

Who and how many can work from home in Norway?

Evidence from task descriptions

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Abstract:

The COVID-19 crisis has forced great societal changes, including forcing many to work remotely (work from home) in an effort to increase social distancing. The ability to work from home has long been considered a perk, but we have few estimates of how many are actually able to work from home. This paper attempts to estimate the share of the Norwegian jobs that can be performed remotely by combining register-based labor statistics and the official documentation of the ISCO-08 standard. We find that approximately 39% of Norwegian jobs can be performed at home. The results suggest that the pandemic and the government's attempts to mitigate this crisis may have a quite uneven impact on the population. Those who are already disadvantaged are often less likely to have remote-friendly jobs and thus are hit more severely.

Keywords: Covid-19; Working from home; Job advertisements; Unconventional data; Norway

JEL classification: D24, J22, J61, O30, R12, R32

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Sammendrag

I forbindelse med covid19-epidemien har myndighetene satt i verk en rekke tiltak for å hindre smittespredning. Et viktig tiltak har vært anbefalingen om økt bruk av hjemmekontor. Hjemmekontor har to effekter på smitten ved at det både påvirker i hvilken grad en selv kan bli smittet og i hvilken grad en kan smitte andre. I denne artikkelen undersøker vi i hvilken grad hjemmekontor er mulig for ulike jobber og yrker i Norge. Bruken av hjemmekontor er et fundamentalt spørsmål i arbeidsmarkedet som også er av interesse selv etter at epidemien har gått over.

Vår analyse er basert på to forskjellige typer data: i) informasjon om arbeidsoppgaver for hvert yrke beskrevet i den nåværende internasjonale standarden for yrkesklassifisering (ISCO-08); ii) statistikk over antall arbeidsforhold fra Statistisk sentralbyrå (SSB). Ved å bruke ISCO-08-beskrivelsene av oppgavene som skal utføres, var respondenter fra et online arbeidsmarked, Amazon Mechanical Turk bedt om å vurdere om de tror at disse oppgavene sannsynligvis kan utføres hjemmefra. Basert på svarene etablerer vi en indeks som beskriver hvor sannsynlig det er at jobbene kan utføres hjemmefra for hvert yrke. Ved å kombinere disse indeksene med statistikk om arbeidsforhold, kan vi få informasjon om andelen jobber som kan utføres hjemme.

Resultatene våre viser at omtrent 39 prosent av jobbene i Norge kan utføres hjemme. Disse jobbene er ofte bedre betalt. Andel jobber som kan utføres hjemme varierer mye på tvers av geografiske områder i Norge. Det er en større andel av disse jobbene i store byer enn på landsbygda. Bruken av hjemmekontorer varierer også over undergrupper i befolkningen. I gjennomsnitt er det mindre sannsynlig at innvandrere, lavt utdannede og enslige foreldre har jobber som kan utføres hjemme. Tiltak for å hjelpe disse gruppene bør derfor bli prioritert. Vi har også sett på andel jobber som kan utføres hjemmefra i andre europeiske land. Som forventet opplever vi at rike og mer utviklede land har større andeler av jobber som kan utføres hjemmefra enn mindre utviklede land.

Analysen er et forsøk på å kombinere konvensjonelle og ukonvensjonelle kilder til statistikk- og forskningsformål. Resultatene antyder at det er alternative måter å samle inn informasjon om dette temaet på. Selv om vi erkjenner at undersøkelser og administrative registre fremdeles er den mest pålitelige kilden, antyder vår studie at det er alternative måter å samle inn relevant informasjon på som gir mindre kostnader og som er mer effektive.

1 Introduction

COVID-19 pandemic hit the world hard and unprepared. In a study of the Spanish flu, [Hatchett et al. \(2007\)](#) show that non-pharmaceutical interventions known as “social distancing” during a pandemic can significantly reduce the disease transmission and lower both the peak and cumulative excess mortality. Learning from the historical lessons, many countries, including Norway, implemented measures to limit physical contact between people. Encouraging working remotely (working from home) is one important part of these measures. Not all jobs are remote-friendly and can be performed away from offices.¹ Workers with non-remote friendly jobs are forced into a situation where they have to choose between two unfortunate options: increased risk of infection or substantial economic loss due to lost work opportunities. On the other hand, the prevalence of remote-friendly jobs can be seen as an indicator of the impact of such “social distancing” policy on the economy. However, there is very limited knowledge of the prevalence and characteristics of remote-friendly jobs.

In this paper, we try to answer the question: who and how many can work from home in Norway. Our analysis is based on two different types of data: a) the information of tasks described in the current International Standard Classification of Occupations (ISCO-08), b) official statistics on occupational employment published by Statistics Norway (SSB). Using the ISCO-08 descriptions of tasks to be performed, respondents from an online labor marketplace, Amazon Mechanical Turk (MTurk), are asked to evaluate whether they think these tasks can likely be performed from home. Based on the responses, we establish a remote-friendly measure for each occupation. Combing these measures with occupational employment statistics, we can obtain information on the prevalence of remote feasible jobs. With the help of the employment register, we can also identify what kind of individuals are more likely to have remote-friendly jobs.

We find that approximately 39% of Norwegian jobs can be performed at home. Remote-friendly jobs are often paid better than non-remote friendly jobs. The prevalence of remote-friendly jobs varies a lot across geographical areas in Norway. There is a larger share of remote-friendly jobs in urban than in rural areas. To some extent, this is good news given that urban areas often face bigger challenges in limiting the spread of COVID-19 given their high population density. More importantly, as many have worried, workers who are already disadvantaged in the labor market, such as young entrants, immigrants, low educated and single parents, are often less likely to have remote-friendly jobs. We have also combined our remote-friendly measures with country specific employment data from Eurostat and estimated the prevalence of remote-friendly jobs in other European countries. As expected, we find that rich and more developed countries have larger shares of jobs that can be performed from home than poor and less developed ones.

Studies of remote work feasibility are rare before the COVID-19 pandemic. Among the increasing literature on this issue, almost all studies are based on existing surveys ([Alipour et al., 2020](#); [Barbieri et al., 2020](#); [Mongey et al., 2020](#)). One exception is the study by [Dingel and Neiman \(2020\)](#), where they explore the same question in the United States. While their main analysis is based on the Occupational Information Network (O*net) surveys with questions covering “work context” and

¹A note on nomenclature: For brevity, we sometimes refer to “remote-friendly” jobs rather than “jobs that can be performed remotely”. We use the terms interchangeably, always referring to jobs that can be performed from home. This does not mean that such employees actually work from home either permanently or occasionally.

“generalized work activities, they have also tried to manually evaluate remote feasibility for each occupation themselves. However, existing surveys are often designed for other purposes so that information obtained may not directly answer the question of interest. Moreover, the surveys may be implemented some years back which may lead to concerns of timeliness. Considering the rapid technological progress in information technology, the concern of timeliness may be particularly relevant for this topic. On the other hand, new surveys of a representative sample of all workers are rather costly in time and resource, which makes it not a practical alternative for our purpose. Our approach in this paper is similar to the manual evaluation method applied by [Dingel and Neiman \(2020\)](#). However, we don’t do evaluations ourselves but rely on respondents from MTurk. While we acknowledge that well-designed surveys are still the most reliable source, our study suggests an unconventional data source where reliable information can be easily obtained with much less cost.

We cannot directly test the reliability of the results obtained via MTurk. Instead, we have done several robustness checks. In the first check, we use Norwegian job advertisements published by the Norwegian welfare administration (NAV) between January 2012 and March 2019, in which there are mentions of possibilities to work remotely. We identify those advertisements and construct the relative frequencies of remote-friendly jobs across 9 major ISCO-08 occupational groups. A comparison between the observed frequencies and those predicted using our results could be a crude method for quality check. We also compare our remote-friendly measure with that by [Dingel and Neiman \(2020\)](#). We find that these two results are very similar on the major group level (correlation 0.93), although they differ somewhat on the unit group level (correlation 0.65). [Dingel and Neiman \(2020\)](#)’s results also predict a higher share of jobs which can be done from home than ours, but the difference is rather small (42% vs 39%).

There have been two surveys in Norway that include questions concerning remote work feasibility: The Norwegian labor force survey in 2017 and a recent survey by the Norwegian Institute of Transport Economics (TØI). The Norwegian labor force survey has asked about possibilities of remote work, covered in a report by [Nergaard et al. \(2018\)](#). The question was whether the respondent had the *opportunity* to work from home when she/he wants to. This is not to say that the job could be performed remotely in its entirety, and neither to say that those who weren’t given the opportunity all have jobs that cannot be performed from a home office. According to the labor force survey, around 35% can work from home, which is somewhat lower than what we find in the current analysis. The results on occupation and industry groups are broadly similar to what we obtained but with some differences. For example, around 29 percent of workers in “Clerical support workers” who participated the survey responded that they had the opportunity to work from home at times, much lower than the results we obtained. This is likely attributable to the distinction mentioned above: Not having the *opportunity* to work from home does not necessarily mean that the job can not be performed remotely. The other survey by TØI is designed especially for the COVID-19 situation. The main focus is the effectiveness of remote work ([Nordbakke, 2020](#)). While the survey does provide an overall estimate of the prevalence of remote-friendly jobs (48%), it has a relatively small sample size (950) and contains very limited information: neither occupational nor geographical aspects of the jobs are collected.

2 Method

We want to establish an estimate on the prevalence of remote-friendly jobs in Norway. Although jobs are different, they can be organized into a limited number of occupations according to the tasks and duties undertaken. The ISCO-08 contains 426 occupations (Armed forces occupations are excluded in this analysis) at the unit group level. Detailed task descriptions for these occupations are listed in the ISCO-08 documentation. Using these descriptions, we try to provide an assertion of whether an occupation is likely to be performed from home. To do this, we created a public labeling job through Amazon Mechanical Turk (MTurk) (Amazon, 2020). MTurk is “a marketplace for work that requires human intelligence”. Researchers can generate a Human Intelligence Task that MTurk users can work on. It has gained increasing popularity in social sciences. Researches have shown that MTurk can provide quick and reliable responses at relatively low costs (Buhrmester et al., 2011; Berinsky et al., 2012).

In the task we posted on MTurk, each occupation was presented together with a brief description. The exact question formulation was “Can this type of job likely be performed from a home office?”, and an example of a job description could be:

Electrical engineers conduct research and advise on, design, and direct the construction and operation of electrical systems, components, motors and equipment, and advise on and direct their functioning, maintenance and repair, or study and advise on technological aspects of electrical engineering materials, products and processes.

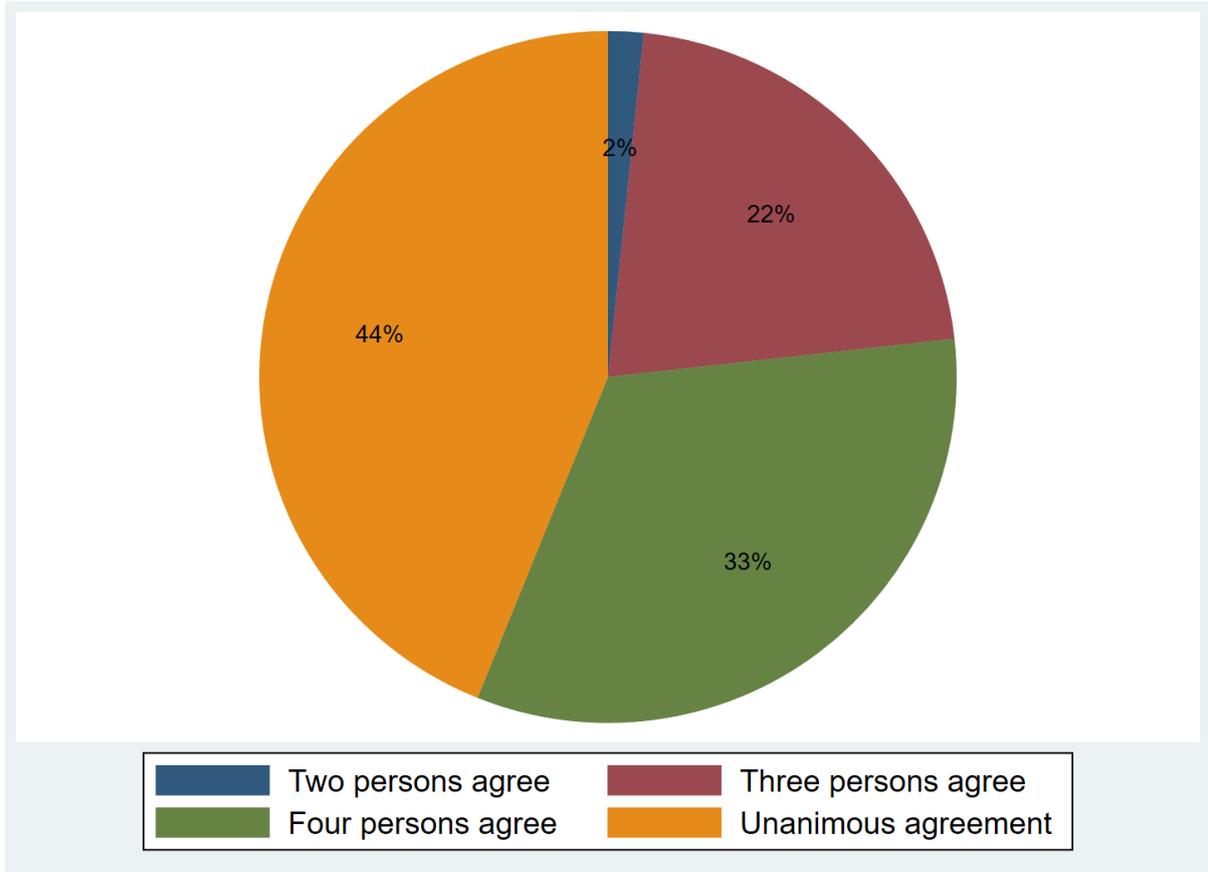
The respondent was asked to evaluate whether it was likely that the job could be performed primarily from a private home. The alternatives were “Yes”, “No” and “Unknown”, which were provided with the following description:

- 1. Yes: This job can be performed primarily from an office in a private home*
- 2. No: Substantial parts of this job must be performed outside the employees home*
- 3. Unknown: There is not enough information to decide.*

We provided an “uncertain” option in addition to the “yes/no” options in order to reduce arbitrary responses to uninformative occupation descriptions. To reduce the serendipity in the evaluations, we acquired five labels from different respondents independently for each occupation. The MTurk task started at Apr 07, 2020, 10:55 AM UTC. The task was done after approximately 4 hours. We did not impose any special requirement for turks to participate in this job. Nor did we require that participating turks must make evaluations of all occupations. A total of 80 different turks participated in our MTurk task. There were large variations in how many occupations each turk evaluated. Half of them evaluated 16 occupations or less, while on average one turk evaluated around 32 occupations.

These respondents do not always agree with each other. Figure 1 shows how they agree/disagree. For the majority of occupations (around 77% of occupations), at least 4 respondents agree on the same answer. Interestingly, the “unknown” label is seldom used: it is assigned 40 times, less than 2% of all labels assigned. Thus, the disagreement among respondents is probably not an indication

Figure 1: Agreement among the respondents from MTurk



that some occupations are difficult to evaluate for the respondents. However, certain occupations do contain both tasks that can be performed remotely and not. Respondents may have to decide whether the tasks which cannot be performed from home constitutes a “substantial” part of this job. Take the above example of the occupation “electrical engineer”, while the task of conducting research, design and providing advice can be done remotely, it is much harder to direct the construction and operation of the electrical system from a home office. Among the five respondents who are asked to evaluate this occupation, three answered “No”, while the other two answered “Yes”. The disagreement, as we interpret, is not due to human labelling errors, but rather represents the possible heterogeneity within the occupation group. We, therefore, consider the average as an imperfect but good measure. Formally, for occupation j , we have $i = 1, \dots, 5$ different labels. Define

$$\gamma_i(j) = \begin{cases} 1 & \text{if answer “Yes”} \\ 0.5 & \text{if answer “Don’t know”} \\ 0 & \text{if answer “No”} \end{cases}$$

and the remote-friendly measure $\gamma(j)$ can then simply defined as the average $\gamma(j) = \sum \gamma_i(j)/5$. Note that to assign 0.5 to the answer “Don’t know” is somewhat arbitrary, since “Don’t know” may not imply that half part of the jobs in this occupation can be done from home. An alternative is simply to drop these evaluations, which we have also tried and the main results do not change much.

One may question our practice of using the average value as the remote-friendly measure. The

problem is most serious for the “marginal” occupations where at most three respondents that agree with each other. We could, however, treat evaluations of these occupations as missing and assign either all 1 or all 0 to those occupations. This way, we treat jobs of these occupations as either all remote-friendly or all non-remote friendly, thus establish the lower or upper bound of the prevalence estimate, respectively. Note that no restriction/assumption is made for these marginal occupations when constructing these bounds, this bounding practice is very similar to the so-called “worst case” bounds in the partial identification literature, see for example [Manski \(2003\)](#).

Amazon has also provided a final label for each occupation based on the individual answers. They also provided a confidence measure which is supposed to describe how uncertain this final label is. We could instead use this final label to classify the occupations into two groups: those can be worked from home and those cannot. However, we realized that by doing so, we ignore potential heterogeneities within each occupation and we were not able to utilize all information available. Nevertheless, we have tried this option. See section 4 for a brief discussion of the results.

Respondents to our task on MTurk were not subject matter experts and likely reside in different countries. This adds to the importance of obtaining more than one label per occupation. However, we did not try to correct for possible cultural differences — some jobs that cannot be performed remotely in other countries may be possible be performed remotely in Norway. We should consider the evaluations as “international”, which is also true for the ISCO-08 standard itself.

With the estimated remote-friendly measure for each occupation, we use the employment data from Statistics Norway (SSB) to evaluate the prevalence of remote-friendly jobs in Norway.

3 Results

3.1 Remote feasibility: job and worker characteristics

Combining the Mechanical Turk annotations and the labor statistics per occupation,² we find that in 2019 around 39 percent of the jobs in Norway can be performed from home. Applying the bounding approach discussed in Section 2, we get the lower bound for this prevalence to be 24% and the upper bound to be 51%. The range is somewhat wide, but still informative.

Splitting into ISCO-08 major occupational groups, we estimate what percentage of jobs in these groups are remote-friendly. The results are presented in Table 1. The share of jobs that can be performed remotely varies from 1.7 to 66.8 percent. “Managers”, “Professionals” are groups where many of the employees can work remotely, but an even higher share of “clerical support workers” are likely able to do their jobs from home. Only a small fraction of workers in occupations like “elementary occupation workers” and “plant and machine operators assemblers” can work from home. Table 1 also reports the lower and upper bound for the percentage of remote-friendly jobs in each occupation group.

Jobs are characterized by wages and working hours. In general, occupations that can be performed remotely also pay better, as shown in Table 2. The difference between remote- and non-remote pay is much less pronounced when we split the data by occupational groups, and the pattern is not

²Statbank, Statistics Norway. Data can be obtained at <https://www.ssb.no/en/statbank/table/12542/>

Table 1: Percentage of occupations are remote-friendly across occupational group

Occupational group	Percent remote friendly			No. of Jobs
	Estimate	Lower Bound	Upper Bound	
Managers	66.8	40.7	83.8	222,678
Professionals	49.1	40.2	56.4	652,356
Technicians and associate professionals	40.3	24.4	53.6	374,858
Clerical support workers	62.3	57.4	64.9	169,230
Service and sales workers	34.2	7.7	59.9	573,415
Skilled agricultural, forestry and fishery workers	17.3	16.7	18.2	21,631
Craft and related trades workers	16.5	2.0	27.9	219,843
Plant and machine operators and assemblers	6.9	6.6	7.2	163,197
Elementary occupations	1.7	1.7	1.7	134,400
All occupations	38.5	24.0	50.9	2,531,608

Table 2: Monthly wage payments for remote/non-remote jobs

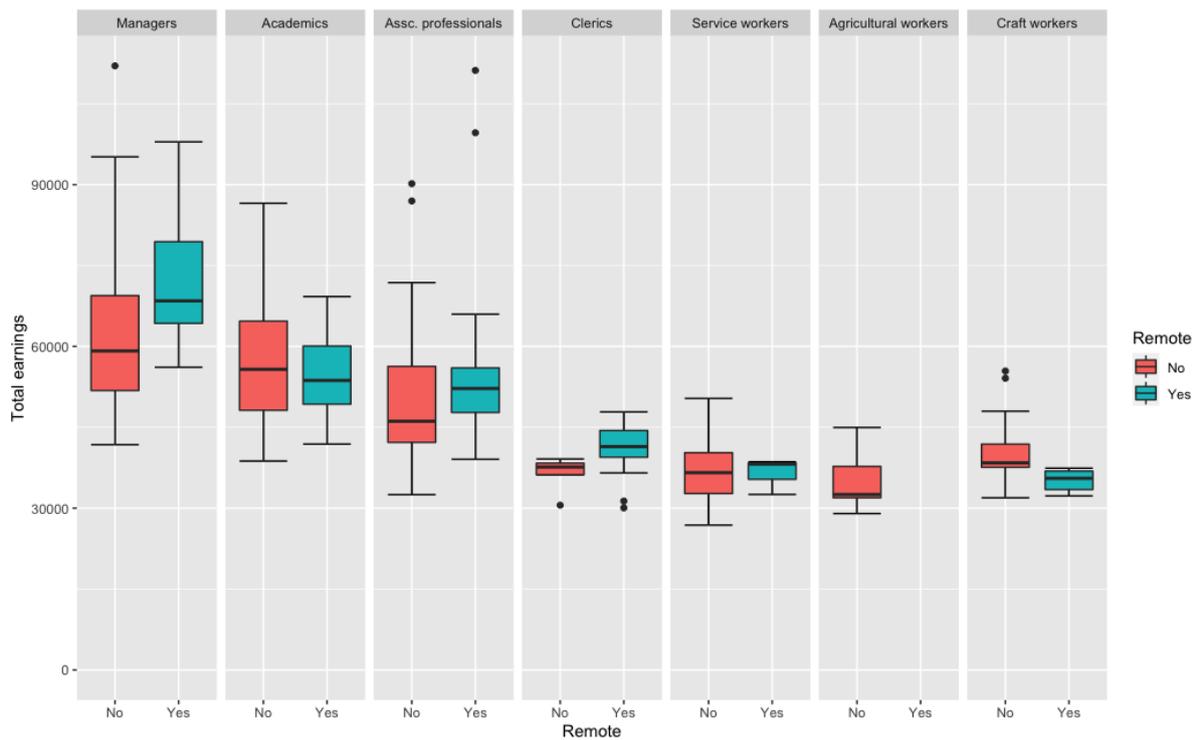
Remote friendly	No. of occupations	No. of jobs	Average earnings	Median earnings
High (>0.8)	47	348,136	56,146	50,974
Medium (0.2 - 0.8)	208	1,439,876	45,171	43,619
Low (<0.2)	139	743,596	44,214	43,174

unequivocal (Figure 2). In general, there is a wage premium for remote-friendly jobs. However, the difference is minimal for the occupation “professional”. In addition, remote-friendly jobs are more likely to be full-time jobs, indicating that workers of less remote-friendly jobs are also less likely to have a stable job.

Previous literature shows that workers with different characteristics sort into different occupations. Using administrative registers from SSB, we can link workers to jobs and study the characteristics of workers in more detail. The results suggest that, as many have worried, workers who are already disadvantaged in the labor market, such as lower-skilled young workers, single parents and immigrants, are often less likely to have remote-friendly jobs and suffer more from economic hardship caused by shutdowns and social distancing. There is a strong positive correlation between education level and remote work possibility. Those with at least a master’s degree have a 50% chance to be able to work from home, while those with only primary/elementary education have only a 15% chance. In addition, older workers are found to be more likely to have a remote-friendly jobs. These observations imply that low-skilled young people are likely be impacted by the crisis particularly hard. Single parents often work less hours, earn less, and face more challenge in labor market. They do not have similar ability to diversify income shocks as couples either. Our results show that they are also less likely to have remote-friendly jobs. Labor market qualifications and prospects vary widely among immigrants. On average immigrants in Norway have a smaller chance to have remote-friendly jobs compared with natives.

There is also a clear difference across genders. Female workers are more likely to have remote-friendly jobs than male workers, and thus might be less exposed to the social distancing policy. However, there has been argued that the possibility to work from home might actually not be ben-

Figure 2: Earnings for remote and non-remote feasible jobs different ISCO groups



eficial for female workers as they often have to take on additional housework in this situation. To account for possible correlations between these characteristics, we tried to estimate the average marginal effects for these variables on the probability of having a remote-friendly job. The patterns remain the same when we use either a simple regression model or a more sophisticated fractional model imposing that the outcome variable is limited to be within the interval $[0,1]$.

3.2 Variation of the prevalence of remote feasibility across different regions and industries

The geographic location of jobs has been a point of interest for years, amid both pressure for workers to centralize and specialize, and fears of increased inequality between cities and rural areas. Figure 3 shows the percentage of workers who can work from home in Norway. There is large heterogeneity across different regions. We estimate that 43 percent of the jobs in Oslo can be done from home. On the other end of the spectrum, in municipalities like Båtsfjord just over a quarter of the jobs can be done remotely. As we expected, cities have a higher share of remote-friendly jobs, which may be fortunate considering the greater need for social distancing in urban areas. The pattern looks clear, especially in the area surrounding Oslo. Other major cities in Norway like Bergen, Trondheim, and Stavanger stand out on the map as well.

By introducing a measure of urbanness, we can analyze the relationship more formally. We use population per square km as a proxy for urbanness. From Figure 4, we see a clear correlation between “urbanness”, or population pr km^2 , and the prevalence of remote-friendly jobs. Denser populated areas imply greater risks of COVID-19 spread, but this increased risk may be mitigated by better opportunities for remote work.

Figure 3: Percentage of workers who can work from home, Norway

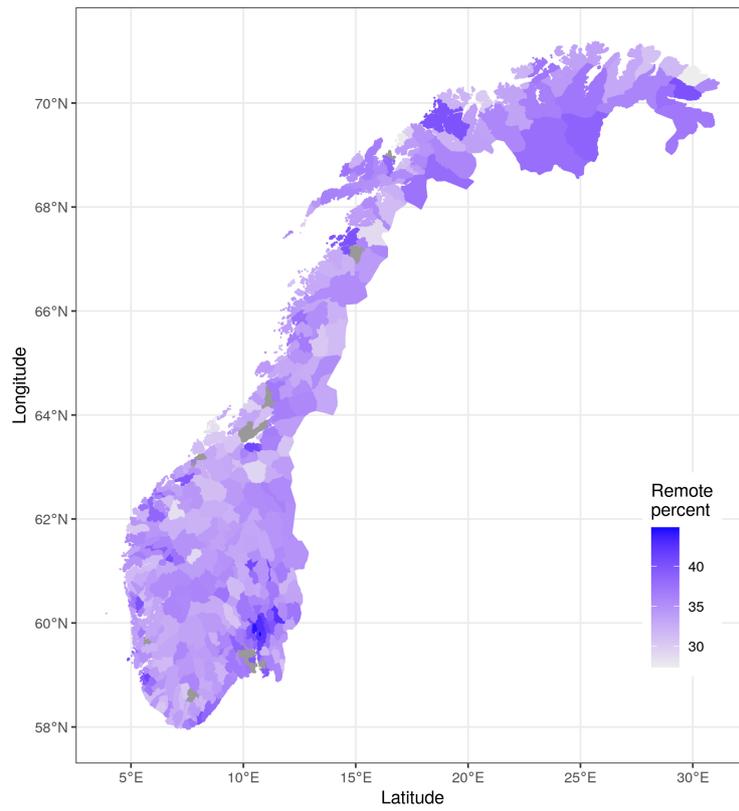


Figure 4: Shares of Remote feasible jobs and population density

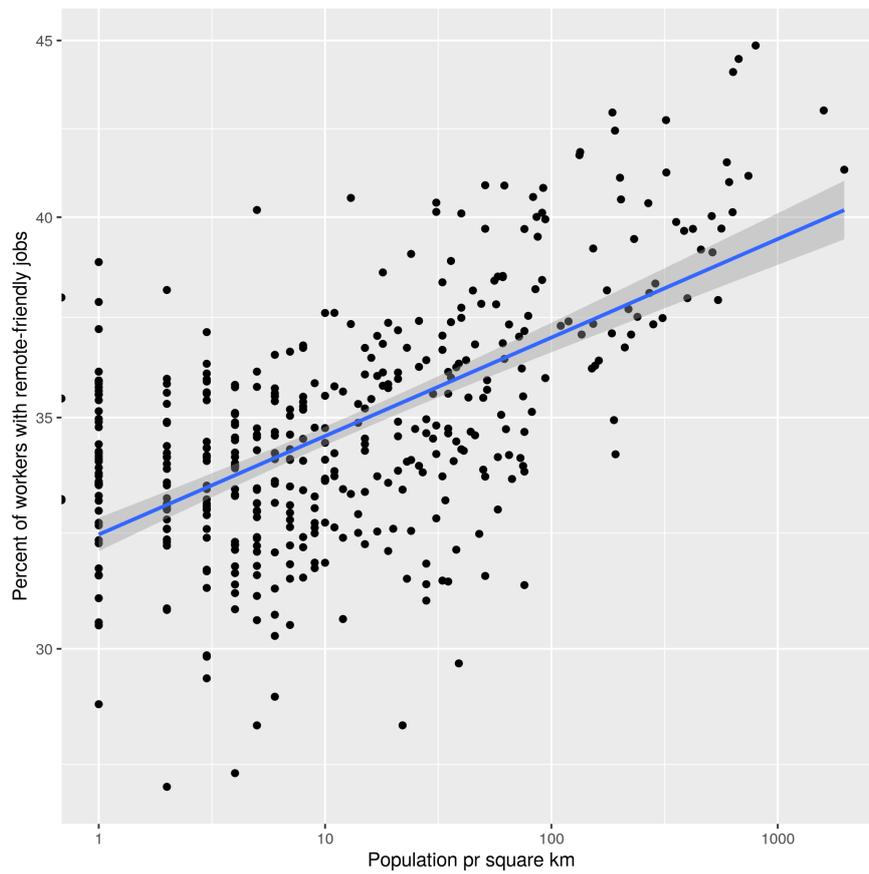
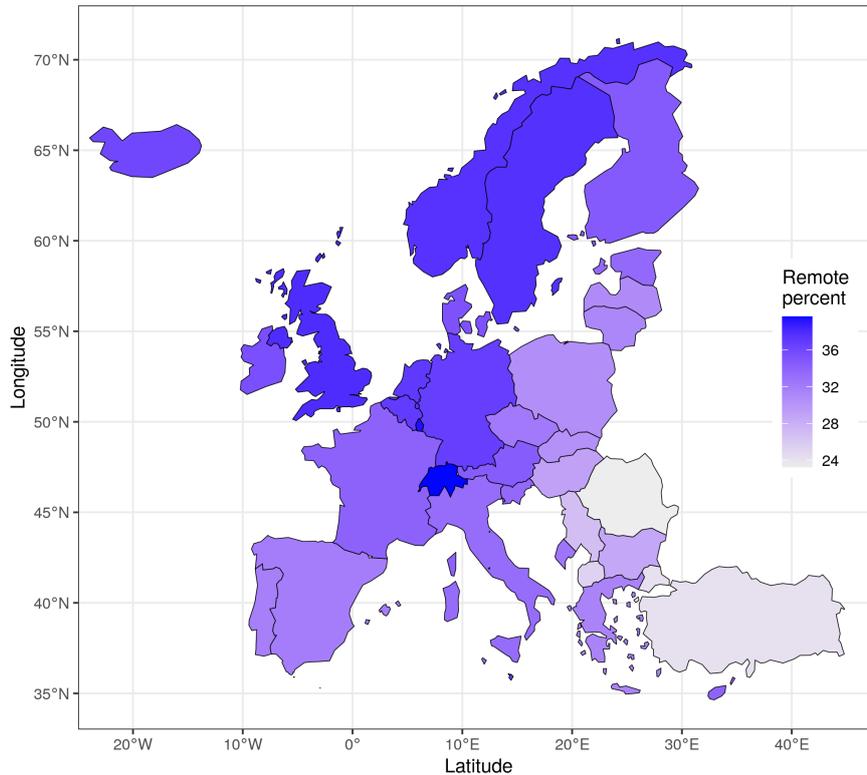


Figure 5: Percentage of workers who can work from home, Europe



There is also significant variation in the remote work feasibility across different industries. Industries such as Financial and Insurance (83%), Information and Communication (75%), and Education (57%) have the highest share remote-friendly jobs, in contrast to primary and secondary industries which typically have much lower values ranging from 15% to 30%. There are also few jobs that can be worked from home in accommodation and food service (17%) and Human health and social work (26%).

3.3 European results

The European statistical agency, Eurostat, publishes data on employment by ISCO-08 major groups. Combining the results presented in Table 1, we can use these data to estimate the prevalence of remote-friendly jobs in Europe. Note that we have used the Norwegian employment sizes when aggregating from the ISCO-08 unit groups, which may differ across countries.

Figure 5 presents the geographic variation of our remote-friendly share of jobs that can be worked from home across Europe. The countries with the highest share of remote-eligible jobs are rich countries, with Switzerland and Luxembourg topping the list. On the other side, the countries with the lowest share of remote-eligible jobs are mostly less developed countries in southeast Europe.

4 Validation and robustness check

4.1 Validating results against job-ads

To evaluate the results from Mechanical Turk, we use job advertisements from the Norwegian welfare administration (NAV). These job advertisements have been published as open data by NAV, and contain the text, title, employer information, and annotations made by subject matter experts at NAV including the occupational code of the job. The dataset covers January 2002 through March 2019 (a total of 2.6 million ads), but due to changes in the ISCO structure (a switch from ISCO-98 to ISCO-08 in 2012), we do not go further back than 2012. Furthermore, the volume of NAV ads increased sharply in 2018 due to new sources of data. From 2018 the NAV data are close to being complete in covering formally advertised jobs in Norway. Some shops still advertise in their shop window, local newspapers, or similar informal channels, but the vast majority of jobs posted online are now included in the NAV dataset.

Because the possibility to work from home is a perk for many, some employers mention it in their job ads to attract candidates. We search the texts for mentions of “hjemmekontor” and “heimkontor”, two distinctive words unlikely to mean anything other than the possibility of working from home. We find that there are quite few, only around 2.5 among every 1000, announcements that actually include these words. Obviously, far from all announcements of jobs that can be performed remotely include these words. We cannot derive the total number of remote-friendly jobs from these job ads data alone. However, it may say something important about the relative frequency of remote-friendly jobs across the occupational groups under some suitable assumptions, as we show in the following.

Let Y_i be the variable indicating whether the job announcement for job i contains the phrase “working from home”, i.e:

$$Y_i = \begin{cases} 1 & \text{contains “hjemmekontor” or “heimkontor”} \\ 0 & \text{otherwise} \end{cases}.$$

Whether to list the phrase “working from home” in the announcement for job i depends obviously on the feasibility that the job can be performed remotely. However, other factors may also play a role in this decision. That is, for a job i of occupation j , the probability that we can find the phrase “working from home” in the job ads, $Pr(Y_i = 1)$, can be written as:

$$Pr(Y_i = 1) = q_a(i)q_f(i) = p_a(j)p_f(j)\varepsilon(i) \quad (1)$$

where $q_a(i)$ measures the probability that the employer considers the working from home feature important to attract candidates for job i , $q_f(i)$ is the probability that job i is a remote-friendly job. $p_a(j)$ and $p_f(j)$ are the corresponding mean probabilities on the occupation level respectively. $\varepsilon(i)$ captures the heterogeneity across jobs within the same occupation. From (1), we see that the occupation specific share of “working from home” announcements in occupation group j is given

Table 3: Relative frequency of remote-possibilities across ISCO groups

Occupational group	Relative remote frequency		
	MTurk	Job ads	Difference
Managers	4.3%	4.2%	0.1%
Professionals	61.0%	49.8%	11.3%
Technicians and associate professionals	15.6%	32.5%	-16.8%
Clerical support workers	4.3%	5.5%	-1.2%
Service and sales workers	7.5%	7.0%	0.5%
Skilled agricultural, forestry and fishery workers	0.1%	0.0%	0.1%
Craft and related trades workers	6.4%	0.9%	5.5%
Plant and machine operators and assemblers	0.5%	0.1%	0.4%
Elementary Occupations	0.3%	0.0%	0.3%

Table 4: Having phrases “working from home” in job posting and the remote-friendly measure: Logit analysis

term	estimate	std.error	statistic	p.value
Intercept	-7.04	0.04	-172.13	0.0000
Remote-friendly measure	2.05	0.06	36.19	0.0000

by

$$\bar{Y}_j \longrightarrow p_a(j)p_f(j).$$

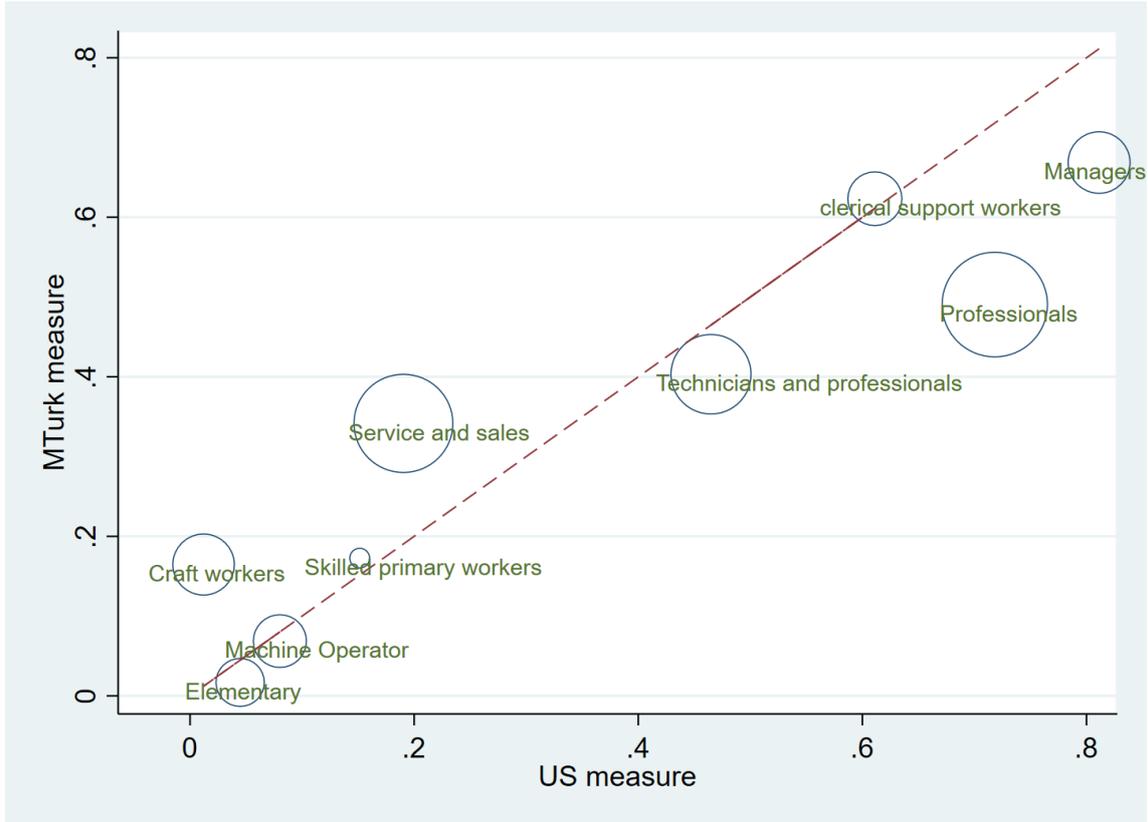
If we assume that $p_a(j)$ does not vary across occupations, then we have

$$\frac{\bar{Y}_j}{\bar{Y}_k} \longrightarrow \frac{p_f(j)}{p_f(k)}. \quad (2)$$

That is, the relative frequency among occupations can be consistently estimated, which points out a way to check the consistency between our MTurk results and the observed patterns in the NAV data.

Table 3 presents the actual observed relative frequencies from the job announcement data and those predicted using our remote-friendly measure. Large discrepancies are found for three major groups “Professional”, “Craft and related trades workers” and “Technicians and associate professionals”. Our measure from the MTurk predicts more cases of the mentions of “home office” than what are actually observed in the NAV data for the first two groups, and less cases for the last group. There are two potential explanations to these discrepancies. It could be that our MTurk results are biased. However, we think it is more likely that employers in these occupations have different perceptions on the importance of the “working from home” feature to attract candidates. In other words, $p_a(j)$ differ across different occupation groups. In our case, $p_a(j)$ for the first two groups are smaller than that for the last group. While we have no means to actually check this claim, there are many possible explanations for such differences. One of them is the following: In the job announcements, exact wage is seldom listed. From Figure 2, we see that for the groups “Technicians and associate professionals”, wages of remote-friendly jobs are on average higher than wages of non-remote jobs.

Figure 6: The US classification and ours, ISCO major groups



To some extent, being able to work from home can be seen as proxy of high wages. So the employers may have stronger incentives to include these words to attract potential applicants. Overall, we think the correlation we see in Table 3 is decent considering the spuriousness of the data.

Another way to check the quality of the remote-friendly measure we derived from MTurk results is to study whether it is a strong predictor for the observed patterns in the NAV data. One simple approach is to merge the NAV data with the remote-friendly measure based on the ISCO occupations, and then apply a Logit model with the outcome variable Y_i and our the remote-friendly measure as explanatory variable. Table 4 presents the results from such a model, where we see that the remote-friendly measure has a strong positive impact on the probability of including these “working from home” related phrases in the job postings. While the model is not a direct test of the measure, this strong positive correlation presumably indicates relative consistency in these two data sources and provides some supports to our remote-friendly measure.

4.2 Robustness check: using alternative classification results

There are several very recent analyses that study the remote feasibility of jobs: [Dingel and Neiman \(2020\)](#), [Brynjolfsson et al. \(2020\)](#), [Mongey et al. \(2020\)](#), and [Lena Hensvik and Rathelot \(2020\)](#) for the United States, [Alipour et al. \(2020\)](#) for Germany, and [Barbieri et al. \(2020\)](#) for Italy. Unlike our study, they rely on different surveys, and the results are established on their national occupation classifications.

Although their results are based on the OES/SOL occupation groups, [Dingel and Neiman \(2020\)](#)

manage to use the crosswalk between the OES groups and the ISCO-08 groups. This crosswalk provides an opportunity to compare our results with theirs. As a robustness check, we have redone the above analyses using the US classification results. Given the many to many nature of the crosswalk, we do not expect that their results and ours agree with each other on the lower levels of occupation groups, but they should be similar on a more aggregated level, such as the ISCO major group. Using the US classifications, the overall share of remote-friendly jobs in Norway is estimated to be around 42%, slightly higher than our estimate 39%. Figure 6 presents the scatter plot of shares of jobs predicted using their measures against those using ours for 9 major ISCO occupation groups together with the 45-degree line. The bubble size represents the employment numbers in Norway. There is a strong positive correlation between these results. The key patterns we found in Section 3 on earnings, worker’s characteristics, geographic and industry variations remain to be the same when using the results by [Dingel and Neiman \(2020\)](#).

We also used the final labels generated by MTurk as the remote-friendly measures. Since the label takes only value 0 or 1, occupations are classified into two distinct groups. In this case, the overall share of remote-friendly jobs is estimated to be somewhat lower, around 36%, while the other patterns we have studied remain the same as well.

5 Conclusion

The increased interest of remote work highlights the need to expand our knowledge of occupations and their contents. In this paper, we study the remote work feasibility for different occupations in Norway. This analysis sheds more light on a fundamental problem in the labor market. The results suggest that the pandemic and the government’s attempts to mitigate this crisis may have quite an uneven impact on the population. Those who are already disadvantaged in the labor market, such as immigrants, young workers, and single parents, are often more likely to have non-remote friendly jobs and thus are hit more severely. Policies aimed especially towards these particular groups should have a high priority on the government’s list.

When planning the slow reopening of offices, schools, and organized activities, the knowledge of the different potential of remote working would potentially be an important factor for policymakers. Areas, where a high percentage of workers have jobs that can be done from home, maybe more impacted by a return to offices and schools than areas where remote work is less common. Large differences in remote work across regions may suggest that regional differences in reopening society are beneficial. In addition, these estimates may be useful for assessing the economic impact of the pandemic, as occupations with high remote feasibility are less impacted by the shutdown.

On the other hand, for national statistical institutions in Europe, the most natural option would be to expand the existing ISCO ontology with this data. This analysis is an attempt to combine conventional and unconventional sources for statistical and research purposes. The results we have found also suggest that alternative approaches to collecting such information are feasible. Although there were some discrepancies between the job announcements and the annotations via MTurk, there is a pattern, and the differences between such sources should be explored. From an economic perspective, this may tell us something about employer preferences related to hiring, and from the perspective of a national statistical institution, such sources may, if calibrated correctly, provide

further information about the labor market and working conditions. The possibilities are not limited to the question of working from home. Job ads are a great resource for describing actual jobs and what they entail, although the picture the advertisements paint might be a little rosy.

References

- Alipour, J.-V., Falck, O., & Schüller, S. (2020). *Germany's capacities to work from home*. (IZA DP No. 13152)
- Amazon. (2020). *Amazon mechanical turk documentation*. Retrieved from <https://docs.aws.amazon.com/mturk/index.html>
- Barbieri, T., Basso, G., & Scicchitano, S. (2020). *Italian workers at risk during the covid-19 epidemic*. (SSRN: <https://ssrn.com/abstract=3572065>)
- Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for experimental research: Amazon.com's mechanical turk. *Political Analysis*, 20(3), 351–368. Retrieved from <http://www.jstor.org/stable/23260322>
- Brynjolfsson, E., Horton, J., Ozimek, A., Rock, D., Sharma, G., & Ye, H. Y. T. (2020). *Covid-19 and remote work: An early look at us data*. Retrieved from https://john-joseph-horton.com/papers/remote_work.pdf (MIT, manuscript)
- Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's mechanical turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, 6(1), 3–5. Retrieved from <http://www.jstor.org/stable/41613414>
- Dingel, J. I., & Neiman, B. (2020). *How many jobs can be done at home?* (NBER Working Paper No. w26948)
- Hatchett, R. J., Mecher, C. E., & Lipsitch, M. (2007). Public health interventions and epidemic intensity during the 1918 influenza pandemic. *Proceedings of the National Academy of Sciences*, 104(18), 7582–7587. Retrieved from <https://www.pnas.org/content/104/18/7582>
- Lena Hensvik, T. L. B., & Rathelot, R. (2020). *Which jobs are done from home? evidence from the american time use survey*. (The University of Warwick, Department of Economics, working paper 466)
- Manski, C. (2003). *Partial identification of probability distributions: Springer series in statistics*. Springer.
- Mongey, S., Pilossoph, L., & Weinberg, A. (2020, May). *Which workers bear the burden of social distancing policies?* (Working Paper No. 27085). National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w27085> doi: 10.3386/w27085
- Nergaard, K., Andersen, R. K., Alsos, K., & Oddervoll, J. (2018). *Flexible working schedule: an analysis of arrangements in norwegian labor market*. (In Norwegian, “Fleksibel arbeidstid. en analyse av ordninger i norsk arbeidsliv”, Fafo Institute for Labour and Social Research, working paper 2018:15)
- Nordbakke, S. (2020). *Reduced effectiveness with home office*. Retrieved from <https://kantar.no/kantar-tns-innsikt/redusert-effektivitet-med-hjemmekontor/> (in Norwegian, “Redusert effektivitet med hjemmekontor” Kantar AS webarticle.)