Potential Benefits and Determinants of Remote Work During the COVID-19 Pandemic: Evidence from Japanese Household Panel Data

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Abstract

This study examines the impact of remote work on various outcomes, such as work hours, income, well-being, time-allocation, and lifestyle habits during the COVID-19 pandemic. It also identifies the characteristics of workers and jobs that contribute to the continuous implementation of remote work using the "Japan Household Panel Survey (JHPS)" and "JHPS Special Survey for COVID-19 (Waves 1 and 2)." Focusing on its potential benefits, we conjecture that the exogenous shift to remote work due to the pandemic had a heterogeneous impact on workers. The first difference models, in which unobservable time-invariant worker heterogeneity is removed, indicate a positive impact on income, working hours, well-being, and time allocation for those who continued to work remotely after the state of emergency was lifted in 2020. Those who only worked remotely as a stopgap measure during the first state of emergency, experienced negative impacts. The multinomial logit models indicate that remote work tends to be continuously conducted in workplaces where performance is valued, not hours worked, flexible work arrangements are allowed, and better management practices are conducted. In addition, workers with better IT skills, those exposed to new technologies, and those engage in abstract tasks are more likely to work remotely after the state of emergency.

Keywords: COVID-19, Remote Work, Work from home, Panel data, Skill, Task

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1. Introduction

In Japan, even if the government declares a state of emergency in relation to the COVID-19, there is no system in place to make remote work mandatory; therefore, workers or companies can choose between remote work or office work. However, when the country first went into an emergency state in April 2020, remote work was used as an emergency measure in many companies because of social demands and government requests to prevent the spread of the COVID-19 infection. Therefore, as Morikawa (2020) pointed out, the implementation of remote work on that particular occasion could be partly driven by exogenous factors to contain the elements of a natural experiment. In a situation where most workers are legally obliged to work from home due to strict lockdowns, as is the case in Europe and the United States, it is difficult to examine the impact of remote work through a comparison between remote workers and office workers. In this regard, the situation in Japan is suitable for examining the impact of remote work as it includes a certain degree of exogeneity and a certain number of workers who commute to work.[1]

The "Japan Household Panel Survey (JHPS)" (conducted in early February 2020) and its supplementary survey "JHPS Special Survey for COVID-19 (Wave 1)" (conducted in late May 2020) provide information on the implementation of remote work in Japan before and after the first declaration of a state of emergency in Japan. According to these surveys, the share of workers working from home increased from less than 10% in February 2020, immediately before the COVID-19 outbreak, to approximately 30% in April of the same year. However, after the state of emergency was lifted in May 2020, an increasing number of workers returned to office work, and the percentage of remote work dropped to approximately 10% in September 2020, according to the "JHPS Special Survey for COVID-19 (Wave 2)" (conducted in late October 2020).

One of the possible reasons why remote work did not take root after the first state of emergency was dropped is that many companies and workers did not have the appropriate infrastructure and environment in which they could work smoothly from home; therefore, productivity and well-being declined. In fact, when asked about the challenges and difficulties in telecommuting in the "JHPS Special Survey for COVID-19 (Wave 1)," the top answers were "Difficulty of communicating and sharing information" and "Difficulty of accessing work materials,"[2] suggesting that there is room for

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[1] The "stringency index," created and published by Oxford University to measure the stringency of the federal governments' response to the COVID-19 infection, comprises a four-level index concerning workplace closure ("3" means requests for complete workplace closure and remote work except for essential workers, "2" means requests for partial workplace closure and remote work, "1" means recommendations of workplace closure and remote work, and "0" is not applicable). On April 10, 2020, while the average of 185 countries was 2.3, Japan's index was 1, a low stringency level for remote working.

[2] More specifically, 59.7% of the workers answered that the "Communication/information exchange at work is difficult," while 49.9% said that the "The access to work-related material is difficult." Furthermore, 50.6% of the workers

improvement in the way remote work was conducted. In other words, companies that had telecommuting systems in place before the pandemic and devised ways to communicate and share information online through digitalized operations and materials may have been able to cope with the emergency transition to remote work without any problems. In contrast, companies that were forced to implement remote work may not have been able to make a smooth transition.

If there were no restrictions, companies and workers would choose between working from home and commuting, whichever provides more benefits. Before the pandemic, the number of remote workers in Japan was very small, which may be because the disadvantages outweighed the advantages. However, in recent years, an increasing number of companies in Japan have been adopting flexible work arrangements through work style reforms and new technologies. There has also been a growing demand for remote work for better work-life balance. Thus, for some companies and workers, the advantages of remote work appeared to outweigh the disadvantages.

On the other hand, commuting to the office and working uniformly for long hours has long been the norm in many Japanese workplaces. As discussed in Kawaguchi and Motegi (2021) and Barrero et al. (2021), there may have been a stigma associated with remote work, since it is seen as a form of shirking. Such stigma, as well as institutional factors, including an unsuitable environment and insufficient devices for online work activities, may have acted as constraints. Thus, remote work has not actually been implemented even for workers who can potentially benefit from it.

However, the sudden shift to remote work in the wake of the pandemic may have served to remove such constraints exogenously, which altered the stigma and institutional factors to generate various benefits and promote remote work. We therefore conjecture that the exogenous shift to remote work due to the sudden COVID-19 pandemic in April 2020 had a heterogeneous, rather than uniform, impact on workers. That is, it had a positive impact on the workers who could potentially benefit from remote work and a negative impact on the rest. In addition, those who realized the net advantages of remote work continued to work remotely after the state of emergency was lifted and the rest resumed office work as the disadvantages became known.

Although the results are still mixed, several studies have examined the impact of remote work during the COVID-19 pandemic based on workers' surveys.[3] Previous studies include Angelucci et al. (2020); Etheridge and Wang (2020); Morikawa (2020); Kawaguchi and Motegi (2021); Bertoni et al. (2021); Barrero et al. (2021); and Ishii et al. (2021).[4] While most of them examine the effects on

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answered that "The separation between work and private life becomes unclear."

[3] Kitagawa et al. (2021) use employee data from four Japanese manufacturing firms to examine the effects of remote work on productivity and mental health.

[4] There are many examples of studies published before COVID-19, such as Noonan and Glass (2012), Bellmann and Hubler (2020), Kouki and Sauer (2020), Song and Gao (2020), Mann and Holdsworth (2003), Eurofound and the International Labour Office (2017), Bloom et al. (2015), Choudhury et al. (2019), Rupietta and Beckmann (2016), Mas and Pallais (2017), Morikawa (2018), Hagihara and Kume (2017), Furukawa (2007), Shibuya et al. (2019), Chino

one or two outcomes (e.g., employment, income, subjective (self-reported) productivity, mental health, and anxiety), our study uses representative panel data to estimate the impact of remote work on a broader set of outcomes including, working hours, income, mental health, subjective productivity, work engagement, anxiety, time allocation (housework hours and childcare hours), and lifestyle habits (sleep hours, exercise frequency, drinking frequency, number of cigarettes smoked, and body mass index [BMI]).

Our study also differs from previous studies in that it examines the possibility of the heterogeneous impact of remote work by classifying Japanese workers into three groups depending on the implementation pattern of remote work in April 2020 under the first state of emergency, and in September 2020 after the declaration was lifted. It is considered that the potential benefits of remote work were greater for workers who continued to work remotely. Therefore, we expect the impact of the exogenous shift to remote work in April 2020 to be positive for those who continued to work from home from April to September 2020, but negative for those who worked from home in April, but returned to the office before September 2020. However, we also expect that the negative impact for the latter group would disappear in September 2020, as they would have returned to the office after the state of emergency was lifted.

In addition, this study not only uses the exogenous shift to working remotely under the state of emergency as a natural experiment, as done by Morikawa (2020), but also uses a first-difference model with panel data to eliminate unobservable time-invariant heterogeneity among workers.[5] There is a concern on the endogeneity regarding the implementation of remote work as some workers cannot choose this setup because they are in charge of tasks that are difficult to perform remotely before and after the beginning of the pandemic. However, we suppose that such endogeneity is accounted for, as it is driven by time-invariant factors that will be eliminated when taking the time differences in the first-difference model. Our study period includes three different time points: February 2020, right before the COVID-19 pandemic; April 2020, under the first state of emergency declared in Japan during the pandemic; and September 2020, after the emergency declaration was lifted. The first-difference model focuses on the changes between February and April 2020 and between February and September of the same year.

We also investigate which workers are more likely to be classified into each of the three groups. We try to identify the characteristics of workers and jobs that contribute to the continuous implementation of remote work. By applying a multinomial logit model consisting of three groups, we examine the effects of worker characteristics (e.g., education, income, and employment status) and

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(2019), and Kazekami (2020). These studies looked at the positive and negative impacts of remote work on various outcomes.

[5] Ishii et al. (2021) adopt a different identification strategy based on instrumental variable estimation, but they use cross-sectional data collected through an online survey.

job characteristics (e.g., management practice, the type of job tasks, IT skills, and exposure to new technologies) on the implementation pattern of remote work.

Previous studies examining the factors behind remote work during the COVID-19 pandemic include Bick et al. (2020), Brynjolfsson et al. (2020), Morikawa (2020), Okubo (2020), Kawaguchi and Motegi (2021), and Ishii et al. (2021).[6] Using the "Japanese Panel Study of Employment Dynamics" (JPSED), an online panel survey conducted by the Recruit Works Institute, Kawaguchi and Motegi (2021) finds a significant association between the probability of remote work and the type of job tasks, as well as human resource management practices during the COVID-19 pandemic. Similarly, using cross-sectional data from online surveys, Ishii et al. (2021) estimates the associations of remote work with employment status, income level, education, sex, firm size, and human resources management practices, after controlling for the possibility of remote work. Our current study differs in that we use representative household panel data in which respondents were randomly sampled by a two-stage stratified random sampling method from all around Japan, and surveyed by the drop-off and pick-up method. In addition, this study focuses on the difference in the time-series pattern of remote work to explore the factors that prolong remote work during the pandemic. This study also investigates the association of remote work with IT skills and the degree of exposure to new technologies.

The rest of this paper is structured as follows: Section 2 discusses the theoretical framework of choosing remote versus office work and their impact, explaining the estimation approach. Section 3 explains the data and variables used in the analysis. Section 4 estimates the impact of remote work on various outcomes using a first-difference model. Section 5 uses a multinomial logit model to examine the factors associated with the use of remote work. Finally, Section 6 presents the conclusions of the study.

2. Theoretical framework and estimation approach

This section describes the worker's problem of choosing between remote work and office work in Japan during the COVID-19 pandemic based on McFadden's (1978) random utility model. First, we suppose that worker i chooses working arrangement j, working from home ($j = H$) or commuting to the office ($j = O$), to maximize the linear conditional random utility $U_{ij} = V(X_i, \delta_{ij}) + \varepsilon_{ij} = (\beta_j' X_i - \delta_{ij}) + \varepsilon_{ij}$. Here, X_i is a vector of the characteristics of workers and jobs, δ_{ij} is the fixed cost incurred when working arrangement j is chosen, and ε_{ij} is an unobservable idiosyncratic error.

Before the COVID-19 outbreak, a remote work setup was rarely adopted due to stigma as well as institutional factors such as insufficient devices and environment for online work activities, so fixed

[6] There are also many studies to estimate potential probability or capacity to conduct remote work including Dingel and Neiman (2020), Boeri et al (2020), and Holgersen et al. (2021).

costs associated with a remote work arrangement were regarded as large. For the sake of simplicity, we assume that fixed costs are incurred only when remote work is chosen ($\delta_{iH} > 0, \delta_{iO} = 0$). However, we also assume that such fixed costs can disappear as the stigma and institutional factors would become insignificant after remote work is fostered by its implementation. The changes in the stigma of remote work may reflect a change in workers' perceptions of it. Likewise, changes in institutional factors may reflect the development of devices and environment for online work activities in the workplace. In this regard, based on an original survey in the United States, Barrero et al. (2021) shows that two-thirds of the respondents reported improved perception regarding remote work since the pandemic, which is consistent with our assumption.

By focusing on the fixed costs of remote work, we can classify the status of workers before the pandemic, $S_i = \{1,2,3\}$, as shown in Equation (1):

$$S_i = \begin{cases} 1\ (office) & if \quad \beta_H{}'X_i - \beta_O{}'X_i < 0 \\ 2\ (office) & if \quad 0 < \beta_H{}'X_i - \beta_O{}'X_i < \delta_{iH} \\ 3\ (home) & if \quad \delta_{iH} < \beta_H{}'X_i - \beta_O'X_i \end{cases} \tag{1}$$

In both the first and second statuses in Equation (1), workers choose office work. However, in the first status ($S_i = 1$), their utility from office work is larger than that from remote work, regardless of the fixed costs of remote work δ_{iH}. In contrast, in the second status ($S_i = 2$), the workers would have chosen remote work if the fixed costs δ_{iH} were less than the net benefits from remote work. In other words, remote work potentially provides a larger utility for the second status. Finally, in the third status ($S_i = 3$), workers choose remote work because it yields greater utility than office work even if fixed costs δ_{iH} are incurred.

Suppose that after the outbreak of COVID-19, many companies decided shifting from working in the office to working remotely to prevent the spread of the coronavirus. Then, many workers in the first and second statuses were compelled to work remotely. Among such workers, the various outcomes of those who were in the first status ($S_i = 1$) will be negatively impacted because the utility from remote work is smaller than that from office work. In contrast, workers in the second status ($S_i = 2$) will experience positive impacts from the exogenous shift from office work to remote work under the state of emergency. This is because the utility from remote work is larger than that from office work, and they will not incur the fixed cost of remote work, δ_{iH}, because it is forced exogenously.

Furthermore, after the state of emergency was lifted, remote work would not take root for workers in the first status ($S_i = 1$) who were forced to work remotely, because the utility would be larger if they chose to commute to work as before. In contrast, the workers in the second status ($S_i = 2$) continued to work remotely after the state of emergency was lifted. This is because the fixed cost associated with remote work, δ_{iH}, disappears once workers experience it during the state of emergency,

and net utility from remote work will become positive. Therefore, workers who shift to remote work under the state of emergency will be divided into two groups: those who continue to work remotely after the emergency declaration is lifted and whose various outcomes are positively impacted ($S_i = 2$), and those who return to office work ($S_i = 1$).

Based on the above arguments, we estimate the impact of remote work on various outcomes by using panel data from the workers. We classify workers into three groups: group g_i^0, which includes workers who did not work remotely in April 2020, at the beginning of the state of emergency, nor September of the same year, after it ends; group g_i^1, which includes workers who switched to remote work in April and returned to the office in September (those who were in the first status ($S_i = 1$) before the pandemic); and group g_i^2, which includes workers who began working from home in April 2020 and continued doing so until September 2020 (those who were in the second status ($S_i = 2$)).[7] Then, we estimate equation (2):

$$(y_{it} - y_{iFeb}) = \alpha + \gamma^1 g_i^1 + \gamma^2 g_i^2 + \theta(n_{it} - n_{iFeb}) + e_{ij}, t = \{Apr, Sep\}, \qquad (2)$$

Equation (2) is the first difference model representing the periods between February and April 2020 ($t = Apr$), and February and September 2020 ($t = Sep$). Here, y_{it} indicates various outcome variables: monthly income, working hours, well-being, private time, and lifestyle habits; g_i^1 and g_i^2 are dummy variables that represent the groups defined by the pattern of work arrangement (remote or office work) in April and September 2020. Using the group that does not work from home both in April and September 2020 as a reference, g_i^1 takes the value of "1" for the group that only uses it in April 2020, and g_i^2 takes the value of "1" for the group that uses it both in April and September 2020; γ^1 and γ^2 are the coefficients of these dummy variables. In addition, n_{it} is a control variable indicating the number of COVID-19 confirmed cases per 100,000 people in the prefecture where each worker resides.

We suppose that the selection of each group is associated with the characteristics of workers and companies, such as education, types of job tasks, IT skills, and human resource management practices; however, it is random after controlling for time-invariant individual heterogeneity, as the characteristics of workers and companies will not change in a short period of time (from February to September 2020). Therefore, as Equation (2) represents, we employ the first difference model to remove time-invariant individual heterogeneity, such as the workers' personal and job-related attributes or unobservable factors.

When we take the difference between February and April 2020 in the estimation, group g_i^1 is expected to have few potential benefits. Therefore, the coefficient γ^1 of the dummy variable g_i^1 is

[7] To simplify the analysis, workers who already worked from home before the pandemic and continued to do so (those who were in the third status) were excluded.

expected to be negative ($\gamma^1 < 0$). Additionally, group g_i^2 potentially enjoys many advantages from this arrangement; hence, the coefficient γ^2 of the dummy variable g_i^2 is expected to be positive ($\gamma^2 > 0$). When we take the difference between February and September 2020, its coefficient γ^1 is expected to be zero ($\gamma^1 = 0$), since the group that goes back to the office in September 2020 experiences no disadvantages from remote work. The group that continues remote work presumably enjoys better outcomes than before the pandemic, so the coefficient γ^2 is expected as positive ($\gamma^2 \geq 0$).

Given that tasks and working conditions are different depending on employment status, we estimate equation (2) separately for each form of employment: regular (permanent contract) and non-regular.

We also investigate the characteristics of workers and jobs that contribute to their classification in each group of working arrangement patterns (g_i^0, g_i^1, g_i^2). In other words, we estimate what characteristics are associated with positive outcomes of remote work by estimating the following multinomial logit model:

$$G\{g_i^0, g_i^1, g_i^2\} = a + b'x_i + c'w_i + u_i \qquad (3)$$

In Equation (3), x_i represents worker characteristics such as sex, educational background, age, employment status, and family structure; w_i is a vector of job characteristics, including management practices, types of job tasks (routine, abstract, or manual), level of IT skills, and a degree of exposure to new technologies such as AI; a, b, c are the respective coefficients, and u_i is an error term. To identify the types of workers more likely to continue choosing remote work, we focus on the effects on the probability of choosing g_i^2.

3. Methodology

(1) Data

This study uses data from the "JHPS 2020" and "JHPS Special Survey for COVID-19 (Wave 1 and Wave 2)." The JHPS is a representative Japanese panel survey that tracks the same individuals over time and provides a wide range of information, such as working conditions, time use, income, health, well-being, education, and assets. To create a microcosm of Japan, it surveys approximately 4,000 adults (males and females, and their spouses) extracted by a two-stage stratified random sampling method every February since 2004. To compensate for the attrition in the panel survey, new samples were added in 2007, 2009, 2012, and 2018, resulting in 5,470 respondents in the 2020 survey.

Targeting the respondents of the JHPS 2020, the "JHPS Special Survey for COVID-19" was carried out via mail or online in April 2020 to capture the impact of the COVID-19 pandemic on employment, income, work hours, work arrangement, health, well-being, and time use in real time.

The first survey was conducted from late May 2020 to early June of the same year to capture the situation in the early days of the pandemic. The second survey was conducted with the respondents of the first survey between mid-October 2020 and early November of the same year. Among the respondents of the JHPS 2020, 3,857 responded to the first survey (response rate of 70.5%), and 3,221 respondents from the first survey responded to the second survey (response rate of 83.5%)[8].

(2) Sample and variables

The sample used in the estimation was chosen from the respondents of the JHPS 2020 survey conducted in February 2020. We selected a sample of employees aged 20 to 64 who did not conduct remote work at that time and answered both the first and second JHPS Special Surveys for COVID-19. The sample size was reduced to 867 workers. We defined that remote work was adopted if the respondent worked from home at least once in the fourth weeks of February and April, and the third week of September 2020, respectively.

As outcome variables, we use monthly income, working hours, well-being (mental health, subjective productivity, work engagement, and anxiety), time allocation (housework and childcare time), and lifestyle habits (sleep, exercise, drinking, smoking, and BMI) as outcome variables. The mental health variable is the Kessler Psychological Distress Scale (K6), which comprises six questions that measure mental health, such as "Did you feel excessively nervous?" Respondents answered using a 5-point Likert scale. The total score ranges from 0 to 24 points, where the higher the score, the more severe the mental problems. The subjective performance variable is the Health and Work Performance Questionnaire (HPQ), which is a subjective indicator of work performance. Each respondent self-evaluated their work performance in the past four weeks, rating it from 0 to 10, with higher scores indicating higher subjective productivity. The work engagement variable is the Utrecht Work Engagement Scale (UWES-3), which is a short version of the Utrecht Work Engagement Scale (UWES) created by Shimazu et al. (2008). It indicates a positive mental health situation with regard to work based on three questions related to vigor, dedication, and absorption; higher scores indicate higher work engagement. The anxiety variable is an original scale used to measure how the respondent experienced a vague sense of anxiety during the pandemic, ranging from 1 to 5. It takes the value of "1" if the respondents feel very anxious or a little anxious for no particular reason, and "0" otherwise.

With regard to lifestyle habits, we focus on sleep time, exercise frequency, frequency of alcohol consumption, number of cigarettes smoked on weekdays, and BMI in each of the three periods. All habits are assessed based on the JHPS 2020 carried out in February, the first JHPS COVID-19 in April 2020, and the second JHPS COVID-19 in September 2020.

Regarding the analysis to identify the factors that affect the implementation of remote work, we

[8] The percentage of online responses was 19% in the first survey and 23% in the second.

first control for the possibility of remote work at the occupational level. This possibility is calculated based on the numerical information obtained from the "Japanese version of O-NET" offered by the Japan Institute for Labor Policy and Training. Specifically, we utilize teleworkability information, which quantifies the feasibility of remote work in terms of the percentage of days working from home (0%, less than 20%, between 20% and 39%, between 40% and 59%, between 60% and 79%, and 80% or above). Based on a table provided by Komatsu and Mugiyama (2021), which matches each occupation in the "Japanese version of O-NET" with that of the census, we calculate the index of ability to conduct remote work for each occupation. We also control for the number of days of remote work before COVID-19 (February 2020). These two variables are intended to control for the nature of jobs and tasks related to the possibility of remote work.

For the determinants of remote work, we focus on the characteristics of workers and jobs. Worker characteristics include sex, age, education, marital status, employment status, income, and firm size. Job characteristics include workplace variables that take a value of "1" if each of the following statements is true: "people who work overtime and on holidays and weekends are highly evaluated," "job performance is highly evaluated," "late arrival is allowed after overtime work or holiday work," "the boss seeks to share information with members," and "the boss seeks a balanced workstyle." It also includes task and skill variables, such as job tasks, IT skills, and measures of exposure to new technologies (levels of adopting new technologies in the workplace) such as AI.

For the type of job tasks, the JHPS 2020 contains task indexes based on a study by Autor and Handel (2013), which uses the Princeton Data Improvement Initiative (PDII) survey from Princeton University. Using these indicators, we create three task indexes for routine, abstract, and manual tasks. The routine task index measures the degree of repetitive work, the manual task index assesses the degree of physical work, and the abstract task index measures the number of atypical and complex problems that must be solved.

For IT skills, we create a variable based on whether the respondent could use spreadsheet software such as Excel, macro functions in spreadsheet software, and programs to evaluate IT skills. Higher scores correspond to better IT skills.[9] As for exposure to new technology, we create a variable indicating the number of new technologies, such as cloud computing, robots, and AI introduced or used in the workplace; the higher the scores, the greater the exposure to new technologies.[10]

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[9] We use three IT-related items on the JHPS 2020 questionnaire ("simple operations using spreadsheet software," "use of macro function on spreadsheet software," and "data processing/analysis using programming language") and give them a five-level score in which "5" means "I can do it easily" and "1" means "I do not know." Then, we sum up the score of the three indicators and create a variable in which "15" is the highest skill level and "3" is the lowest.

[10] Using items from the JHPS 2020 that ask whether six new technologies, "cloud computing," "robots," "RPA (Robotic Process Automation)," "artificial intelligence (AI)," "wearable device," and "telework/remote work," have been introduced or used in the workplace, we create a dummy variable that takes the value of "1" for every item introduced. Then, based on the total value of this six-item dummy variable, we create another variable that takes the value of "6"

Table 1 presents the descriptive statistics of the variables used in the analysis. It reports the means and standard deviations of all variables using all samples and each of the three groups to analyze the implementation of remote work. Looking at Table 1, we find that the group that conducted remote work in April and September 2020 has the highest average monthly income, followed by the group that only worked remotely in April 2020. The group that did not work from home in April or September 2020 has the lowest figures. The average working hours in February 2020 are the longest in the group that worked from home in April and September 2020, and the lowest in those who did not work from home in either month. The mental health variable (K6) also significantly differs across the groups. People who worked from home in April and September show the lowest K6 scores and have better mental health conditions under the state of emergency than the other groups. The work characteristics also indicate that individuals who worked from home in both April and September 2020 tend to be evaluated not by the duration of working hours, but by their performance, or tend to adopt flexible work styles.

4. Impact of remote work implementation

Table 2 shows the estimation results of the first difference model (Equation 2) for the impact on working hours and monthly income. Regarding the changes in the working hours among regular workers in April 2020, the coefficient for the group "remote work only in April" is significantly negative. The estimated coefficient indicates that remote work reduces working hours by approximately six hours per week. However, this reduction cannot be observed among regular workers who conducted "remote work both in April and September." It is thus understood that workers who worked from home temporarily as an emergency measure at the beginning of the COVID-19 pandemic were not as productive as they were in the office. This finding is consistent with the conjecture in the previous section. Furthermore, among regular workers, the coefficients of remote work patterns are not statistically significant for changes in working hours in September 2020, suggesting that the working hours of workers in the group who "remote work only in April" were no longer reduced when they returned to the office. Meanwhile, among non-regular workers, it is shown that the number of working hours increased significantly in September 2020. This can be interpreted as a result of the increasing demand for non-regular workers when economic activities resumed after the declaration was lifted. Looking at the estimation results for the monthly income changes from February to April 2020, the coefficients of the group "remote work both in April and September" are significantly positive for both regular and non-regular workers. Although monthly income decreased on average during the pandemic, the group that continued to work remotely was able to mitigate the decrease in

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if the introduction of new technologies is at its most advanced level, and "0" if it has not progressed at all.

monthly income even under the first emergency declaration. As for the other groups and the changes in monthly income from February to September, no statistically significant differences are found.

Table 3 shows the impact of work from home on well-being. Table 3(1) shows that the non-regular workers in the group that continued to work from home after the state of emergency was lifted have improved mental health conditions in September 2020. This result may reflect the fact that many non-regular workers are women, who find it easier to achieve work-life balance when they work from home regularly. Looking at subjective productivity, we see that both regular and non-regular workers in the group "remote work only in April" experienced significant decline in this aspect in April 2020. This result indicates that the potential benefits of remote work are small for workers who have temporarily introduced it as a stopgap measure. We can also confirm that there was no longer a decline in subjective productivity in this group when they returned to normal work schedules in September, as we conjectured. Table 3(2) shows the estimation results of the impact on work engagement and anxiety, which indicates that most of the coefficients of remote work pattern are insignificant. However, for work engagement, the group "remote work only in April" exhibits significant increases in April 2020 for non-regular workers, which is contrary to our conjecture.

Table 4 shows the effects of remote work on housework and childcare. We see that the weekly hours for housework of regular workers who "remote work both in April and September" increased by approximately 3.7 hours in April 2020, and 2.1 hours in September 2020, even though the working hours did not decrease. However, we cannot confirm any significant increases in hours of housework for the group "remote work only in April," although their working hours in April 2020 decreased significantly (as indicated in Table 2). Regular workers who continuously worked from home may have demanded for a remote work setup to be adopted in their workplace. Once this option became a reality, they could reduce commuting time and allocate more hours for house tasks. On the other hand, Table 4 shows that childcare hours in April 2020 increased mainly among regular workers in the group "remote work only in April." This result is possibly due to the adoption of remote work as a stopgap measure overlapping with children's school closures, resulting in temporarily longer hours for childcare.

Lastly, Table 5 shows the estimated impact of remote work on changes in lifestyle habits. Table 5(1) indicates that both regular and non-regular workers in the group "remote work both in April and September" slept longer in April 2020. Non-regular workers who participated in remote work in April and September also enjoyed more sleep in September 2020. Workers who continued to work from home since April 2020 could presumably shift to a home office more easily and secure more time for sleep. As for exercise frequency, Table 5(1) shows no significant changes in any case. Table 5(2) shows that the regular workers in the group "remote work only in April" consumed alcohol less frequently in April and September 2020. However, the table also shows a significant increase in the number of cigarettes smoked for non-regular workers in September 2020. As for BMI, Table 5(3) showed no

significant changes.

In summary, the impact of remote work on income, well-being, time allocation, and lifestyle habits are generally positive for the group "remote work both in April and September," but is negative for the group "remote work only in April." These results are consistent with our conjecture that the shift to remote work has heterogeneous impacts depending on its potential benefits.

5. Determinants of remote work

Tables 6–8 report the estimation results of the multinomial logit model of Equation (3), which tries to identify the characteristics of the workers who are likely to experience a positive impact by shifting to remote work. The three groups are used as dependent variables, while worker and job characteristics are used as explanatory variables. Table 6 represents the estimation results using basic worker characteristics as explanatory variables. Tables 7 and 8 illustrate the results obtained by adding job characteristics as explanatory variables. In both tables, the marginal effects on the probability of being classified into each group are reported.

In Table 6, to confirm a possible difference among regions depending on the magnitude of the COVID-19 pandemic, we conduct estimations for three cases: all samples, workers living in "special alert prefectures[11]," and those living in other prefectures. Looking at Table 6, we find that the marginal effects of teleworkability are significantly positive for the group "remote work both in April and September" and negative for the group "not remote work either in April and September." Moreover, the number of remote work days in February (before the pandemic) are significantly positive for the groups "remote work both in April and September" and "remote work only in April." These results indicate that the type of jobs and tasks, which are reflected in these two variables, are deeply associated with the implementation of remote work.[12]

It is worth noting that even when controlling for the nature of jobs and tasks, we can find significant factors that affect the implementation of remote work. For example, workers who hold at least a university degree are more likely to work from home during the pandemic, especially in special alert prefectures. Furthermore, although the results vary per region, non-regular workers are generally less likely to work from home compared to regular workers. Additionally, workers with a higher income are more likely to conduct remote work. The number of COVID-19 infections is also

[11] In April 2020, the Japanese government designated 13 prefectures as "special alert prefectures" where it was necessary to promote efforts to prevent the spread of COVID-19.

[12] This result is consistent with the findings of Ishii et al. (2021), who find positive associations between remote work and teleworkability in the early phase of the pandemic and pointed out the inequality in the implementation of remote work caused by the characteristic of workers and jobs.

associated with a higher probability for remote work, especially in special alert prefectures.[13]

Looking at Table 7, where we add job characteristics as variables, we can confirm a significant association with the probability of remote work. For example, in workplaces where "people who work overtime and on holidays and weekends are highly evaluated," the marginal effect for "not remote work either in April or September" is significantly positive. On the contrary, that of "job performance is highly evaluated" is significantly positive for "remote work both in April and September" and negative for "not remote work either in April or September." These results indicate that remote work is hardly embraced in workplaces where long working hours is valued, possibly because it is difficult to keep track of how they work in a remote setup. The marginal effect of "late arrival is allowed after overtime work or holiday work," however, is significantly positive for "remote work both in April and September," meaning that workplaces allowing a flexible work arrangement tend to successfully continue to offer remote work options. As for the boss's management practice, we see that the marginal effects of "the boss seeks to share information with members" and "the boss seeks balanced work style" is significantly negative for "not remote work either in April or September," implying that better management practices are associated with a higher probability of remote work. These results are consistent with those found by Kawaguchi and Motegi (2021) with different panel data and variables.

Finally, looking at Table 8, where we added variables indicating job tasks, IT skills, and measures of exposure to new technologies, we find that the abstract task index has a significantly positive marginal effect, while the manual task index has a negative effect for "remote work both in April and September." This suggests that, compared to manual tasks, remote work done on a regular basis is more suitable for abstract tasks, which is consistent with the findings of Kawaguchi and Motegi (2021). We also find that the marginal effects of IT skills and the measures of exposure to new technologies are significantly positive for "remote work both in April and September" and negative for "not remote work either in April or September." These findings indicate that having better IT skills and more exposure to new technologies could enhance remote work on a regular basis.

6. Concluding remarks

Given the exogenous shift to remote work due to the COVID-19 pandemic, we investigate the impact of remote work on various outcomes after controlling for the potential endogeneity of its implementation using first-difference models. Focusing on the potential benefits of remote work, which are measured by the work arrangement patterns during the pandemic, the results from our study suggest that the shift to remote work has had heterogeneous impacts on productivity, well-being, and

[13] These results are also consistent with those obtained by previous studies, such as Okubo (2020) and Ishii et al. (2021).

time allocation. On one hand, workers who continued to work remotely even after the first state of emergency in Japan, who were thought to potentially benefit from of remote work, experienced its positive impact, such as productivity improvement, better mental health, and better work-life balance. On the other hand, workers who only temporarily implemented remote work as a stopgap measure, presumably with low potential benefits, were not as productive as they were in the office. Additionally, we find several characteristics of workers and jobs as successful factors for remote work. Specifically, workplaces that evaluate performance over hours worked, allow flexible work arrangements after overtime, and implement better management practices tend to successfully embrace remote work. In addition, workers with better IT skills, more exposure to new technologies, and were more engaged in abstract tasks were more likely to continue working remotely after the state of emergency in 2020.

Although the number of remote workers in Japan is still small, there has been a growing demand for remote work arrangements to improve work-life balance. There is an urgent need to make remote work a common practice, not only to achieve better work-life balance, but also to build a more resilient work setup, especially in the event of natural disasters and pandemics. To make remote work arrangements more productive and efficient, our study suggests that it is necessary for organizations to place more emphasis on human resource management, employee performance, flexible work arrangements, better management practices, and the adoption of new technologies. Additionally, developing the skillset of workers to enable them to catch up with new technologies and allowing them to engage in abstract tasks are necessary to make remote work more efficient and productive.

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Table 1 – Descriptive statistics

	A.Total		B. Remote work both in April and September		C.Remote work only in April		D. Not remote work either in April or September	
	means	S.D.	means	S.D.	means	S.D.	means	S.D.
[Teleworkability]								
Teleworkability	0.158	0.067	0.184	0.041	0.176	0.059	0.150	0.071
A number of remote work days in February	0.178	0.878	0.564	1.486	0.646	1.608	0.006	0.126
Working from home in April 2020	0.283	0.451	1.000	0.000	1.000	0.000	0.000	0.000
Working from home in September 2020	0.115	0.320	1.000	0.000	0.000	0.000	0.000	0.000
[Worker Characteristics]								
Male	0.528	0.500	0.713	0.455	0.605	0.490	0.480	0.500
Age	48.31	11.84	46.39	11.34	45.77	11.77	49.21	11.83
20s	0.061	0.239	0.050	0.218	0.109	0.313	0.051	0.220
30s	0.186	0.390	0.277	0.450	0.211	0.409	0.166	0.372
40s	0.282	0.450	0.257	0.439	0.265	0.443	0.290	0.454
50s	0.285	0.451	0.277	0.450	0.286	0.453	0.285	0.452
60s	0.150	0.357	0.129	0.337	0.116	0.321	0.161	0.368
High school graduate	0.363	0.481	0.109	0.313	0.184	0.389	0.447	0.498
Junior college graduate	0.181	0.385	0.109	0.313	0.156	0.365	0.198	0.399
University graduate or above	0.456	0.498	0.782	0.415	0.660	0.475	0.356	0.479
Married	0.743	0.437	0.812	0.393	0.748	0.435	0.730	0.444
Having a child under 12	0.247	0.431	0.356	0.481	0.265	0.443	0.225	0.418
Having family member who needs care	0.187	0.390	0.178	0.385	0.177	0.383	0.191	0.394
Member of labor union	0.245	0.430	0.327	0.471	0.306	0.462	0.217	0.412
Size of organization								
Under 4 people	0.037	0.188	0.010	0.100			0.049	0.217
5-29 people	0.181	0.385	0.059	0.238	0.095	0.295	0.220	0.415
30-99 people	0.155	0.363	0.129	0.337	0.150	0.358	0.161	0.368
100-499 people	0.187	0.390	0.168	0.376	0.204	0.404	0.187	0.390
Over 500 people and government	0.440	0.497	0.634	0.484	0.551	0.499	0.383	0.486
Employment status								
Regular	0.646	0.479	0.842	0.367	0.769	0.423	0.585	0.493
Contracted	0.074	0.262	0.069	0.255	0.075	0.264	0.075	0.264
Part-time	0.245	0.430	0.079	0.271	0.122	0.329	0.300	0.459
Dispatched	0.015	0.121	-	-	0.014	0.116	0.018	0.131
Commission	0.021	0.142	0.010	0.100	0.020	0.142	0.022	0.148
Individual annual income								
Under 2million yen	0.282	0.450	0.129	0.337	0.129	0.337	0.343	0.475
2million to 4million yen	0.275	0.447	0.168	0.376	0.238	0.427	0.301	0.459
4million to 6million yen	0.216	0.412	0.208	0.408	0.252	0.435	0.209	0.407
6million to 8million yen	0.135	0.342	0.168	0.376	0.245	0.431	0.104	0.305
8million to 10million yen	0.059	0.237	0.208	0.408	0.102	0.304	0.026	0.158
Over 10million yen	0.032	0.176	0.119	0.325	0.034	0.182	0.018	0.131
[Job Characteristics]								
"People who work overtime and on holidays and weekends are highly evaluated"	0.172	0.377	0.113	0.319	0.141	0.349	0.189	0.392
"Job performance is highly evaluated"	0.337	0.473	0.526	0.502	0.421	0.495	0.285	0.452
"Late arrival is allowed after overtime work or holiday work"	0.147	0.354	0.333	0.474	0.136	0.344	0.118	0.323
“The boss seeks to share information with members”	0.461	0.499	0.520	0.502	0.575	0.496	0.423	0.494
“The bosses themselves seeks a balanced workstyle”	0.367	0.482	0.500	0.503	0.425	0.496	0.331	0.471
Routine task index	0.006	0.994	0.003	0.840	-0.091	0.941	0.029	1.029
Abstract task index	0.058	1.018	0.729	0.906	0.319	0.948	-0.114	0.994
Manual task index	-0.016	1.003	-0.713	0.619	-0.321	0.898	0.168	1.011
IT skill index	8.886	2.840	10.97	2.685	9.578	2.651	8.388	2.722
Level of exposure to new technologies	0.463	0.946	1.690	1.529	0.490	0.936	0.259	0.623

Table 1 – Descriptive statistics (continued)

	A.Total		B. Remote work both in April and September		C.Remote work only in April		D. Not remote work either in April or September	
[Outcome]								
Monthly income of February	28.30	19.72	41.67	22.57	33.28	16.87	25.06	18.75
Monthly income of April	27.73	18.22	41.08	21.71	33.33	16.56	24.35	16.68
Monthly income of September	28.43	19.59	41.64	21.73	33.51	17.64	25.14	18.53
Weekly working hour in February	37.54	15.74	42.05	13.26	39.90	16.10	36.25	15.84
Weekly working hour in April	33.02	15.70	35.20	14.20	31.66	16.23	32.98	15.79
Weekly working hour in September	34.65	17.13	37.00	20.17	38.22	16.67	33.42	16.57
K6 in February	3.993	4.450	3.347	4.277	3.755	4.240	4.154	4.519
K6 in April	5.422	4.815	4.347	4.184	5.432	4.831	5.595	4.891
K6 in September	4.970	4.845	4.059	4.015	4.897	4.560	5.134	5.018
HPQ in February	6.270	1.701	6.525	1.775	6.429	1.553	6.192	1.718
HPQ in April	5.904	1.890	5.931	1.861	5.796	1.887	5.925	1.898
HPQ in September	6.147	1.788	6.376	1.938	6.397	1.704	6.052	1.775
UWES in February	9.214	3.841	9.300	3.702	9.701	3.614	9.085	3.910
UWES in April	9.251	3.913	9.700	3.338	9.714	3.602	9.070	4.056
UWES in September	8.914	4.005	9.515	3.815	9.388	3.471	8.705	4.137
A vague sense of anxiety in April	0.539	0.499	0.465	0.501	0.527	0.501	0.554	0.497
A vague sense of anxiety in September	0.536	0.499	0.460	0.501	0.524	0.501	0.552	0.498
Weekly housework hour in February	10.04	11.91	6.033	8.049	6.969	9.155	11.40	12.71
Weekly housework hour in April	10.62	12.62	8.881	10.77	8.015	9.124	11.51	13.47
Weekly housework hour in September	10.63	13.33	7.240	7.628	8.714	12.80	11.64	14.05
Weekly childcare hour in February	3.646	10.90	3.996	11.85	2.906	8.811	3.760	11.19
Weekly childcare hour in April	4.764	14.87	6.783	19.78	5.073	13.93	4.365	14.15
Weekly childcare hour in September	3.932	12.89	3.752	9.752	3.376	9.379	4.090	14.01
Weekday sleeping hour in February	6.300	0.997	6.231	0.901	6.304	0.943	6.311	1.025
Weekday sleeping hour in April	6.411	0.986	6.682	0.935	6.366	0.982	6.379	0.990
Weekday sleeping hour in September	6.322	0.989	6.415	0.907	6.261	0.994	6.322	1.001
Exercise frequency in February	1.387	0.688	1.506	0.729	1.511	0.768	1.341	0.658
Exercise frequency in April	1.430	0.673	1.570	0.769	1.585	0.720	1.371	0.636
Exercise frequency in September	1.500	0.688	1.683	0.747	1.541	0.676	1.460	0.676
Alcohol drinking frequency in February	1.659	0.982	1.688	1.063	1.780	1.011	1.621	0.957
Alcohol drinking frequency in April	2.549	1.619	2.760	1.518	2.493	1.568	2.528	1.646
Alcohol drinking frequency in September	2.536	1.600	2.768	1.406	2.531	1.550	2.500	1.639
Number of cigarettes smoked in February	2.162	5.964	0.772	3.886	1.707	5.447	2.494	6.315
Number of cigarettes smoked in April	2.207	6.083	0.861	3.758	1.497	4.769	2.590	6.599
Number of cigarettes smoked in September	2.123	5.811	0.901	3.833	1.231	4.449	2.530	6.292
BMI in February	22.97	3.641	23.86	3.602	22.98	3.186	22.83	3.732
BMI in April	23.09	3.927	23.73	3.579	23.21	3.190	22.95	4.126
BMI in September	23.13	3.980	23.80	3.614	23.23	3.294	23.00	4.170
[The number of COVID-19 confirmed cases in each prefecture per 100thousands people]								
in April 6th	2.967	2.157	3.738	2.225	3.342	2.216	2.754	2.094
in September 15th	62.65	49.68	83.69	50.07	73.08	51.95	56.81	47.80

Notes: 1. The numbers of observation are A:875, B:101, C:147, and D:627.
2. The exercise frequency variable takes the value of "3" for three or more times a week, "2" for two times or less in a week, and "1" if the person does not exercise.
3. The drinking frequency variable takes a value of "5" for daily drinking, "4" for three or more times a week, "3" for one or two times in a week, "2" for a few times in a month, and "1" for no drinking at all.

Table 2 – The impact of the implementation of remote work
on changes in the working hour and monthly income: first difference estimation results

	Dependent variable：Change in working hour				Dependent variable：Change in monthly income			
	February to April 2020		February to September 2020		February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")								
"Remote work both	-1.942	0.0900	-1.525	-1.765	1.217*	1.855**	1.209	1.322
in April and September"	(1.752)	(2.699)	(2.098)	(3.264)	(0.686)	(0.722)	(1.193)	(0.871)
"Remote work only in April"	-5.953***	2.240	0.0255	5.740*	0.739	0.708	0.541	1.471
	(1.962)	(2.041)	(2.240)	(3.129)	(0.551)	(0.537)	(1.413)	(1.282)
Change in the number of COVID-19 confirmed case								
From February to April	0.117	-0.116			0.102	-0.0373		
	(0.325)	(0.323)			(0.169)	(0.0777)		
From February to September			-0.00718	0.000519			-0.00122	0.00814
			(0.0161)	(0.0138)			(0.0107)	(0.00663)
Constant	-4.515***	-2.504*	-3.426***	-2.146*	-1.239	-0.199	0.0594	-1.007
	(1.055)	(1.376)	(1.190)	(1.223)	(0.885)	(0.334)	(0.993)	(0.862)
Number of observation	670	426	625	378	671	416	623	370
R2	0.017	0.002	0.001	0.013	0.003	0.008	0.001	0.005
F-value	3.17**	0.46	0.35	1.26	1.24	2.52*	0.35	1.26

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
2: The upper row shows the coefficient, and the numbers in brackets are robust standard error.

Table 3 – The impact of the implementation of remote work on changes in well-being: first difference estimation results

(1) Mental health condition/subjective productivity

	Dependent variable：Change in mental health condition (K6)				Dependent variable：Change in subjective productivity (HPQ)			
	February to April 2020		February to September 2020		February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")								
"Remote work both	0.252	-1.289	0.402	-2.431**	-0.437	-0.417	0.169	-0.486
in April and September"	(0.463)	(1.151)	(0.424)	(1.140)	(0.274)	(0.771)	(0.278)	(0.518)
"Remote work only in April"	0.586	0.0997	0.617	-0.500	-0.448**	-0.583*	0.208	-0.212
	(0.447)	(0.611)	(0.420)	(0.721)	(0.207)	(0.323)	(0.196)	(0.330)
Change in the number of COVID-19 confirmed case								
From February to April	-0.101	-0.0494			-0.00871	0.0250		
	(0.0831)	(0.0883)			(0.0409)	(0.0538)		
From February to September			-0.00459	0.00860**			-0.00142	0.00112
			(0.00359)	(0.00413)			(0.00171)	(0.00188)
Constant	1.450***	2.015***	1.030***	0.645*	-0.201	-0.348*	-0.0464	-0.141
	(0.285)	(0.364)	(0.266)	(0.356)	(0.140)	(0.183)	(0.130)	(0.159)
Number of observation	679	421	637	380	685	420	636	374
R2	0.004	0.004	0.005	0.022	0.010	0.007	0.002	0.004
F-value	0.88	0.62	1.06	2.81**	2.27*	1.22	0.53	0.47

(2) Work engagement and anxiety

	Dependent variable：Change in work engagement (UWES)				Dependent variable：Change in anxiety	
	February to April 2020		February to September 2020		April to April 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")						
"Remote work both	0.343	0.151	0.485	-0.161	-0.0485	0.0383
in April and September"	(0.366)	(0.979)	(0.390)	(0.785)	(0.0707)	(0.101)
"Remote work only in April"	0.117	0.911*	0.270	0.117	-0.0369	-0.0217
	(0.323)	(0.552)	(0.350)	(0.678)	(0.0531)	(0.0872)
Change in the number of COVID-19 confirmed case						
From February to April	0.0745	0.0386				
	(0.0696)	(0.0813)				
From February to September			-0.000421	-0.000875		
			(0.00273)	(0.00316)		
From April to September					-7.05e-05	-0.000264
					(0.000453)	(0.000556)
Constant	-0.203	-0.221	-0.387*	-0.342	0.0419	-0.0173
	(0.214)	(0.263)	(0.203)	(0.255)	(0.0330)	(0.0451)
Number of observation	678	425	631	379	630	375
R2	0.005	0.008	0.003	0.000	0.002	0.001
F-value	0.98	1.1	0.62	0.06	0.31	0.13

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
2: The upper row shows the coefficient, and the numbers in brackets are robust standard error.

Table 4 – The impact of the implementation of remote work
on changes in housework /childcare time: first difference estimation results

	Dependent variable：Change in housework hour				Dependent variable：Change in childcare hour			
	February to April 2020		February to September 2020		February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")								
"Remote work both	3.731***	-1.668	2.136**	-0.962	2.793	-0.565	-0.110	0.483
in April and September"	(0.922)	(1.676)	(0.838)	(1.466)	(2.546)	(0.803)	(1.448)	(0.667)
"Remote work only in April"	0.982	-0.359	1.848	0.796	2.001**	2.526	0.483	0.985
	(0.661)	(1.358)	(1.179)	(1.275)	(0.937)	(1.792)	(0.868)	(1.068)
Change in the number of COVID-19 confirmed case								
From February to April	-0.0331	0.436			-0.0266	0.111		
	(0.147)	(0.398)			(0.252)	(0.325)		
From February to September			-0.00683	-0.00179			0.00113	-0.0171*
			(0.00803)	(0.00887)			(0.00643)	(0.00871)
Constant	-0.128	-0.236	0.594	0.425	0.211	0.133	-0.252	0.945
	(0.526)	(1.096)	(0.519)	(0.781)	(0.735)	(0.878)	(0.452)	(0.961)
Number of observation	666	420	627	374	662	413	621	373
R2	0.026	0.006	0.009	0.001	0.010	0.005	0.001	0.007
F-value	5.67***	0.52	2.42*	0.36	1.72	1.29	0.14	1.71

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2: The upper row shows the coefficient, and the numbers in brackets are robust standard error.

Table 5 – The impact of the implementation of remote work on changes in daily habits: first difference estimation results

(1) Sleep time

	Dependent variable：Change in sleep hour				Dependent variable：Change in exercise frequency			
	February to April 2020		February to September 2020		February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")								
"Remote work both in April and September"	0.335***	0.710***	0.0561	0.415**	-0.0270	-0.274	0.0820	-0.404
	(0.112)	(0.189)	(0.0787)	(0.191)	(0.0999)	(0.218)	(0.0978)	(0.249)
"Remote work only in April"	0.0394	-0.0292	-0.0530	-0.206*	0.0558	-0.0587	-0.01000	-0.0336
	(0.0765)	(0.137)	(0.0837)	(0.112)	(0.0750)	(0.138)	(0.0730)	(0.140)
Number of observation	672	423	631	379	621	386	581	338
R2	0.024	0.031	0.002	0.024	0.001	0.007	0.009	0.015
F-value	3.82***	5.00***	0.47	3.08**	0.25	0.89	1.61	0.90

(2) Drinking frequency/Number of cigarettes smoked

	Dependent variable：Change in alcohol drinking frequency				Dependent variable：Change in number of smoked			
	February to April 2020		February to September 2020		February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")								
"Remote work both in April and September"	-0.246	-0.892	-0.335	-0.718	0.197	0.0159	0.400	0.166
	(0.239)	(0.602)	(0.240)	(0.623)	(0.300)	(0.0956)	(0.333)	(0.114)
"Remote work only in April"	-0.506**	-0.0233	-0.442**	-0.231	0.0565	0.0741	0.0578	0.225*
	(0.207)	(0.360)	(0.217)	(0.353)	(0.224)	(0.151)	(0.262)	(0.128)
Number of observation	464	215	429	193	683	428	637	383
R2	0.015	0.023	0.012	0.017	0.001	0.000	0.002	0.001
F-value	2.60*	1.21	1.74	0.90	0.35	0.26	0.74	1.14

(3) BMI

	Dependent variable：Change in BMI			
	February to April 2020		February to September 2020	
	Regular workers	Non-Regular workers	Regular workers	Non-Regular workers
Working arrangement (reference: "Not remote work either April nor September")				
"Remote work both in April and September"	-0.162	0.0490	-0.197	0.0109
	(0.136)	(0.269)	(0.151)	(0.285)
"Remote work only in April"	0.0863	0.231	0.0371	0.241
	(0.0975)	(0.176)	(0.128)	(0.221)
Number of observation	671	415	627	371
R2	0.005	0.008	0.005	0.003
F-value	0.97	2.22*	0.77	0.97

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
2: The upper row shows the coefficient, and the numbers in brackets are robust standard error.
3: The change in the number of COVID-19 confirmed case are controlled in each estimation.

Table 6 – The impact of personal attributes on the probability of remote work implementation: multinomial logit model estimation results

	(1) Total			(2) Workers in special alart prefectures			(3) Workers in other prefectures		
	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September
Teleworkability	0.387*	0.215	-0.602***	0.627**	0.183	-0.809***	-0.0362	0.252	-0.216
	(0.202)	(0.217)	(0.224)	(0.296)	(0.289)	(0.292)	(0)	(0.321)	(0.348)
A number of remote work days in February	0.0872***	0.147***	-0.235***	0.0966***	0.129***	-0.225***	0.303	1.205	-1.508
	(0.0230)	(0.0390)	(0.0598)	(0.0303)	(0.0434)	(0.0707)	(0)	(167.3)	(207.7)
Male	0.0201	-0.0369	0.0167	0.0348	-0.0659	0.0311	0.0192	-0.00151	-0.0177
	(0.0272)	(0.0308)	(0.0330)	(0.0384)	(0.0415)	(0.0440)	(0)	(0.0432)	(0.0480)
Age category (ref: 20s)									
30s	0.0465	-0.0701	0.0236	0.0391	-0.0558	0.0167	0.424	-0.198	-0.226
	(0.0446)	(0.0480)	(0.0512)	(0.0617)	(0.0658)	(0.0685)	(0)	(15.94)	(42.75)
40s	-0.00199	-0.0813*	0.0833	-0.00910	-0.0555	0.0646	0.387	-0.214	-0.173
	(0.0462)	(0.0481)	(0.0513)	(0.0645)	(0.0671)	(0.0695)	(0)	(15.94)	(42.75)
50s	0.00409	-0.0695	0.0654	-0.0231	-0.0571	0.0802	0.402	-0.181	-0.221
	(0.0472)	(0.0494)	(0.0534)	(0.0673)	(0.0702)	(0.0735)	(0)	(15.94)	(42.75)
60s	0.0544	-0.0839	0.0294	0.0293	-0.0303	0.000988	0.439	-0.257	-0.182
	(0.0515)	(0.0580)	(0.0622)	(0.0737)	(0.0781)	(0.0809)	(0)	(15.94)	(42.75)
Educational level (ref: Highschool graduate)									
Junior colleage graduate	0.0582	0.0667	-0.125***	0.0200	0.0848	-0.105*	0.417	-0.0447	-0.372
	(0.0402)	(0.0409)	(0.0418)	(0.0613)	(0.0575)	(0.0572)	(0)	(7.923)	(21.25)
University graduate or above	0.0783**	0.0697**	-0.148***	0.0739*	0.0803*	-0.154***	0.411	-0.0228	-0.388
	(0.0304)	(0.0319)	(0.0325)	(0.0406)	(0.0427)	(0.0417)	(0)	(7.923)	(21.25)
Married	-0.00686	0.0191	-0.0122	0.00926	0.0296	-0.0389	-0.0103	-0.00200	0.0123
	(0.0296)	(0.0340)	(0.0354)	(0.0439)	(0.0468)	(0.0481)	(0)	(0.0452)	(0.0491)
Having a child under 12	0.0412	-0.0153	-0.0259	0.0383	-0.0412	0.00293	-0.00991	0.0230	-0.0131
	(0.0280)	(0.0341)	(0.0360)	(0.0393)	(0.0458)	(0.0481)	(0)	(0.0488)	(0.0539)
Having family member who needs care	0.0120	-0.00834	-0.00370	0.0267	-0.00988	-0.0168	-0.0193	-0.0144	0.0337
	(0.0266)	(0.0320)	(0.0340)	(0.0372)	(0.0416)	(0.0435)	(0)	(0.0529)	(0.0579)
Employment status (ref: Regualr)									
Contracted	-0.0280	0.0362	-0.00820	-0.0507	-0.0165	0.0672	0.0823	0.124	-0.206**
	(0.0453)	(0.0565)	(0.0578)	(0.0637)	(0.0707)	(0.0758)	(0)	(0.0982)	(0.105)
Part-time	-0.0841**	0.0151	0.0690	-0.0935*	-0.00578	0.0992	-0.0268	0.0667	-0.0400
	(0.0331)	(0.0535)	(0.0536)	(0.0541)	(0.0694)	(0.0690)	(0)	(0.121)	(0.121)
Dispatched	-0.137***	0.0297	0.107	-0.181***	0.0308	0.150	-0.0349	-0.0801	0.115
	(0.0162)	(0.0943)	(0.0950)	(0.0222)	(0.113)	(0.114)	(0)	(52.74)	(6.712)
Commission	-0.104**	0.00181	0.102	-0.0200	-0.0920	0.112	-0.0469	-0.0681	0.115
	(0.0428)	(0.0906)	(0.0966)	(0.129)	(0.103)	(0.132)	(0)	(2.753)	(2.754)
Annual income (ref: Under 2millions yen)									
2million to 4million yen	-0.0184	0.0796**	-0.0612	-0.000647	0.0961**	-0.0955	-0.0618	0.0613	0.000461
	(0.0396)	(0.0317)	(0.0436)	(0.0563)	(0.0428)	(0.0590)	(0)	(0.0502)	(0.0746)
4million to 6million yen	-0.0275	0.141***	-0.113**	0.0103	0.163***	-0.173**	-0.0761	0.112*	-0.0359
	(0.0432)	(0.0446)	(0.0553)	(0.0633)	(0.0624)	(0.0767)	(0)	(0.0657)	(0.0885)
6million to 8million yen	-0.0295	0.219***	-0.190***	-0.0272	0.269***	-0.242***	-0.0458	0.126	-0.0801
	(0.0460)	(0.0588)	(0.0676)	(0.0634)	(0.0790)	(0.0904)	(0)	(0.0842)	(0.107)
8million to 10million yen	0.133*	0.221***	-0.354***	0.154	0.263**	-0.417***	0.0850	0.102	-0.188
	(0.0761)	(0.0829)	(0.0905)	(0.0972)	(0.105)	(0.110)	(0)	(0.113)	(0.154)
Over 10million yen	0.122	0.0838	-0.206**	0.123	0.0581	-0.181	0.186	0.174	-0.360
	(0.0827)	(0.0748)	(0.0960)	(0.0992)	(0.0804)	(0.111)	(0)	(0.206)	(0.223)
Member of labor union	-0.00678	-0.00835	0.0151	-0.00241	-0.0164	0.0188	-0.00643	-0.0158	0.0223
	(0.0235)	(0.0295)	(0.0315)	(0.0335)	(0.0397)	(0.0421)	(0)	(0.0439)	(0.0498)
Size of organization (ref: under 4 people)									
5-29 people	-0.432	1.679	-1.247	-0.651	1.831	-1.180	0.283	1.101	-1.384
	(25.14)	(91.99)	(66.85)	(29.11)	(87.25)	(58.15)	(0)	(268.2)	(252.5)
30-99 people	-0.364	1.745	-1.381	-0.552	1.940	-1.388	0.292	1.134	-1.426
	(25.14)	(91.99)	(66.85)	(29.11)	(87.25)	(58.15)	(0)	(268.2)	(252.5)
100-499 people	-0.389	1.750	-1.361	-0.545	1.922	-1.377	0.240	1.149	-1.389
	(25.14)	(91.99)	(66.85)	(29.11)	(87.25)	(58.15)	(0)	(268.2)	(252.5)
Over 500 people and government	-0.341	1.761	-1.419	-0.478	1.930	-1.452	0.215	1.168	-1.383
	(25.14)	(91.99)	(66.85)	(29.11)	(87.25)	(58.15)	(0)	(268.2)	(252.5)
The number of COVID-19 confirmed cases in each prefecture per 100thousands people									
in April	-0.00162	-0.00141	0.00303	-0.0163	-0.00348	0.0198	0.00551	-0.00348	-0.00203
	(0.00885)	(0.0106)	(0.0114)	(0.0148)	(0.0171)	(0.0180)	(0)	(0.0155)	(0.0169)
in September	0.000693*	0.000559	-0.00125***	0.00107*	0.000334	-0.00141*	0.000225	0.000701	-0.000926
	(0.000384)	(0.000458)	(0.000485)	(0.000640)	(0.000723)	(0.000749)	(0)	(0.000577)	(0.000669)
Number of observation	875	875	875	562	562	562	313	313	313
Log-Likelihood	-514.8705			-374.2893			-106.70298		
McFadden index	0.253			0.2509			0.3609		

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
2: The upper row shows the marginal effects, and the numbers in brackets are robust standard error.

Table 7 – The impact of work characteristics on the probability of remote work implementation: multinomial logit model estimation results

	(1)			(2)			(3)			(4)			(5)		
	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September
Job-Characteristics															
"People who work overtime and on holidays and weekends are highly evaluated"	-0.0462	-0.0171	0.0633*												
	(0.0321)	(0.0345)	(0.0362)												
"Job performance is highly evaluated"				0.0448**	0.0237	-0.0685**									
				(0.0210)	(0.0258)	(0.0272)									
"Late arrival is allowed after overtime work or holiday work"							0.0956***	-0.0375	-0.0580						
							(0.0229)	(0.0359)	(0.0370)						
“The boss seeks to share information with members”										-0.00154	0.0604**	-0.0589**			
										(0.0205)	(0.0249)	(0.0263)			
“The bosses themselves seeks a balanced workstyle”													0.0371*	0.0282	-0.0653**
													(0.0207)	(0.0258)	(0.0271)
Teleworkability	0.326	0.244	-0.570**	0.383*	0.223	-0.607***	0.270	0.194	-0.464*	0.375*	0.208	-0.584***	0.361*	0.198	-0.559**
	(0.211)	(0.230)	(0.235)	(0.205)	(0.225)	(0.228)	(0.210)	(0.235)	(0.243)	(0.205)	(0.220)	(0.226)	(0.204)	(0.223)	(0.228)
A number of remote work days in February	0.0905***	0.153***	-0.243***	0.0859***	0.149***	-0.235***	0.0822***	0.143***	-0.225***	0.0844***	0.145***	-0.230***	0.0824***	0.143***	-0.225***
	(0.0247)	(0.0408)	(0.0632)	(0.0242)	(0.0427)	(0.0647)	(0.0230)	(0.0429)	(0.0638)	(0.0230)	(0.0389)	(0.0597)	(0.0226)	(0.0391)	(0.0595)
Male	0.0248	-0.0495	0.0247	0.0254	-0.0369	0.0116	0.0171	-0.0573*	0.0402	0.0219	-0.0372	0.0153	0.0193	-0.0408	0.0215
	(0.0289)	(0.0323)	(0.0346)	(0.0279)	(0.0319)	(0.0337)	(0.0290)	(0.0338)	(0.0362)	(0.0277)	(0.0314)	(0.0338)	(0.0275)	(0.0317)	(0.0337)
Age category (ref: 20s)															
30s	0.0653	-0.0868*	0.0216	0.0387	-0.0806	0.0419	0.0457	-0.0930*	0.0472	0.0448	-0.0630	0.0181	0.0495	-0.0739	0.0243
	(0.0488)	(0.0508)	(0.0548)	(0.0451)	(0.0499)	(0.0523)	(0.0474)	(0.0533)	(0.0564)	(0.0456)	(0.0497)	(0.0532)	(0.0453)	(0.0498)	(0.0530)
40s	0.0133	-0.0938*	0.0805	-0.00422	-0.0858*	0.0900*	-0.00947	-0.0924*	0.102*	-0.00361	-0.0706	0.0742	0.00354	-0.0822	0.0786
	(0.0500)	(0.0505)	(0.0545)	(0.0466)	(0.0500)	(0.0525)	(0.0491)	(0.0530)	(0.0564)	(0.0472)	(0.0500)	(0.0535)	(0.0469)	(0.0500)	(0.0531)
50s	0.00823	-0.0755	0.0673	-0.0186	-0.0715	0.0901	0.00258	-0.0708	0.0682	-0.00308	-0.0635	0.0666	0.00817	-0.0646	0.0564
	(0.0515)	(0.0523)	(0.0572)	(0.0488)	(0.0519)	(0.0551)	(0.0492)	(0.0542)	(0.0583)	(0.0486)	(0.0515)	(0.0557)	(0.0486)	(0.0520)	(0.0559)
60s	0.0537	-0.0635	0.00973	0.0462	-0.0791	0.0329	0.0416	-0.0746	0.0330	0.0437	-0.0778	0.0342	0.0482	-0.0789	0.0307
	(0.0564)	(0.0613)	(0.0664)	(0.0531)	(0.0614)	(0.0652)	(0.0551)	(0.0636)	(0.0683)	(0.0536)	(0.0600)	(0.0645)	(0.0535)	(0.0602)	(0.0642)
Educational level (ref: Highschool graduate)															
Junior colleage graduate	0.0512	0.0834*	-0.135***	0.0617	0.0762*	-0.138***	0.0554	0.0775*	-0.133***	0.0553	0.0612	-0.116***	0.0439	0.0671	-0.111***
	(0.0416)	(0.0427)	(0.0434)	(0.0406)	(0.0426)	(0.0426)	(0.0410)	(0.0440)	(0.0446)	(0.0410)	(0.0421)	(0.0428)	(0.0411)	(0.0427)	(0.0431)
University graduate or above	0.0701**	0.0850**	-0.155***	0.0713**	0.0778**	-0.149***	0.0626**	0.0870**	-0.150***	0.0718**	0.0777**	-0.150***	0.0726**	0.0816**	-0.154***
	(0.0316)	(0.0338)	(0.0341)	(0.0308)	(0.0333)	(0.0331)	(0.0316)	(0.0350)	(0.0351)	(0.0310)	(0.0330)	(0.0333)	(0.0309)	(0.0333)	(0.0333)
Married	0.000507	0.0174	-0.0179	0.000480	0.0169	-0.0174	-0.0188	0.0301	-0.0114	-0.00566	0.0167	-0.0110	-0.00253	0.0207	-0.0181
	(0.0319)	(0.0359)	(0.0374)	(0.0316)	(0.0363)	(0.0370)	(0.0319)	(0.0379)	(0.0390)	(0.0312)	(0.0358)	(0.0370)	(0.0313)	(0.0358)	(0.0369)
Having a child under 12	0.0330	-0.0222	-0.0108	0.0252	-0.0196	-0.00569	0.0380	-0.0126	-0.0254	0.0363	-0.0251	-0.0112	0.0317	-0.0160	-0.0157
	(0.0296)	(0.0357)	(0.0375)	(0.0294)	(0.0358)	(0.0374)	(0.0300)	(0.0370)	(0.0388)	(0.0291)	(0.0354)	(0.0373)	(0.0292)	(0.0355)	(0.0372)
Having family member who needs care	0.0133	-0.0220	0.00869	0.0192	-0.00836	-0.0108	0.0142	-0.0193	0.00510	0.0190	-0.0102	-0.00885	0.0130	-0.0116	-0.00137
	(0.0277)	(0.0336)	(0.0356)	(0.0272)	(0.0332)	(0.0349)	(0.0275)	(0.0348)	(0.0368)	(0.0271)	(0.0330)	(0.0350)	(0.0272)	(0.0331)	(0.0351)
Employment status (ref: Regualr)															
Contracted	-0.0214	0.0217	-0.000301	-0.0167	0.0350	-0.0183	-0.0218	0.0340	-0.0122	-0.0266	0.0461	-0.0195	-0.0242	0.0392	-0.0149
	(0.0479)	(0.0578)	(0.0601)	(0.0479)	(0.0587)	(0.0593)	(0.0486)	(0.0608)	(0.0623)	(0.0470)	(0.0592)	(0.0602)	(0.0473)	(0.0584)	(0.0599)
Part-time	-0.0825**	0.00787	0.0747	-0.0747**	0.0128	0.0620	-0.0731*	-0.00654	0.0797	-0.0902***	0.0232	0.0670	-0.0879***	0.0226	0.0653
	(0.0356)	(0.0565)	(0.0563)	(0.0362)	(0.0564)	(0.0557)	(0.0389)	(0.0568)	(0.0573)	(0.0325)	(0.0545)	(0.0547)	(0.0332)	(0.0555)	(0.0554)
Dispatched	-0.137***	0.0389	0.0986	-0.134***	0.0289	0.106	-0.135***	0.0505	0.0847	-0.139***	0.0207	0.118	-0.138***	0.0250	0.113
	(0.0165)	(0.102)	(0.103)	(0.0161)	(0.0980)	(0.0985)	(0.0161)	(0.113)	(0.114)	(0.0166)	(0.0919)	(0.0927)	(0.0166)	(0.0940)	(0.0948)
Commission	-0.0964*	-0.0259	0.122	-0.101**	-0.0118	0.112	-0.0899*	-0.0209	0.111	-0.0989**	0.0172	0.0816	-0.0950*	0.0129	0.0821
	(0.0493)	(0.0839)	(0.0923)	(0.0427)	(0.0889)	(0.0950)	(0.0515)	(0.0924)	(0.0999)	(0.0490)	(0.0999)	(0.107)	(0.0523)	(0.0984)	(0.106)

Table 7 – The impact of work characteristics on the probability of remote work implementation (continued)

	(1)			(2)			(3)			(4)			(5)		
	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September
Annual income (ref: Under 2millions yen)															
2million to 4million yen	-0.0148	0.0749**	-0.0601	-0.0234	0.0895***	-0.0661	-0.0143	0.0730**	-0.0587	-0.0197	0.0824**	-0.0627	-0.0143	0.0859**	-0.0716
	(0.0409)	(0.0330)	(0.0451)	(0.0412)	(0.0332)	(0.0451)	(0.0417)	(0.0354)	(0.0471)	(0.0410)	(0.0327)	(0.0450)	(0.0410)	(0.0337)	(0.0454)
4million to 6million yen	-0.0191	0.150***	-0.131**	-0.0280	0.152***	-0.124**	-0.0129	0.143***	-0.130**	-0.0267	0.149***	-0.123**	-0.0217	0.146***	-0.125**
	(0.0446)	(0.0468)	(0.0574)	(0.0451)	(0.0459)	(0.0566)	(0.0457)	(0.0494)	(0.0600)	(0.0447)	(0.0462)	(0.0572)	(0.0445)	(0.0464)	(0.0570)
6million to 8million yen	-0.0216	0.230***	-0.208***	-0.0304	0.229***	-0.199***	-0.0203	0.231***	-0.210***	-0.0282	0.213***	-0.185***	-0.0275	0.217***	-0.190***
	(0.0473)	(0.0604)	(0.0692)	(0.0476)	(0.0594)	(0.0682)	(0.0485)	(0.0639)	(0.0727)	(0.0474)	(0.0585)	(0.0681)	(0.0467)	(0.0592)	(0.0682)
8million to 10million yen	0.140*	0.231***	-0.371***	0.113	0.226***	-0.339***	0.182**	0.208**	-0.390***	0.132*	0.209**	-0.341***	0.133*	0.220***	-0.352***
	(0.0787)	(0.0852)	(0.0930)	(0.0767)	(0.0841)	(0.0919)	(0.0876)	(0.0903)	(0.0985)	(0.0782)	(0.0831)	(0.0927)	(0.0773)	(0.0850)	(0.0933)
Over 10million yen	0.134	0.0829	-0.217**	0.109	0.0769	-0.185*	0.189*	0.0822	-0.271**	0.126	0.0838	-0.210**	0.108	0.0821	-0.190**
	(0.0864)	(0.0754)	(0.0981)	(0.0831)	(0.0722)	(0.0951)	(0.0977)	(0.0818)	(0.109)	(0.0861)	(0.0762)	(0.0994)	(0.0818)	(0.0752)	(0.0961)
Member of labor union	-0.00792	-0.0172	0.0251	-0.000438	-0.0206	0.0210	0.00110	-0.0265	0.0254	-0.00448	-0.0118	0.0163	-0.00190	-0.0103	0.0122
	(0.0246)	(0.0304)	(0.0324)	(0.0242)	(0.0305)	(0.0322)	(0.0244)	(0.0319)	(0.0338)	(0.0240)	(0.0302)	(0.0323)	(0.0241)	(0.0304)	(0.0324)
Size of organization (ref: under 4 people)															
5-29 people	-0.413	1.549	-1.136	0.700	1.338	-2.038	-0.438	1.765	-1.327	-0.455	1.600	-1.145	-0.463	1.620	-1.156
	(15.71)	(56.18)	(40.47)	(105.4)	(136.2)	(109.9)	(26.65)	(103.8)	(77.16)	(20.38)	(74.64)	(54.26)	(19.75)	(72.02)	(52.27)
30-99 people	-0.341	1.611	-1.270	0.762	1.396	-2.158	-0.365	1.816	-1.451	-0.387	1.671	-1.284	-0.392	1.688	-1.296
	(15.71)	(56.18)	(40.47)	(105.4)	(136.2)	(109.9)	(26.65)	(103.8)	(77.16)	(20.38)	(74.64)	(54.26)	(19.75)	(72.02)	(52.27)
100-499 people	-0.374	1.633	-1.259	0.736	1.404	-2.140	-0.399	1.837	-1.438	-0.415	1.673	-1.258	-0.420	1.693	-1.273
	(15.71)	(56.18)	(40.47)	(105.4)	(136.2)	(109.9)	(26.65)	(103.8)	(77.16)	(20.38)	(74.64)	(54.26)	(19.75)	(72.02)	(52.27)
Over 500 people and government	-0.331	1.643	-1.312	0.779	1.420	-2.199	-0.358	1.852	-1.494	-0.368	1.682	-1.314	-0.380	1.704	-1.324
	(15.71)	(56.18)	(40.47)	(105.4)	(136.2)	(109.9)	(26.65)	(103.8)	(77.16)	(20.38)	(74.64)	(54.26)	(19.75)	(72.02)	(52.27)
The number of COVID-19 confirmed cases in each prefecture per 100thousands people															
in April	-0.000245	-0.000509	0.000754	-0.00209	-0.00430	0.00640	-0.00253	-0.000509	0.00304	0.000152	-0.00330	0.00314	0.00160	-0.00268	0.00108
	(0.00942)	(0.0111)	(0.0118)	(0.00940)	(0.0114)	(0.0120)	(0.00905)	(0.0114)	(0.0120)	(0.00906)	(0.0110)	(0.0117)	(0.00909)	(0.0109)	(0.0117)
in September	0.000678*	0.000434	-0.00111**	0.000752*	0.000768	-0.00152***	0.000701*	0.000486	-0.00119**	0.000652*	0.000585	-0.00124**	0.000608	0.000613	-0.00122**
	(0.000408)	(0.000478)	(0.000506)	(0.000407)	(0.000491)	(0.000514)	(0.000392)	(0.000488)	(0.000512)	(0.000392)	(0.000473)	(0.000501)	(0.000393)	(0.000469)	(0.000497)
Number of observation	822	822	822	834	834	834	784	784	784	844	844	844	842	842	842
Log-Likelihood	-489.83511			-493.9593			-471.824			-503.99779			-502.82887		
McFadden index	0.2543			0.2575			0.2555			0.2499			0.2509		

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2: The upper row shows the marginal effects, and the numbers in brackets are robust standard error.

Table 8 – The impact of tasks/technology on the probability of remote work implementation: multinomial logit model estimation results

	(1)			(2)			(3)			(4)			(5)		
	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September
Routine task index	0.0149	-0.00796	-0.00698												
	(0.0118)	(0.0133)	(0.0141)												
Abstract task index				0.0267**	-0.00490	-0.0218									
				(0.0125)	(0.0149)	(0.0161)									
Manual task index							-0.0623***	-0.00199	0.0643***						
							(0.0166)	(0.0154)	(0.0165)						
IT skill score										0.0179***	0.000457	-0.0184***			
										(0.00412)	(0.00492)	(0.00529)			
Exposure to new tehchnologies													0.0660***	-0.0148	-0.0512***
													(0.00728)	(0.0134)	(0.0144)
Teleworkability	0.443**	0.173	-0.617***	0.447*	0.196	-0.643***	0.0276	0.169	-0.196	0.220	0.211	-0.431*	0.231	0.240	-0.472**
	(0.209)	(0.213)	(0.226)	(0.230)	(0.233)	(0.242)	(0.208)	(0.232)	(0.242)	(0.200)	(0.221)	(0.225)	(0.187)	(0.214)	(0.221)
A number of remote work days in February	0.0867***	0.145***	-0.232***	0.0767***	0.142***	-0.219***	0.0839***	0.140***	-0.224***	0.0877***	0.152***	-0.239***	0.0633***	0.133***	-0.197***
	(0.0237)	(0.0383)	(0.0598)	(0.0234)	(0.0388)	(0.0598)	(0.0218)	(0.0363)	(0.0558)	(0.0227)	(0.0397)	(0.0602)	(0.0167)	(0.0351)	(0.0496)
Male	0.0168	-0.0329	0.0161	0.0191	-0.0446	0.0255	0.0159	-0.0338	0.0179	-0.00163	-0.0347	0.0364	-0.00322	-0.0226	0.0258
	(0.0277)	(0.0308)	(0.0336)	(0.0292)	(0.0327)	(0.0352)	(0.0280)	(0.0310)	(0.0335)	(0.0272)	(0.0313)	(0.0331)	(0.0238)	(0.0306)	(0.0323)
Age category (ref: 20s)															
30s	0.0474	-0.0710	0.0236	0.0363	-0.0487	0.0124	0.0413	-0.0654	0.0241	0.0337	-0.0718	0.0381	0.0441	-0.0697	0.0257
	(0.0446)	(0.0474)	(0.0513)	(0.0475)	(0.0511)	(0.0542)	(0.0445)	(0.0476)	(0.0510)	(0.0443)	(0.0481)	(0.0510)	(0.0396)	(0.0473)	(0.0503)
40s	-0.00667	-0.0817*	0.0883*	-0.0126	-0.0730	0.0856	-0.00786	-0.0768	0.0847*	-0.00775	-0.0811*	0.0889*	0.00614	-0.0805*	0.0743
	(0.0463)	(0.0476)	(0.0515)	(0.0492)	(0.0512)	(0.0543)	(0.0462)	(0.0479)	(0.0511)	(0.0460)	(0.0481)	(0.0511)	(0.0417)	(0.0472)	(0.0504)
50s	0.00224	-0.0749	0.0727	-0.00516	-0.0440	0.0491	0.00414	-0.0729	0.0688	0.00346	-0.0717	0.0682	0.00188	-0.0654	0.0635
	(0.0473)	(0.0490)	(0.0537)	(0.0506)	(0.0524)	(0.0564)	(0.0470)	(0.0496)	(0.0534)	(0.0470)	(0.0494)	(0.0531)	(0.0420)	(0.0486)	(0.0524)
60s	0.0462	-0.0794	0.0332	0.0512	-0.0505	-0.000749	0.0257	-0.0735	0.0478	0.0515	-0.0843	0.0327	0.0588	-0.0818	0.0230
	(0.0520)	(0.0575)	(0.0624)	(0.0552)	(0.0612)	(0.0655)	(0.0521)	(0.0579)	(0.0620)	(0.0514)	(0.0582)	(0.0620)	(0.0473)	(0.0576)	(0.0618)
Educational level (ref: Highschool graduate)															
Junior colleage graduate	0.0552	0.0686*	-0.124***	0.0441	0.0641	-0.108**	0.0511	0.0718*	-0.123***	0.0615	0.0621	-0.124***	0.0581	0.0695*	-0.128***
	(0.0411)	(0.0410)	(0.0424)	(0.0423)	(0.0431)	(0.0440)	(0.0397)	(0.0408)	(0.0417)	(0.0394)	(0.0407)	(0.0415)	(0.0374)	(0.0407)	(0.0415)
University graduate or above	0.0811***	0.0685**	-0.150***	0.0654**	0.0717**	-0.137***	0.0641**	0.0680**	-0.132***	0.0709**	0.0640**	-0.135***	0.0711**	0.0711**	-0.142***
	(0.0304)	(0.0316)	(0.0328)	(0.0310)	(0.0331)	(0.0336)	(0.0301)	(0.0320)	(0.0327)	(0.0302)	(0.0319)	(0.0325)	(0.0283)	(0.0320)	(0.0324)
Married	-0.00429	0.0116	-0.00731	-0.00222	0.0104	-0.00821	-0.0107	0.0152	-0.00453	-0.0103	0.0234	-0.0131	-0.00831	0.0164	-0.00809
	(0.0298)	(0.0336)	(0.0357)	(0.0311)	(0.0351)	(0.0369)	(0.0298)	(0.0339)	(0.0356)	(0.0292)	(0.0341)	(0.0352)	(0.0263)	(0.0334)	(0.0347)
Having a child under 12	0.0371	-0.00710	-0.0300	0.0446	-0.00624	-0.0384	0.0452	-0.0139	-0.0313	0.0412	-0.0154	-0.0258	0.0368	-0.00984	-0.0270
	(0.0284)	(0.0340)	(0.0364)	(0.0285)	(0.0351)	(0.0371)	(0.0280)	(0.0340)	(0.0362)	(0.0276)	(0.0340)	(0.0358)	(0.0250)	(0.0338)	(0.0354)
Having family member who needs care	0.0128	-0.00670	-0.00609	0.0182	-0.0173	-0.000859	0.0113	-0.00675	-0.00455	0.00663	-0.0102	0.00357	0.0112	-0.0160	0.00482
	(0.0271)	(0.0321)	(0.0345)	(0.0274)	(0.0336)	(0.0356)	(0.0269)	(0.0321)	(0.0341)	(0.0263)	(0.0322)	(0.0339)	(0.0241)	(0.0321)	(0.0334)
Employment status (ref: Regualr)															
Contracted	-0.0292	0.0419	-0.0127	-0.0108	0.0454	-0.0346	-0.0125	0.0327	-0.0202	-0.0301	0.0314	-0.00130	-0.0115	0.0375	-0.0260
	(0.0453)	(0.0562)	(0.0582)	(0.0496)	(0.0594)	(0.0602)	(0.0471)	(0.0554)	(0.0571)	(0.0426)	(0.0557)	(0.0562)	(0.0422)	(0.0564)	(0.0573)
Part-time	-0.0898***	0.0299	0.0599	-0.0787**	0.0205	0.0582	-0.0726**	0.0213	0.0513	-0.0758**	0.0156	0.0602	-0.0698**	0.000687	0.0691
	(0.0324)	(0.0546)	(0.0551)	(0.0363)	(0.0582)	(0.0577)	(0.0355)	(0.0545)	(0.0540)	(0.0343)	(0.0540)	(0.0534)	(0.0317)	(0.0521)	(0.0521)
Dispatched	-0.138***	0.0344	0.104	-0.134***	0.0528	0.0809	-0.134***	0.0214	0.112	-0.135***	0.0177	0.117	-0.134***	0.0280	0.106
	(0.0163)	(0.0944)	(0.0951)	(0.0160)	(0.106)	(0.107)	(0.0152)	(0.0901)	(0.0906)	(0.0154)	(0.0899)	(0.0904)	(0.0144)	(0.0960)	(0.0965)
Commission	-0.105**	0.00318	0.102	-0.0966**	0.00466	0.0920	-0.0961**	-0.00906	0.105	-0.0906*	0.00493	0.0856	-0.101***	-0.00712	0.108
	(0.0425)	(0.0889)	(0.0956)	(0.0470)	(0.0943)	(0.101)	(0.0458)	(0.0845)	(0.0914)	(0.0514)	(0.0925)	(0.0993)	(0.0346)	(0.0913)	(0.0949)

Table 8 – The impact of tasks/technology on the probability of remote work implementation (continued)

	(1)			(2)			(3)			(4)			(5)		
	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September	Remote work both in April and September	Remote work only in April	Not remote work either in April or September
Annual income (ref: Under 2millions yen)															
2million to 4million yen	-0.0104	0.0764**	-0.0660	-0.0153	0.0692**	-0.0539	-0.0145	0.0812**	-0.0667	-0.0108	0.0812**	-0.0704	-0.0110	0.0692**	-0.0582
	(0.0394)	(0.0320)	(0.0436)	(0.0449)	(0.0329)	(0.0479)	(0.0401)	(0.0321)	(0.0438)	(0.0404)	(0.0322)	(0.0438)	(0.0382)	(0.0317)	(0.0426)
4million to 6million yen	-0.0201	0.145***	-0.125**	-0.0354	0.147***	-0.111*	-0.0236	0.148***	-0.125**	-0.0261	0.137***	-0.111**	-0.0247	0.129***	-0.104*
	(0.0427)	(0.0458)	(0.0558)	(0.0487)	(0.0478)	(0.0611)	(0.0436)	(0.0454)	(0.0557)	(0.0433)	(0.0442)	(0.0547)	(0.0404)	(0.0443)	(0.0538)
6million to 8million yen	-0.0197	0.216***	-0.196***	-0.0352	0.217***	-0.182**	-0.0300	0.212***	-0.182***	-0.0397	0.210***	-0.170**	-0.0524	0.212***	-0.159**
	(0.0459)	(0.0600)	(0.0684)	(0.0515)	(0.0622)	(0.0739)	(0.0458)	(0.0583)	(0.0671)	(0.0447)	(0.0577)	(0.0665)	(0.0407)	(0.0584)	(0.0659)
8million to 10million yen	0.137*	0.233***	-0.370***	0.106	0.243***	-0.348***	0.104	0.222***	-0.327***	0.104	0.220***	-0.324***	0.0460	0.251***	-0.297***
	(0.0755)	(0.0848)	(0.0909)	(0.0778)	(0.0888)	(0.0973)	(0.0705)	(0.0832)	(0.0904)	(0.0712)	(0.0829)	(0.0904)	(0.0616)	(0.0878)	(0.0928)
Over 10million yen	0.158*	0.0124	-0.171*	0.0855	0.0956	-0.181*	0.106	0.00580	-0.112	0.0844	0.0805	-0.165*	0.0873	0.0798	-0.167*
	(0.0894)	(0.0641)	(0.0958)	(0.0829)	(0.0807)	(0.101)	(0.0785)	(0.0585)	(0.0855)	(0.0754)	(0.0733)	(0.0923)	(0.0727)	(0.0746)	(0.0921)
Member of labor union	-0.00704	-0.0139	0.0209	-0.0146	0.00438	0.0102	-0.00829	-0.0119	0.0202	-0.00569	-0.00438	0.0101	-0.00439	-0.00639	0.0108
	(0.0237)	(0.0295)	(0.0319)	(0.0244)	(0.0301)	(0.0327)	(0.0236)	(0.0295)	(0.0316)	(0.0231)	(0.0293)	(0.0312)	(0.0221)	(0.0292)	(0.0310)
Size of organization (ref: under 4 people)															
5-29 people	-0.418	1.638	-1.220	-0.399	1.533	-1.134	-0.456	1.665	-1.210	-0.426	1.658	-1.231	-0.286	1.570	-1.284
	(24.69)	(91.45)	(66.76)	(13.56)	(50.12)	(36.56)	(26.98)	(98.12)	(71.14)	(22.96)	(85.16)	(62.20)	(15.57)	(68.63)	(53.06)
30-99 people	-0.361	1.712	-1.350	-0.342	1.601	-1.259	-0.395	1.733	-1.338	-0.367	1.724	-1.358	-0.254	1.647	-1.393
	(24.69)	(91.45)	(66.76)	(13.56)	(50.12)	(36.56)	(26.98)	(98.12)	(71.14)	(22.96)	(85.16)	(62.20)	(15.57)	(68.63)	(53.06)
100-499 people	-0.372	1.697	-1.325	-0.351	1.586	-1.235	-0.420	1.729	-1.309	-0.389	1.730	-1.340	-0.281	1.646	-1.366
	(24.69)	(91.45)	(66.76)	(13.56)	(50.12)	(36.56)	(26.98)	(98.12)	(71.14)	(22.96)	(85.16)	(62.20)	(15.57)	(68.63)	(53.06)
Over 500 people and government	-0.330	1.719	-1.390	-0.309	1.606	-1.297	-0.376	1.748	-1.372	-0.335	1.742	-1.407	-0.251	1.663	-1.412
	(24.69)	(91.45)	(66.76)	(13.56)	(50.12)	(36.56)	(26.98)	(98.12)	(71.14)	(22.96)	(85.16)	(62.20)	(15.57)	(68.63)	(53.06)
The number of COVID-19 confirmed cases in each prefecture per 100thousands people															
in April	-0.00162	-0.00208	0.00370	0.00101	-0.00186	0.000853	-0.00174	-0.00179	0.00353	-0.00326	-0.000818	0.00408	0.00345	-0.00231	-0.00114
	(0.00900)	(0.0106)	(0.0115)	(0.00923)	(0.0109)	(0.0117)	(0.00901)	(0.0106)	(0.0114)	(0.00861)	(0.0105)	(0.0111)	(0.00872)	(0.0104)	(0.0110)
in September	0.000626	0.000652	-0.00128***	0.000608	0.000561	-0.00117**	0.000636	0.000579	-0.00121**	0.000740**	0.000539	-0.00128***	0.000417	0.000590	-0.00101**
	(0.000393)	(0.000458)	(0.000494)	(0.000400)	(0.000472)	(0.000501)	(0.000394)	(0.000458)	(0.000486)	(0.000373)	(0.000454)	(0.000475)	(0.000380)	(0.000448)	(0.000472)
Number of observation	854	854	854	815	815	815	856	856	856	875	875	875	867	867	867
Log-Likelihood	-498.97078			-480.89264			-492.13965			-504.04759			-472.9445		
McFadden index	0.2551			0.2564			0.2696			0.2687			0.3064		

Notes: 1: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2: The upper row shows the marginal effects, and the numbers in brackets are robust standard error.