective measures of productivity pre and post lockdown, respondents reported a decline in productivity in Japan (Morikawa,2020) and in the

US (Bartik et al, 2020) but not in the UK (Etheridge and Wang, 2020). Some common factors emerge across these studies:

- The effect of WFH on productivity was not homogenous across all occupation. Workers in occupations more suitable to WFH experienced an increase in productivity.
- It takes time and resources to effectively work remotely. Remote work productivity is positively correlated with previous WFH experience.

Women and workers in low-paying occupations exhibited the largest reduction in productivity during the pandemic (Etheridge and Wang et al, 2020, Feng and Savani, 2020). The quality of telecommunication equipment and difficulty of quick communication are commonly cited as reasons for the decline in productivity. But much of the decline in productivity may be due to the lockdown itself. As many schools moved to remote learning, the presence of children at home had a negative impact on the productivity of individuals working from home, especially women (Etheridge et al, 2020).

WFH and physical and mental health

As previously mentioned, the pre-pandemic literature pointed to a potential negative impact of WFH on mental health (Tavares 2017). As the experiment in Bloom et al (2015) highlights, some workers who telecommuted missed the more direct social interaction with coworkers in the workplace, leading to an increase in feelings of isolation. These problems were exacerbated during the pandemic, as social gathering restrictions and fears of contagion further heightened the feeling of isolation. In the US, the amount of substance abuse increased dramatically during the pandemic, usually used as a coping mechanism to the stressors created by the pandemic.⁶ Increased stress and burnout have been extensively documented for essential worker and first responders (Lai et al, 2020; Bettinsoli et al, 2020). But deterioration in mental well-being was also common among those

⁶ <https://www.apa.org/monitor/2021/03/substance-use-pandemic>

working from home (Evanoff et al, 2020). While it is difficult to separate the specific impact of WFH from the general pandemic induced anxiety, the pre-pandemic literature suggests that some of the decline in mental health may be directly related to WFH. This decline was larger for women and low-income workers (Xiao et al, 2021). In fact, Ghosh and Renna (2021) show that stress inequality increased in the UK during the pandemic. The increase in stress for women working from home was associated with increased childcare responsibility (Sato et al, 2021). However, there is a lot of heterogeneity on the impact of WFH on mental health. Individual characteristics and personal circumstances play an important role on whether WFH has a negative or a positive impact on mental health. Some workers reported an increase in mental well-being following the adoption of WFH practices (Anderson et al, 2015). A reduction in commuting time and the prospect of a healthier work-life balance are important advantages of WFH which should not be discounted.

The shift from in-person to remote work can also affect physical health (Xiao et al, 2021). Not every worker was able to easily adapt to the abrupt changes in work arrangement brought by the pandemic. Some individuals did not have a designated space at home or ergonomically appropriate workstations (Larrea-Araujo et al, 2021). Poor work conditions can explain the increases in musculoskeletal problems among telecommuters during Covid (Radulovic et al, 2021). Moreover, the extended screen time due to most meetings being moved to virtual platforms has led to an increase in eye problems (Saldanha et al, 2021).

Conclusions: toward a new normal?

In the current Covid-19 crisis, the opportunity to work from home (WFH) has become a crucial tool which has allowed workers to maintain employment and firms to remain open, while overall limiting infection spread and the risk of even larger macroeconomic recessive impacts. During the lockdown, several OECD countries recorded rates of WFH close to 50% of the working population (OECD, 2021).

Several countries are now facing the fourth wave of the Coronavirus, driven by the greater contagiousness of the Omicron variant. Before the SARS-COV-2 moves from the pandemic to the endemic stage, new waves of infection are still likely and WFH will remain a viable solution to the containment of the spread. Facebook and some other companies, mainly in the Information Technology sector, have already determined they will allow a large number of employees to permanently work from home. The health emergency has forced many companies to accelerate the diffusion of remote work leading the way to a revolution about the nature of the workplace in the future (Bonacini et al. 2021a). According to the estimates in Barrero et al (2020), 20 percent of all full workdays will be provided remotely after the pandemic ends, as compared to just 5 percent in 2017–2018. The authors discuss a number of mechanisms that will bring to a structural shift to WFH in the wake of the Coronavirus pandemic, including better-than-expected WFH experiences during the pandemic, investments in physical and human capital that enable and support WFH, a significantly reduced stigma associated with WFH, and a clear desire by many workers to avoid public transport and crowded facilities even after the pandemic ends (Bloom et al. 2021).

In line with the current literature, we believe the COVID-induced shift to WFH will have long lasting effects. Once companies (and workers) have sustained significant fixed costs due to the adoption of WFH technologies, changes in production processes, and the acquisition of the required human capital, it is unlikely that they will want to go back to full in person work arrangements (Brynjolfsson et al. 2020). While we are not likely to revert to old paradigms of work arrangements, the COVID experience has highlighted the health problems associated with fully remote work and the inability of many workers to execute their activity remotely. Moreover, remote working can limit creativity and innovation which typically benefits from interaction and physical proximity between people. Therefore, hybrid work arrangements are likely to become the dominant model for jobs amenable to these arrangements. This trend can be detected in opinion surveys. Less than 1 in 5 US executives in a PwC Pulse Survey was planning on resuming full in-person operation in fall 2021, and only 4% of respondents planned on remaining exclusively remote. The overwhelming

majority of respondents (more than 3 out of 4) embraced the concept of hybrid work or some mix model where some workers are in-person while others are can work remotely. From the employee point of view, more than half of workers in the same survey expressed a preference for working remotely at least two days per week, with only 19% of all respondents having a strong preference for working exclusively from home.⁷

This push should be modelled into something structural in a new way of producing and managing flexible work practices within firms, with a large reorganization of work, particularly in the field of re-engineering of production processes based on new digital technologies⁸ and on the possibility offered in terms of remote work. In this context, the role of public policies in the process towards a possible "new normal" in the labour market is crucial, by favouring complementarities between technology and human capital and by providing new skills not only for workers but also for managers and entrepreneurs.

⁷ <https://www.pwc.com/us/en/library/pulse-survey/future-of-work.html>

⁸ The technology-related issues connected with WFH is surveyed in the Chapter "Covid-19 and Technology" of this Handbook .

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Table 1: Occupation characteristics used to construct the Dingel-Neiman WFH index.

The conditions from the Work Context Questionnaire are:
• Average respondent says they use email less than once per month (Q4)
• Average respondent says they deal with violent people at least once a week (Q14)
• Majority of respondents say they work outdoors every day (Q17 & Q18)
• Average respondent says they are exposed to diseases or infection at least once a week (Q29)
• Average respondent says they are exposed to minor burns, cuts, bites, or stings at least once a week (Q33)
• Average respondent says they spent majority of time walking or running (Q37)
• Average respondent says they spent majority of time wearing common or specialized protective or safety equipment (Q43 & Q44)
The conditions from the Generalized Work Activities Questionnaire are:
• Performing General Physical Activities is very important (Q16A)
• Handling and Moving Objects is very important (Q17A)
• Controlling Machines and Processes [not computers nor vehicles] is very important (Q18A)
• Operating Vehicles, Mechanized Devices, or Equipment is very important (Q20A)
• Performing for or Working Directly with the Public is very important (Q32A)
• Repairing and Maintaining Mechanical Equipment is very important (Q22A)
• Repairing and Maintaining Electronic Equipment is very important (Q23A)
• Inspecting Equipment, Structures, or Materials is very important (Q4A)

Note: All questions come from the O*NET Work Context and Generalized Work Activities Questionnaires. Data are available for over 900 occupations.

Table 2. Comparison between the Barbieri et al. (2021) the Boeri et al. (2020) and the Montenovo et al. (2020) WFH indexes, top 10 occupations

	Barbieri et al. (2021)		Boeri et al. (2020)		Montenovo et al. (2020)	
	<i>CP2011 5-digit</i>	<i>Occupation description</i>	<i>ISCO 3-digit</i>	<i>Occupation description</i>	<i>CP2011 5-digit</i>	<i>Occupation description</i>
1.	25412	Dialogists and lyricists	112	Managing directors and chief executives	11210	Ambassadors, diplomatic career leaders
2.	25411	Writers and poets	133	ICT service managers	11231	Directors of territorial school offices
3.	33132	Professional interviewers	142	Retail and wholesale trade managers	11242	Directors of higher education, research institutions
4.	31230	Internet technicians	212	Mathematicians, actuaries and statisticians	12390	Other directors and department managers
5.	51252	Distance sellers	232	Vocational education teachers	22151	Chemical and petroleum engineers
6.	25430	Interpreters and translators	233	Secondary education teachers	25221	Legal experts in businesses
7.	33131	Information acquisition technicians	241	Finance professionals	31613	Naval pilots
8.	31640	Train traffic organization technicians	351	ICT operations and user support technicians	33131	Information acquisition technicians
9.	21143	Application analysts and designers	412	Secretaries (general)	52312	Travel and cruise assistants
10.	43220	Pay slips compilers	413	Keyboard operators	11221	Government commissioners

Source: Barbieri et al. (2021)

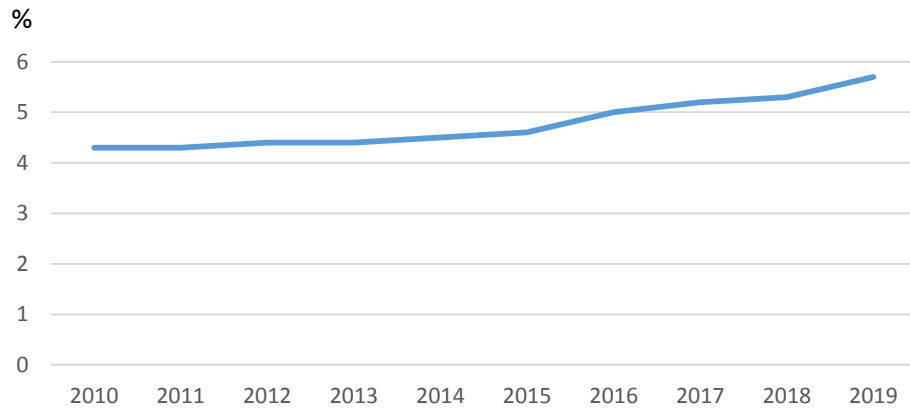
Table 3: Estimated WFH rates for the US during the pandemic

	2020								2021								
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Full sample	35.5	31.3	26.4	24.3	22.6	21.2	21.8	23.7	23.2	22.6	21	18.3	16.6	14.4	13.2	13.4	13.2
Full-time	33.8	28.8	17.6	16.1	16.5	16.4	12.8	14.4	11.4	12.7	13.4	12.7	11.7	8.8	8.2	11.7	9.2
Part-time	36.6	31.4	27	24.7	22.8	21.4	22	24	23.6	22.9	21.2	18.4	16.7	14.7	13.5	13.5	13.3
18-64 years old	36.1	31.9	27	24.9	23.2	21.7	22.3	24.2	23.7	23	21.4	18.7	17.1	14.9	13.6	13.8	13.7
Female	41	35.6	29.3	27	25.7	24	24.5	26.6	25.9	25.1	23	20.1	18.2	15.7	14.2	14.6	14.2
Male	30.8	27.2	24	21.9	19.9	18.8	19.3	21.2	20.8	20.5	19.1	16.6	15.1	13.3	12.3	12.4	12.3
White	38.4	33.6	27.6	25.4	23.9	22.8	23.7	25.6	25.1	24.1	22.3	19.5	17.5	15	13.4	13.6	13.5
Black	29.4	25.7	22.6	21	19.7	17.9	17.9	19.3	18.8	19.5	17.9	14.7	13.6	12.2	10.8	11.2	10.9
Hispanic	23	21.1	18.7	16	14.3	12.7	13	14.3	13.9	13.4	12.9	10.9	9.5	8.5	8	7.9	7.9

Authors calculations from the monthly Current Population Surveys.

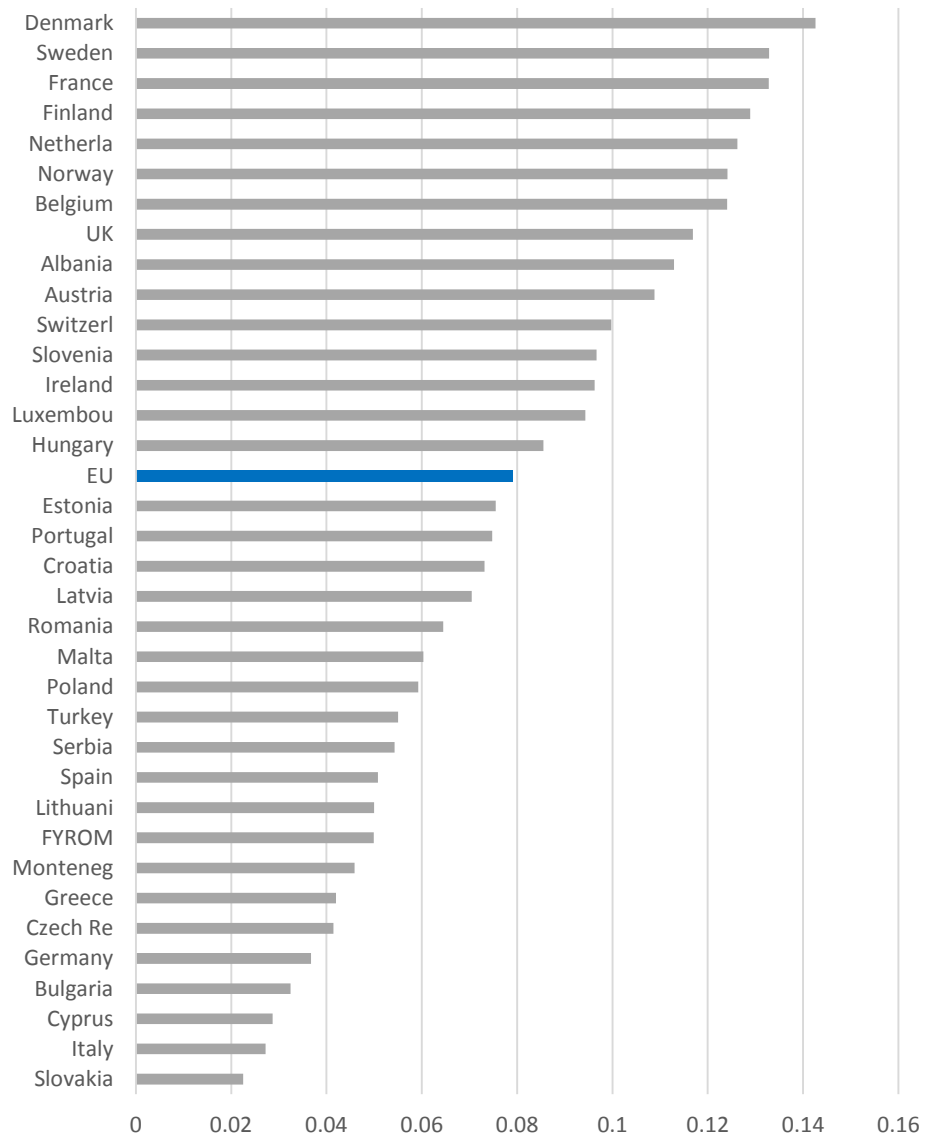
Estimates constructed using population weights.

Fig 1. Incidence of WFH in the US



Source: Authors' calculations using the American Community Survey

Fig 2. Incidence of WFH in EU



Note: rates of WFH daily or several times a week
Authors' calculation from AEWCS, 2015